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Chats With the Editor

SCANNING the pages of this issue our readers will find a wealth of construction material—from the simplest to the most complex receiver. One feature this month deserves special mention. On page 18 we are printing full constructional data on the superheterodyne originally described in the November issue. Flooded with requests from all parts of the country, and from abroad, it became almost imperative that further data be given to at least attempt to stem the tide of correspondence which this set evoked. So we trust we have done our duty well and that all our correspondents will find an answer to their every question.

Next month, due to the craving of the average home constructor for a beautiful thirty-six inch cone speaker, we are going to publish complete details that will enable any reader to make such a cone and get real enjoyment from the task, which, by the way, is not so difficult as it might seem.

Fans who have followed the description of the Henry-Lyford receiver will find another article by Mr. Lyford in this issue which will increase their stock of knowledge on that subject.

For the beginner in our next issue we will have a new article from the pen of Armstrong Perry showing a few of the possibilities of regeneration, while the seasoned builder will find described a well-known receiver with power amplifier installed in the same cabinet.

Be sure to read Robert J. Casey's humorous story of the vicissitudes of broadcasting—it will be found on page 11 of this number.

Frederick Smith
Editor of RADIO AGE.
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Please Mention Radio Age When Writing to Advertisers.
IMPORTANT work is being done for radio broadcasting by the National Radio Coordinating Committee, which has been formed to push the passage of legislation that will regulate the number of stations, their wave lengths and their power. The committee realizes that it is going to be difficult to obtain definite action from the next congress but they are prepared to do their best to convince our national legislators that delay in passing a radio bill is sure to work hardship on a great industry and inflict an increasing annoyance upon twenty-five millions or more of broadcast listeners.

It is obvious to everybody that if the present unregulated rush for wave lengths continues the broadcast listener is going to suffer. The man who has invested considerable sums in receiving equipment will be discouraged by continued failure to tune in his favorite stations without interference from wave-jumpers. His attitude will be communicated to the man who is considering the question of buying a receiver. The facts are so plain they seem almost too obvious to be mentioned.

The owners of WGN recently obtained an injunction against WGES on the contention that in moving its wave length up to 316 it was trespassing upon the wave band used by WGN, whose wave length is 303. WGN alleged that in operating a station and causing upwards of 500,000 persons to take such interest in advance programs of the station that they would buy The Chicago Tribune to obtain the program information the station had established a property right to the air, or a band of the air. This contention was upheld by the court. The Tribune also was upheld in its argument that priority in operating on a wave-length further established the property right. Various stations have given warning that they will protect their wave length by injunction proceedings but WGN is the first to bring the matter to a definite issue. There will be a trial of the WGN-WGES controversy to determine whether the injunction will be permanent. There will be appeals and further litigation and none can say what may be the outcome.

It is clearly set out in the court's decision in the WGN-WGES suit that the court regards the regulation of wave lengths as one properly within the province and duties of congress. It is intimated that any decisions in present controversies will be supplanted and should be supplanted by federal legislation.

That is why every man interested in the progress of radio as a social factor should exert his influence toward prompt action by congress. In any case it should be remembered that it is not the interest of the broadcast station owner which is paramount in any settlement of the question of rights on the air. The prime object should be to care for the millions of radio listeners who are getting news, entertainment and instruction from the broadcast stations. If anybody doubts the immense interest of the public in radio broadcasting let them eliminate broadcasting for a week and then take note of the country-wide howl that would certainly be the first reaction. Radio demands a federal law which is applicable to radio as it functions today. All other means of regulation and control must necessarily break down.

QUEEN MARIE of Roumania afforded Americans an interesting example of the rather autocratic attitude of royalty toward the common herd. And Americans supplied the Queen, with a demonstration of how the home folks in a free country regard even the appearance of slight on the part of distinguished visitors. The Queen was to have spoken from a New York station at a definitely scheduled time and announcements from the station had led hundreds of thousands of listeners to tune in for the Queen's talk. It appears that the Queen arrived at the studio in advance of the time she was scheduled to speak. She wanted to go on at once, explaining that she was in haste to keep another engagement, etc. The studio directors on their side explained that vast numbers of radio listeners expected to hear her at a given moment and that if the time were advanced most of them would be disappointed. The Queen and her entourage declined to wait and departed from the studio. The royal party must have received considerable proof of the general annoyance caused by this failure to carry out the announced program for the Queen's apologies and explanations were profuse on the following morning. The Queen found out two things about America. The people take their radio seriously and they are not Roumanian in their popular interpretation of the rules that govern the relations between royalty and home folks. The Queen was an indefatigable broadcast talker for the remainder of her tour.

THIS magazine enters its sixth year with the present issue. We take this opportunity of wishing a happy and prosperous 1927 for all those who have been our loyal friends since we established the magazine, back in the pioneering days of broadcasting, and to those new friends who are constantly appearing in our list of regular readers. We start the new year with two new departments which we believe will interest those who are radio experimenters as well as many who are not. Everyday mechanics and current developments of science are subjects of sufficient fascination to appeal to all classes of readers. To the readers of Radio Age, who, we assume, are inclined to be technically-minded, we believe the pages on mechanics and popularized science will be particularly welcome.
Radio Frequency Amplification for the Crystal Detector Set

By ARMSTRONG PERRY

ANYONE who took up radio in the natural way has a crystal detector set somewhere in the attic. Anyone with a family, or, even with neighbors, sees times when he would be glad to have a little set all to himself and clamp on a pair of phones to keep out extraneous noises while listening to broadcasts that do not interest the entourage. The weak point of the crystal detector is its limited receiving range. That can be extended, inexpensively, by using a one-tube radio frequency amplifier. Very likely it will make the little receiver reach out five hundred miles, which is about twenty times the usual range of the simple crystal detector hook-up and far enough to pull in an earful any time.

Go on—you can too make it yourself, if you know a screw driver from a pair of pliers. The circuit that includes the detector and phones can be left as it is. If it is a single circuit outfit, the antenna leads directly to the cat whisker that tickles the crystal. The crystal is connected to one tip of the phone cord and the other tip connects with the ground, via a wire or two and a binding post. One end of the inductance coil is hooked to the antenna and the other end to the ground. The tuning condenser usually is shunted around this coil, but may be in series at one end or the other. The coil may or may not be tapped. There may be a fixed condenser shunting the phones, to intensify the signals.

The two-circuit hook-up has two coils instead of one. One is connected to the antenna and ground just as the single coil in the single-circuit outfit is. The other is close to this and the two form a coupler. The coil hooked to the antenna is the primary, because it is the first to receive the energy from the ether. The other coil is the secondary because it is the second to receive the energy. Just as in school, the incoming visitors go through the primary grade first and the secondary next.

The secondary circuit looks, when diagrammed, like the single circuit with the antenna and ground connections omitted. It includes the tuning condenser, the crystal detector and the phones. There may be a condenser in the primary circuit also. It may be in series between the antenna and the primary coil or between the coil and the ground connection, or attached to both ends of the coil in a shunt connection. The single circuit loses less energy and therefore may give louder signals, but selectivity is increased by two circuits connected through a coupler. A weak signal with less interference may be better than a stronger one with more interference.

It is well to diagram the crystal detector outfit so that all details can be seen at a glance. Trying to carry too much information in the head is hard on the brains. Then the radio frequency amplifier should be diagrammed. The diagram may save the price of a tube, if you use it to check up your work just before you start to connect the filament with the wrong end of the “B” battery.

There are various ways of designing a radio frequency amplifier. None of them is too complicated even for a beginner. Following some other fellow's
design takes half the fun out of the job. Be original, and you will discover that some wise guy imitated your design years ago.

The radio frequency amplifier belongs between the detector and the antenna. Start at the antenna and work toward the detector. An expert will, of course, figure out the inductance and capacity of his antenna and design it to fit his set. If he does not forget the tin roofs, metal framed buildings, trees and other nearby objects that may absorb energy and cause capacity effects, he may secure better results than the common variety of radio bug. Roughly, the fundamental wavelength of the aerial is about three times its length. It is quite safe, for ordinary purposes, to run a wire from the garage to the house and trust the variable inductances and condensers to tune to the stations you want to hear.

Variable Condenser

You may place a variable condenser in series between the antenna and the inductance coil that comes next. It will help with the tuning. The inductance coil may be tapped or not. Some prefer a flexible unit, adaptable to wide bands of wavelengths, and others believe in covering a narrow band more efficiently and getting rid of effects caused by dead ends. A 50-turn honeycomb coil, or some other type of coil containing about the same value of inductance, and a .00025 or .0005 condenser work well together for broadcasting wavelengths. Either the coil or the condenser, or both should be variable.

The antenna, or the series condenser, if there is one in the antenna circuit, connects with the grid of the amplifier tube. If the rotor of the condenser, its movable part, is toward the ground, connect the grid to the stator. Changing the connections, so that the stator connects with the ground and grid, may make a difference. Try both ways and compare results on the same signal.

The filament circuit for the tube is the same as in most tube circuits. The directions that come with the tube may state that the positive terminal of the "A" battery should be connected with the rheostat that regulates the current. If the connections are not specified, try both ways. Any type of amplifier tube may be used except the new kind designed for the last stage of audio frequency amplification only. The correct voltages, as stated in the directions, should be applied to filament and plate. The manufacturers know more about these things than the local standing committee. As few constructors care to spend any large sum for add-

It may be difficult to find a potentiometer, unless you shop by mail. I asked three local radio dealers in my town for once and every one of them asked me what that thing was. A wire rheostat can be used by eliminating the connection between the tongue and the end of the coil and connecting the tongue with the grid. The ends of the coil are connected to the filament or "A" battery terminals.

The plate of the tube is connected to the primary coil of the coupler. If a single-circuit crystal set is used, the plate is connected, through a condenser, to the end of the single coil to which the detector is attached. The condenser prevents the "B" battery current from entering the detector, where it might fuse the cat whisker to the crystal. The positive terminal of the "B" battery is connected with the other end of the coil and the negative terminal is connected with the "A" battery. Either minus-to-plus or minus-to-minus connections may be tried. So long as the positive terminal of the "B" battery is kept away from the filament connections there is no danger of burning out the tube. A resistance is connected in series between the plate and the "B" battery.

The output resistance of a tube often is specified by the manufacturer and 11,000 to 15,000 ohms may be required for efficient operation. If a suitable resistance element is not at hand, an old-time amateur device may be tried. Draw a line on paper with a lead pencil or India ink. Place the paper on a little base of dry wood or bakelite where it will form a connection between two screws or binding posts that touch the ends of the line. Test the resistance and change it by erasing the line, or part of it, and making a new line that is thinner or fatter. A short, fat line probably will come nearer providing the proper resistance than a long, thin one.

Where coupled circuits are used, the variable tuning con-
denser may be shunted either around the primary or the secondary coil. Try it in both positions.

Transformer Coupling

CONNECTING the amplifier with the two-circuit crystal detector set, as described above, gives what is known as transformer coupling. The tuning coils can be placed in the antenna circuit and a radio frequency amplifying transformer used for coupling the amplifier to the detector circuit. It will give increased amplification. Connecting the amplifier with a single-circuit crystal set, as stated, gives resistance coupling. Each type of coupling has advantages and disadvantages.

Government experts have stated that resistance-coupled amplifiers seldom give full amplification below 1,000 meters. On the other hand, they save some troubles due to distortion. They require more "B" battery power than transformer-coupled amplifiers, so they are less desirable for use in portable sets.

One weakness of the radio-frequency transformer is that usually it covers a narrow band of wavelengths. The United States Bureau of Standards built several hundred of them, studied them exhaustively and produced a type that gave good amplification over a comparatively wide range. One of the men who worked on the problem resigned from the Bureau and manufactured transformers of this type, but the fact that he made them in plug-in form, so that one could be removed and another substituted easily, indicates that even the best do not give equal amplification over the entire broadcast range of wavelengths.

Some have found it difficult to understand how a radio frequency amplifier amplifies weak signals more in proportion than strong signals, while an audio frequency amplifier amplifies strong signals more than weak ones. The secret lies in the fact that the radio frequency amplifier amplifies the voltage applied to the detector and is not concerned with increasing the power output, while the audio frequency amplifier must amplify the power available to actuate the diaphragm of the phones or the loud speaker. Vibrating a diaphragm or cone and propagating sound waves that must run through thousands of cubic feet of air and make themselves heard by many ears requires much more energy than it does to increase the grid potential of a tube. The small amount of energy used to produce the changes of grid voltage, or the voltage applied to the crystal detector, is used up in the tube and its circuits, while the energy in the plate circuit of the tube comes entirely from the "B" battery.

Grid Influences Plate

VARIATIONS in the grid voltage which, in the case of the single radio frequency amplifying tube, are caused by the very small amounts of power gathered from the radio waves, influence the plate current much more than changes in the plate voltage itself. With the plate voltage at 40, for example, an increase of grid voltage from .04 to 1. increases the plate current from 430 to 580 microamperes, or 167 microamps for each volt. Increasing the plate voltage of one volt increases the plate current only 21.6 microamps. The increase of grid voltage is eight times more effective, therefore, than a corresponding change of plate voltage.

This explains why the radio frequency amplifier can be used effectively with a crystal detector receiver, and give it twenty times as great a range, while the best an audio frequency transformer could do would be to increase the volume on such stations as probably could be heard, at least faintly, with the crystal detector without amplification.

In order to show the extreme simplicity of the crystal set, we are reprinting the diagram above which shows the coil, condenser and detector unit. Taps are shown on the coil, although they are not absolutely necessary—a honeycomb coil of 50 turns, or 50 turns of bell wire on a 3 inch form, will suffice. Full details of this simple crystal receiver appeared in the August issue of Radio Age (1926) page 17.
Experimenter Has Choice of Four Receivers in One

A NOVEL combination of a tuned RF receiver, with a regenerative detector and two stages of audio, which can also be made into a straight regenerative and two of audio, RF, detector and one audio, and regenerative and one audio, is a circuit tuner on the market. While for local work the set works best with just one stage of audio amplification (using Thordarson's R200 audio transformers)—for distant work,—and that is what most of the fans are interested in, the two stages should be used. The schematic circuit on this page shows the method of hooking up the set to give four receiver combinations.

For the change-over switch either a Yaxley, Carter, or Federal four pole, double throw panel switch may be used. The first two named are made in the single hole mounting type, while the Federal requires a cut-out of the panel for insertion.

Remler condensers are used for the tuning which obviate any possibility of body capacity due to the insulated stator and rotor. Because of the precise control of coupling afforded by the use of Micro-couplers, the over all efficiency of this receiver is greatly increased.

The receiver covers the conventional broadcast band from 200 to 550 meters, and should be able to provide any degree of selectivity desired by the builder.
Further Notes on the Henry-Lyford

By ELMORE B. LYFORD

In The previous article on the Henry-Lyford which appeared in this magazine, nearly all of the space was given to a description of the receiver and to constructional details, for those who wished to build one. Of necessity, much of interest to builders of this receiver had to be left out, and it is the purpose of this second article to provide additional information about this popular set.

It is necessary to use UX201A type tubes throughout in the Henry-Lyford with the exception of the second audio stage—the last tube. In this position a UX112 type power tube is necessary. With this arrangement of tubes, 155 volts of “B” battery will be required. The first two 45 volt blocks should be of the heavy duty type, for they supply current to all five tubes of the receiver. The third 45 volt battery may be one of the regular type, for it supplies current to the last tube only, and the drain on it is very light.

All of the “C” battery voltages, as was stated in the previous article, may be secured from one Burgess No. 5540 battery, which is a 7½ volt battery with a tap at every 1½ volt.

Of course, any good “B” eliminator may be used instead of batteries, if desired. Because of the use of sufficient by-pass condensers, the receiver is particularly adaptable to “B” eliminators, and any good one will give very satisfactory results.

A power tube of the UX171 type, may be used in the second audio stage without necessitating any changes in the wiring of the receiver. The only changes that are necessary to use this type of tube are those of the battery supplies. The “B” max. lead in the battery cable runs to B plus 180 volts instead of to B plus 135 volts, and the C minus max. lead runs to C minus 45 volts instead of to C minus 7½ volts.

Isolate DC Component

With any type of power tube which requires a plate supply of more than 135 volts in this second audio stage, precautions should be taken to safeguard the loud speaker windings from too heavy a current through them. Under these conditions, the direct current supply to the plate of this last tube should not be allowed to pass directly through the speaker windings. One way to accomplish this is to use an output transformer between the plate circuit of the tube and the speaker, as shown in Fig. 1. Another equally good method is to use a choke coil and condenser combination, as pictured in Fig. 2. Here the choke coil should have an inductance of about 50 henries, and the condenser should be 2 or 4 mfd. filter type. One terminal of the loud speaker is connected to the blocking condenser, and the other side may be connected to either B minus or B plus, preferably B minus.

The use of a milliammeter in the plate supply lead of the last tube is a practical and convenient
way of checking up on the operation of this tube, and of determining when it is over-loaded. A 0-25 DC milliammeter inserted at X in Fig. 1 or Fig. 2, should show a steady reading when the receiver is in operation. If there is any fluctuation of this milliammeter needle, the tube is being overloaded, and the volume should be reduced. An overloaded audio tube is a prolific source of distortion, if nothing else.

Right here is a good place to say something about loud speakers. An audio amplifier capable of reproducing such a wide range of frequencies as does the one in the Henry-Lyford, deserves nothing less than the best of loud speakers. In no other way can the rich low tones of the receiver be appreciated. Some sort of a cone type loud speaker should be used and the Western Electric is recommended for best results, though there are others which are nearly as good. At any rate, an effort should be made to use the best one that is available.

Questions have been asked about the use of a loop antenna with this receiver. The answer is that this set was not designed for and is not suited to use with a loop. It will work on a short indoor antenna, however, with exceptionally good results. Almost any sort of an antenna which will work with any receiver will work with this one, as long as it is not too large. One of about 75 or 100 feet over-all length— including the leadin—is just about the right, wherever possible.

The use of the rotary coil on the antenna coupling transformer, was explained in the previous article. It allows greatly different antennas to be used with equally good results. It will be found that there is one position of this coil which is best for general use, depending on the location and the antenna, and after this coil is once set, it need not again be changed.

It is convenient, and often very useful, to have on hand a tuning chart of your receiver, and one may easily be made. A typical tuning curve is shown in Fig. 3. This, as may be seen, is a curve of dial settings against wave-length. To make one, first log the settings of as many stations on different wavelengths as possible. These settings should then be plotted on a piece of squared paper, such as may be procured at any stationary store. After a sufficient number of points have been plotted, a smooth curve is drawn through them. The tuning curve for any Henry-Lyford, thus drawn, will correspond very closely to the one shown, both in appearance and position. In locating a station whose wavelength is known but which has not been logged, a reference to this curve will tell you, within a degree, where they should come in on the dial.

The curve of Fig. 3 shows very plainly the advantages of combination type condensers for tuning, such as are used in this receiver. There is no undue “crowding” of stations on either end of the dial, but all of the transmission channels are evenly spaced, making for easy tuning.

The tuning curve illustrated was made for the broadcast type coils, but curves made for the other two sets of plug-in coils for this receiver, for the lower wave-lengths, will look the same. The range of these other coils is from 37 to 125 meters and from 75 to 225 meters, respectively, and the operation of the receiver is the same when using these coils as when using the broadcast type.

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If you are building the Henry-Lyford particularly because of its exceptional distance-getting ability, the use of vernier dials on the tuning condensers is strongly recommended. When the fullest gain of the r. f. amplifier is used, the antenna dial particularly tunes very sharply, and it will be found difficult to tune the receiver properly with ordinary dials. For stations within the radius of 200 miles, tuning is easy, but for any distance work the vernier dials will be very helpful.

The panel size of the receiver is 7x244", and the depth is 9", so that the completed receiver fits readily into any standard cabinet, many styles of which are available. The panel layout of the receiver is simple and dignified, and graces any cabinet.

One final word, about the results which you may expect to obtain. The first hour’s use of this receiver may be a little disappointing, as far as results on DX are concerned, but as soon as the proper use of the balancing condenser is learned, slight disappointment will turn to admiration. Radio receivers, like automobiles, are individual, and each one requires a little familiarity with it before the ultimate results are obtained.
What’s Wrong With Broadcasting?

By ROBERT J. CASEY

When Thomas Edison sounded off some weeks ago on the subject of Radio and its manifold deficiencies, he stirred up more typographical conversation than could be found in the national output of alphabet soup.

"Radio," said Mr. Edison—interrupt me if I quote him incorrectly—"Radio has ceased to be a novelty and is now an affliction. It is consecrated to the dissemination of blah and symptoms of adenoids. I would much rather listen to a phonograph."

Mr. Edison must have known what he was getting into when he made this pronouncement. At any rate he got into it. Every official of every set factory in the country ignoring the publicity it might entail, took his stenographer in hand to answer Mr. Edison. Every soprano who ever got tuned out of a receiving set observed loudly but with becoming modesty that the sage of East Orange knew nothing at all about music. Every broadcaster in the country quit reading applause telegrams long enough to put Mr. Edison in his place and the great American indignation boiled and seethed for days and nights on end.

Of course Mr. Edison was wrong. It is true that the phonograph at its worst moments never brought one the current news. There never was a record built that would deliver at one winking the first sixty-five ballots of a democratic convention or the play-by-play account of a world’s series baseball game. On the other hand the most skillful engineers in the phonograph business have failed utterly to reproduce in wax the overtones of a simple but lovely heterodyne whistle. Some of the sounds of radio are the peculiar property of radio and will remain an object of continuing wonder until the ears of the coming generation grow calloused and unappreciative.

If Mr. Edison were to ask what has been the agency most responsible for the rise of radio to its present high state of efficiency, any city dweller could tell him off-hand. The credit is due entirely to the broadcasters.

In England, where government control has put a curb bit on small town tenors, egg-beater salesmen, harmonica players, and surplus announcers, the bemitted populace is still listening to stations a thousand miles away through aboriginal receivers such as the one-coupler-two-variometer thing that America discarded years ago. The ignorant broadcast listener thinks that a circuit is selective if it will separate stations a couple of hundred meters apart. And he has never given any thought or time to the solution of the so-called "interference problem." The fact that he is totally unacquainted with interference is, of course, a minor point. The poor blighter probably never will know how badly off he is and that is most distressing.

In America, the land of the free hot air, development has been much more encouraging. Government invasion of public rights to the ether has been definitely stopped and at last we are beginning to get enough broadcasting stations to make things interesting. There is at least one station on every possible wave-length and generally two or three. What need to comment on the result?

If Joe Bozo, leading cold-in-the-head of the Høkehholm church choir, desires to make himself better known, he no longer has to journey to Europe for years of vocal culture or camp on the front steps of the impresarios of the Metropolitan opera company. Not Joe! He gets himself a brace of fifty-watt bottles and starts a broadcasting station. The station may not be large—but then there is always a chance that some gent with insomnia in New Zealand may hear him some night when conditions are favorable—and possibly thereafter commit suicide. The talent may not be so good, but on the other hand this deficiency is always compensated for by the modulation which isn’t very good either. Joe cracks his merry quips into his microphone every night and so gets a lot of publicity within a radius of twenty-five miles at an expense far less than that which would have been entailed had he decided to reach the populace of the same territory by postal card.

Høkehholm gets to know Joe very well—so well indeed that when he is mysteriously murdered, which ought
to be any day now, he will be given a fifty word obituary on page 18 of the local Bugle. De Forest, Armstrong, Hertz, Faraday—all of them might find the culmination of their life work in Joe's nightly broadcast. Unfortunately some of them are dead and those who are alive will have to make some new and important discoveries during the coming year if Joe's radius of interference is to be extended another twelve miles.

If Theodore Goolash, the prominent real-estate broker, desires to peddle his lots in his most recently subdivided swamp his first thought is to create good will toward Theodore Goolash and all his works. Formerly such a campaign entailed much thought and quite an outlay of words in the public prints.

Now, thanks to the radio, his problem is simple. He finds a hotel that has not been finished more than twenty-four hours, he fights off the mob of would-be announcers who are jamming the lobby, and he arranges with the proprietor to put a couple of lightning rods on the roof. Then he looks through the book until he finds the wavelength of the neighborhood's most popular station and he refurbishes it with a new set of call letters. In a week or two he is proclaiming his message to the palpitant millions.

His task is even simpler than it used to be. In other days when the government was assuming a paternalistic and un-American attitude on the subject of air-rights the newcomer to the broadcasting station would be assigned a wave length and frequently it was a very inferior wavelength. Nowadays he has his choice of wave-lengths and the trick of picking the frequency of a popular station immediately solves his problem of building up good will.

W HEN he begins to broadcast on such a wavelength he is sure that most of the town will be tuned in and waiting for him. Thousands of listeners who had hoped to hear some advertised program will be tickled stiff to learn that they can listen instead of Mr. Goolash and snappy lines about homes in the suburbs. A lot of the listeners will take steps to move into the suburbs at once—the farther the better and everybody will write letters to Mr. Goolash—letters that he can use as leads for such of his salesmen who survive when his office is bombed.

There was a time when one ukulele did not constitute an orchestra. But that was before five or six hundred one ukulele broadcasters felt themselves called upon to meet the popular demand for more radio stations.

With conditions as they are any fifty of the one-ukulele stations may be tuned in at one setting of the dial. Inasmuch as all of them will be emitting "Don't Steal My Daddy's Medal" or some song ending in "Yoo-hoo, Dear, Just Yoo-hoo," the result will be an ensemble beyond the wildest dreams of Philip Sousa.

Announcers, too, have been given their chance. Where in less enlightened times the town ass had to content himself with being just a town ass, he now finds himself in great demand. "This is station BLAH, Happy Willy Whoosis announcing. We have just received a telegram from Mr. Patrick Knockenschlocker of 4567 McApple-sauce Boulevard asking 'Who was that lady I seen you with last night?' Hah! Hah! Mr. Knockenschlocker, that wasn't no lady, that was my wife.'"

Or "This is station GLUE, The Old Soak announcing. We are broadcasting a play by play account of the football game between * * Ding Ding! did you hear the fire engine going by just now. Hokus McPherson has just come into the stand. Hello Hokus. Did you bring anything with you? I'll turn the microphone and maybe you can hear the telegraph instruments. There are eleven men on the team representing—Fergus Fitzraspberry just interrupt ed to ask if I ever tried to get a drink in Ishpeming. No Fergus, I never tried to get a drink in Ishpeming because I ain't never been to Ishpeming. . . ."

B UT WHY go on with it? There is no particular object in writing about matters that are known intimately to every radio set owner in the country. There are now forty-six stations in Chicago alone, and since the air has been made permanently safe for adenoids it seems quite possible that ev-

(Please turn to page 39)
Try-out Hour for Radio Performers

By

GWEN WAGNER

IT WAS an off hour in one of Chicago's largest radio stations. In the reception room sat a varied collection of human beings, ranging in age anywhere from 10 years up to 55. All wore expressions of rapt expectancy and all clutched satchels of some description or another.

In the studio beyond, a soprano was singing. Passionately and determinedly, but not too well she was caroling, "In the merry, merry muh-UNTH of May!"

Just then the studio director, whom I happened to know, appeared. I went up to him.

"Pardon me," I inquired, indicating the varied collection of human beings and also the soprano voice out in the offering, "but just what is going on around here?"

"Oh," replied the director with a harassed look, "this is try-out hour. They all want to get on the air you know."

I didn't, but no matter. I found out.

According to this particular director, half the people in the world want to go on the stage and the other half want to sing for radio.

"It doesn't make any difference how young or how old they are," he observed, "they're all determined to get on the air. Just let someone make some remark about what a grand voice they've got and they're off."

"Do you give them all a chance?" I queried.

"Oh, certainly!" retorted the director. "Occasionally we run across a find. For example, a bell boy from one of the hotels came up here one afternoon and wanted to sing for us. We tried him out and found he had a very good voice, exceptionally good for broadcasting. Now we use him regularly."

Finds Are Scarce

However, according to various directors whom I later interviewed, "finds" are as scarce as hair ribbons on flappers. In fact, in one studio I was told that out of all the hordes that apply there, less than five per cent exhibit talent that would lend itself to broadcasting. Even this five per cent usually have to be coached in studio technique before they can be used.

These applicants have various reasons for wanting to get on the air. The main reason, according to practically every director I asked, is that they want their friends to hear them. Two others are: publicity and the desire to make money.

One man, however, had rather an unique reason. He came bolting into the studio and wanted to be put on the air instantly. He could sing, he said and that very well indeed. The director courteously suggested a tryout.

"Tryout?" repeated the gentleman "Tryout?"

"Yes," replied the director. "To see whether your voice is suitable for broadcasting you know."

The gentleman cast his eyes toward heaven. Between clenched teeth he muttered something in a foreign tongue. Then he brought his eyes down and his voice up—english.

"But I don't want a tryout! I don't need a tryout! I am an operatic tenor. I can sing! But!" and here he appeared about to brandish something, probably the inevitable music satchel with which all applicants seem to be equipped. "They won't hear me! Can you believe that? They won't hear me! Just now I have come from a manager of an opera company. I have been to him many times. He says he will not hear me sing. He will not listen to me! But," and here the radio aspirant lowered his voice to a husky, confidential tone, "I want to sing on the radio and then he will have to listen to me! Understand? He will HAVE to listen to me!"

It might be said in passing, however, that the "manager" didn't.

Arrives now the little boy whose mother knows that if there (Continued on page 50)
When Radio Turns Navigator

Radio Direction Finder
Guides and Locates Vessels

"UNABLE to give position—last bearings taken three days ago—we're lost!"

Thus reads the terse but dramatic message from a ship in distress. Out in the blackness of the night, pitching and tossing on waves stirred to a frenzy by the wintry gale, are fellow mariners and passengers, far off the traveled ocean lanes and all but lost save for the slender thread of radio communication.

"Keep sending us test signals," flashes back our operator. "Will locate by direction finder." And so the latest wonder of marine radio and the newest aid to modern navigation is brought into play.

Soon our operator is at the radio direction finder in the pilot house. A moment later he is wearing the headphones and manipulating the receiver dials. He begins turning the handwheel, which serves to swing the small loop frame on the deck above into the very teeth of the angry gale. The operator listens intently, the captain and others silently stand nearby; the swings of the hand-wheel become shorter and shorter. Here it is—the line of signals—the direction of their passage through space from the radiating point! But on which side of our ship—in what sense? Now the operator throws a switch, swings the hand-wheel again. The swings become shorter until they virtually stop. The operator now bends down as he peers through a magnifying glass, squinting an eye so as to line up the parallax lines which will give an accurate reading from the compass card below. Then he gives the reading to the pilot of the ship. A few moments later the course is changed, and the ship throbs to the command of full speed ahead in the face of a heavy sea.

One hour, two hours, three hours—and our ship comes within searchlight range of the vessel in distress. A rescue is out of the question in such a rough sea, but we stand by, ready to act if absolutely necessary. The direction finder has completed well the task which radio began.

JUST as the dog turns his ears in determining the direction of sounds, so does the radio direction finder turn its loop to get a bearing on a given transmitter. This ingenious radio device operates on the principle that a given signal of maximum intensity will be received with a loop so placed that its plane is pointing at the radio station which is transmitting. If, on the other hand, the plane of the loop lies at right angles to the direction of the radio transmitter, no energy is picked up and nothing can be heard in the earphones. The position at which the signal drops out, or so-called minimum, is well defined and is employed in reading the direction of the transmitting station from the compass card that forms part of the apparatus.

The standard marine direction finder, as now installed on many ships, is entirely self-contained and occupies less than two square feet of floor space, in the pilot house or chart room. On the deck, above the pilot house or chart room, is the sturdy tripod frame supporting the loop which is encased in bakelite tubing with aluminum alloy fittings. The protective tubing of the loop measures 4½ inches in diameter, while the loop measures 30 inches on a side. A 2 to 1 reduction gear, operating by the vertical handwheel, serves to swing the loop in all directions, even in high gales, without backlash or interference or muscular exertion.

An eight-tube super-hetero-

(Continued on page 41)
Washington Monument Does a Radio Shimmy

Radiates at Third Harmonic of NAA Transmitter

By S. R. WINTERS

Trees, bridges, embankments, streams of water, trolley lines, valleys, large screens, water towers, and other surrounding objects are likely to exercise a distorting influence on radio waves. In effect, this means that if you are one of the millions of radio fans using a coil or loop of wire for radio reception, the directional properties of this pick-up system are effaced. Any one of the above-named objects, when interposed between the transmitting station and your radio receiving set, may cause the wave to deviate from its true course.

Such distortion, other than invalidating the use of a loop antenna in determining the direction of a particular transmitting station, does not operate to the detriment of broadcast listeners. However, when coils of wire are employed as radio direction-finders, the distorting effect of surrounding objects must be systematically avoided or the causes of such wave deviations taken cognizance of and included in direction-finding calculations. Instances of proof may be cited: The United States Navy, before establishing radio compass stations, investigates any objects that might cause radio waves to swerve from their path of rectitude; similarly, the Navy must ascertain the distorting effect of metal in a hangar for a huge dirigible, like the Los Angeles, on which a radio compass is used.

The Radio Laboratory of the Bureau of Standards is called upon to make all kinds of tests to determine the twisting influence of radio waves as caused by objects interposed in their path. The Lighthouse Service, with its radio beacons and their far-reaching implication of service, may request of the Bureau of Standards assistance in determining suspected deviation of waves which would invalidate the effectiveness of direction-finders in taking bearings from radio beacons. Again, the United States Coast Guard, in its recent adaptation of radio direction-finders in trailing rum smugglers, may need to know if the shore line of a river or a concrete bridge is undermining the directional characteristics of these direction finders.

Study Distortion Influences

These suggested services, together with the ever-increasing applications of the radio direction-finder, as well as the loop antenna with our radio receiving sets, place added emphasis upon results of original investigations conducted by the Radio Laboratory of the Bureau of Standards entitled "A Study of the Surroundings Upon the Indications of a Radio Direction Finder." And, while these comprehensive investigations in the field were made some time ago, this writer is fortunate enough to be able to present exclusive information, photographs, and charts disclosing the interesting results. Francis W. Dunmore and Morris S. Strock negotiated this study for the Federal government, exploring into the secrets of trees, bridges, banks of rivers, valleys, and trolley lines.

Even the Washington monument, towering in silent majesty to a height of more than 500 feet, did not escape the searching eye (magnified by a telescope) of these government scientists. And, stranger than fiction was the revelation coaxed from this enduring shaft of marble. It not only has a natural wave length—about 625 meters—but when NAA, the naval station at Arlington, is broadcasting on 2,500 meters, the Washington monument is, in effect, a secondary radio transmitting station. For, we have the words of Francis W. Dunmore, eminent radio engineer and physicist of the Bureau of Standards, as authority for this conclusion. He says: "In this connection it is interesting to note that when the Arlington station was transmitting on 2,500 meters, the signals could be heard on about 800
meters. Observations of direction at this time all showed that the monument was the source, thus indicating it was set in oscillation at the third harmonic of the Arlington wave and was thus radiating into the surrounding region.”

This disclosure would seem to imply that the memory of George Washington may, in the future, be held accountable for some of the ills which beset radio reception. Broadcast listeners who complain to Secretary of Commerce Herbert Hoover about radiating regenerative sets, interference from the Annapolis arc station and code from the Arlington naval station, may protest against a radiating Washington monument! Those that would besmirch the name of the Father of Our Country by referring to his beer recipe and his fondness for the feminine gender may contend that radio interference from the Washington monument is a haunting memory or proof of the adage that “the evil that men do lives after them!” Jest ing aside, the scientific investigation into the influence of this shaft in distorting radio waves produced interesting and valuable information.

Natural Wavelength

Tests in proximity to the Washington monument indicated that the greatest distortion of the wave front was at 625 meters, which observation led to the conclusion that this is the natural wave length of the marble shaft. Signals were sent from a specially installed transmitting station, located at the Soldiers’ Home, on a series of wave lengths, ranging from 400 to 1,000 meters. The direction-finder was stationed, successively, at each of six positions at increasing distances from the monument. Observations were made of the horizontal angle through which the direction-finder must be turned in order to obtain a minimum signal. Some of the observations were productive of peculiar twists of the radio waves; this phenomenon leading the investigators to conclude that these strange distortions were traceable to an underground cable line extending in a southeasterly direction.

With a portable direction-finding outfit, the representatives of the Bureau of Standards invaded a valley, through which coursed a brook, 25 feet wide. Alfred Tennyson, in writing his poem, “The Brook,” was not equipped with such modern instruments, and neither were these fact-searching scientists provided with a poetic license. They are content in informing a radio-interested world that a small body of water causes little distortion to radio waves. The direction-finder was carried from point to point along this leisurely-moving brook, and only in one instance did the invisible wave swerve to any appreciable degree. At this particular point a tree, only six feet away, was held responsible for the radio wave wandering from its path of rectitude.

The tentative conclusion that trees cause deviation of wave fronts prompted the Bureau of Standards to focus its direction finder around a tree in an open field. While the transmitting set, located a number of miles away, at the Soldiers’ Home, was sending on wave lengths of 400 and 1,400 meters, respectively, there was a negligible amount of distortion, either directly in front or behind the tree. However, when the coil antenna and receiving set were placed to the right or left of the tree the intercepted radio wave deviated as much as five degrees. The tree involved in this test was only 40 feet high; which factor prompts the Government investigators to assume that greater distortion would be caused by proportionately larger trees. Radio experimenters might pursue this line of investigation with interesting results.

If broadcast listeners reside in the vicinity of a water tower, this form of structure may prove to be the source of radiation of radio waves—a sort of secondary broadcasting station, if you please! Distortion tests were conducted in proximity to a 150-foot water tower and an electric-power line nearby. The waves swerved considerably but, we are told, that “Observations on the longer wavelength—1,400 meters—indicated that a large part of the distortion may be due to the power wires near which the observations were taken. On the shorter waves the distortion is in such a direction that radiation from the tower is indicated, though the observations on 625 meters make it uncertain whether this is the entire cause!”

Banks and shore lines of rivers may be disconcerting to the otherwise unimpressed progress of all-embracing radio waves. Thus, if you are camping and fishing this coming Summer, with a radio receiving set and loop as a pick-up system, the waves from your favorite broadcasting station may be slightly distorted and your coil antenna, in effect, may lose some of its otherwise sharp directional properties. However, tests behind a 20-foot bank afforded proof of relatively little deviation of radio waves. Furthermore, we are informed that a wave speeding over one-half mile of fresh water, approaching the shore line at an angle of 500 degrees, is not distorted appreciably.

A concrete bridge, if it contains iron reinforcements, is apt to bend radio waves considerably—that is, cause a relatively wide deviation. The Radio Laboratory of the Bureau of Standards placed its portable radio direction-finding equipment on a 150-foot reinforced concrete bridge. Curves plotted as a result of this test showed large angles of distortion, which are attributed to the iron reinforcements of the bridge. In another test, in a small valley—a cut of 500 feet long and 50 feet deep—which was spanned by a small frame bridge, the direction-finder failed to disclose any appreciable distorting affect of the speeding invisible waves. A telephone line crossed this valley, parallel to the bridge.

Distortion measurements were

The Magazine of the Hour
made near a 100-foot wire, supported five feet above the ground, at an angle 45 degrees with the line to the transmitting station. This elevated antenna was tuned to the wave length of this experimental broadcasting station, with the result that a slight distortion of the wave front was recorded. Experiments with the coil aerial, an integral unit of a radio direction-finder, directly under a 100-foot 3-wire antenna, 75 feet overhead, failed to produce any distortion, when the antenna was tuned or untuned. This antenna was stretched at an angle of 15 degrees with the line to the transmitting station. However, when the direction-finder was placed near the lead-in wire the incoming radio wave evidenced a marked deviation. “Very little, if any distortion existed with the antenna untuned,” observed Francis W. Dunmore of the Bureau of Standards. “This shows,” he emphasizes, “The importance of keeping the direction-finder at a considerable distance (100 feet or more) from any such tuned circuit.”

Explore Three Channels

This comprehensive investigation into the reaction of radio waves when they collide with objects in their mad race through the ether involved the design of special equipment for this purpose. For instance, the direction-finder consisted of a coil of wire wound on a frame four feet square. This design made provision for the use of three wave lengths—400, 625 and 1,400 meters. The frame of this aerial was mounted with its plane vertical on a tripod three feet from the ground. The frame was rotated on a vertical axis by the observer, who was located eight feet away and he manipulated two heavy pieces of cord which were attached to the frame. The detector circuit and batteries were placed on a stool three feet high.

The scale on the direction-finder read from zero to 180 degrees, and it could be clamped at any position on the tripod. A pointer on the coil frame turned with the latter and served as an index by which to read the position of the direction-finder. Visual observations were made in determining the direction of the transmitting station, a telescope being mounted upon the coil frame for that purpose. The position of the telescope on the frame was determined by observation made in a large open field, where it was presumed that no distortion existed. The direction-finder was turned to such a position that the signals were inaudible. The telescope was then put in place on the shelf in the middle of the frame so that the image of the transmitting station could be seen on the cross hairs. The telescope was then secured firmly in position.

The radio receiving set or detector circuit for the reception consisted of one vacuum tube, of the non-oscillating type. A small air-core transformer was employed, the particular advantage of which was the reduction of the change in direction with reversal of coil leads to about two degrees. The observer, engaged in making distortion observations, would listen to the radio signals received by this detector circuit, turning the frame of the coil antenna until a minimum signal is heard. The scale reading on the direction-finder is then recorded. The leads to the detector circuit are reversed by means of a switch, and the observation repeated. The mean or average of these two readings is the basis for plotting the chart showing the distorting effect of radio waves when striking different objects.

The transmitting station, established especially for these tests, was located on the grounds of the Soldiers’ Home, three and one-half miles from the Bureau of Standards. The transmitting antenna was supported between an elevated water tank and the tower of a building. The commanding location of the Soldiers’ Home, situated on one of the highest points of the District of Columbia, was a natural advantage favoring these observations. The magnetic compass was discarded as a means of determining the direction of the transmitting station when taking bearings because of its possible effect upon the deviation of the indications on the scale of the direction-finder. The telescope afforded visual means of sighting directly on the transmitting station, located as it was on a commanding hill. Con-

(Please turn to page 46)
Full Data on Building World's Record Super 8

UNPRECEDENTED interest in the type of superheterodyne described on pages 38, 39 and 40 of the November issue of this magazine, coupled with insistent demands from our readers for further and complete building data on the laboratory model which we constructed, prompts the staff to present in the following article all the details of this excellent receiver so that even the novice may duplicate the set.

In the November issue the schematic was shown for the more advanced fans. Pictures were also published. However, in this presentation practically all of the details are shown in pictorial form with the exception of the photograph of the completed receiver equipped with loop and loud speaker, which is shown at the heading of this page. In this manner we hope that all our readers who have bombarded us with questions on this receiver will find their hopes realized when scanning these pages.

Layout diagram of the panel with instructions for drilling and engraving if the latter is desired.
**Detail of Coupler**

A GREAT many of the requests received in this office were for the details of the coupling unit on which in this issue, on page 19, are given the number of turns for the plate, grid and pickup windings. The wire used is No. 26, DCC, and the stator form is 3 inches in diameter, with the rotor being 2½ inches in diameter. The connections are shown in detail at the left of the coupler sketch, while the proper method of wiring them in is shown in the pictorial representation on page 21.

For the more advanced experimenters we are again showing the schematic circuit of the receiver, with slight changes made in it since its first appearance in November. One departure from the original one is the insertion of a C battery in series with the center tap of the loop which will have a tendency to further sharpen up that circuit. This is only suggested for those living under the shadow of a broadcasting station in some of the metropolitan areas.

Tendency of the intermediate to oscillate is suppressed by means of the C battery tap going to the filament terminal of all of the RF transformers, and the first audio. Grid bias is given the last audio where a UX112 is used, this bias being the full voltage of the C battery, 7½ volts.

Two ten ohm rheostats are provided, one for the filament control of three of the intermediate stages while the second one is used for the filament control of the first and second detectors. The tubes to be used are noted in the pictorial representation and this scheme should be followed for best results.

While the midget condenser used for balancing the loop is placed on the panel where it may be easily reached, in actual practice it has been found possible to place it back of the panel and once adjusted for a certain tube in the first detector stage, it can be left alone. Perhaps the average set builder will like it on the panel so it is shown in that position. By means of it the loop may be made either sharp or broad. Switching around the two outside loop terminals may make a difference on the tuning of this midget condenser, and it is rec-
ommended that connections be switched until best results are secured. It is also advisable to try more than one position of the rotor coil inside the coupling unit. With the rotor at right angles to the grid and plate windings on this unit there will be least transfer of energy from the oscillator to the grid of the first detector. In this case there is no tendency of the first tube to block under strong signals. However if the inductive relationship of the pickup rotor and the stator coils is such that maximum energy is picked up from the oscillator there is a possibility of overloading the first detector grid and introducing considerable distortion. Tune in a signal of medium strength and then adjust the pickup coil for best results. Also switch the outside terminals of the loop and see if different results are obtained.

IN OPERATION we found the simplest method of tuning was to set the oscillator condenser, at the right, to a given point and swing the loop condenser, left, back and forth until a gentle hissing sound is heard. This shows that the loop circuit is then resonant at the frequency for which the oscillator is set. A variation of the rheostat controlling the filaments of three of the intermediate stages will result in changing the volume of the signal.

If properly built this receiver will surprise its owner with its ability to pick up long distance signals. The type of audio transformers shown, although those who are finicky on the subject of quality may find it more to their liking to make use of the larger transformers made by the same manufacturer, such as the R200.

For those who like to be relieved of any trouble in the operation of a set, we used this receiver with an Abox filter for the filament supply and a Majestic B eliminator for the plate potential. Thus all we had to do was to turn on a snap switch and the filament and plate power was on. What could be simpler?

Power for the Abox filter is supplied by a five ampere charger, bulb type. This insures sufficient filament voltage to run the Super 8 even if a UX 210 is used in the last stage. Even on extreme distance when the set is working to its utmost there is no hum of an electrical nature, such as modulation. All bulb chargers have a slight mechanical hum, but this does not affect reception.

A few final words. Be sure to solder all connections well. Go over the set twice to make sure that all connections are in accord with the pictorial layout on page 21. When satisfied that all is well, hook up the set to the A and B source and prepare to entertain yourself to your heart's content.

To make the loop and oscillator settings track as nearly as possible, the Quali-tone loop was used since it seems best designed for this particular set.

Set builders may expect a slight deviation from the published loggings, due to a difference in tubes, loop and the amount of C battery applied to the center tap. However the log shown will serve as a guide for the experimenter who should be able to log his own set in the same manner.
Pictorial representation of the World's Record Super 8 from which the novice may wire the set. The schematic is shown elsewhere in this article for the more advanced fans.
Dual Impedance Receiver Has Excellent Tone Quality

TONAL quality has always been an aim of the experimenter. In the receiver shown on these pages this objective has been gained by a combination of one stage of audio amplification followed by two stages of impedance coupling. For the distance enthusiast the set has been arranged for one stage of neutralized RF amplification and a regenerative detector. This combination has been tested thoroughly in the laboratory of this magazine and has performed very satisfactorily in all respects, including that of selectivity. This being under the control of the operator, any degree of selectivity may be secured merely by altering the inductive relationship of the RF primary rotor.

As will be noted from the schematic on page 23 the dual impedances (Samson) are a compromise between transformer and impedance coupling. These give good quality reproduction and are mounted and connected in the same manner as ordinary audio transformers, the condensers being already placed inside of the cases.

In the photograph on page 22, the condenser on the left is for wavelength tuning, the upper knob on the RF coupler in the center of the panel is for the regenerative rotor, while the lower rotor is for the RF plate rotor which permits either fine or broad tuning. The right hand condenser governs the secondary wavelength. The antenna winding on the coupler at the left is fixed. This coupler is arranged horizontally whereas the double rotor coupler is arranged vertically, this eliminating any possibility of inter-action between inductances.

For neutralization of the first RF tube and to prevent this tube from slipping into oscillation and radiating in the antenna circuit, (even though feebly) the 85 mh choke spanned by a .0001 mfd fixed condenser is placed in series with the grid return of the first tube and goes to the negative of the first tube. The neutralizing condenser is placed between the plate of the first tube and the grid end of the 85 mh choke. The connection is shown clearly in the schematic circuit printed in this article.

In the regenerative circuit another 85 mh choke is placed in series with the regenerative rotor between the rotor and the primary of the 2 to 1 audio transformer. It prevents RF energy from going through the primary of the audio transformer and being passed on to the next tube, resulting in distortion. This choke is spanned by a .001 mfd condenser which serves to bypass the RF energy to the filament positive terminal which is common with the ground.

Aside from the features mentioned above the set is a standard, good, radio frequency amplifier with regenerative detector, one straight audio and two impedance stages. The cost of the parts is not excessive and their assembly is simplicity itself.

Pictorial Layout

THOSE who are not accustomed to wiring a receiver from the schematic circuit should consult the pictorial representation of this receiver as shown on page 24. The parts may first be laid out upon the baseboard and the panel as shown in the drawings and the photographs. Then the filament wiring of all the sockets, together with the Am-
Rear view of the completed receiver showing all parts in place and wired

perites, should be placed in before the other wiring is done.

In mounting the double rotor coupler attention should be paid to the fact that upper control is the regenerative one. This winding is larger, in turns, than the primary of the RF circuit, and the coupler should be mounted with the regenerative rotor at the top of the panel and the RF primary at the bottom. All connections of the two couplers are brought out to soldering lugs which makes assembly quite easy. A strip for the binding posts at the rear of the baseboard may be made from a piece of bakelite 7 inches long and about an inch wide. Another smaller strip 2 inches by 1 inch can support the two binding posts for the loud speaker, while another strip of the same size can be used for holding the two binding posts for the antenna and ground.

As shown in the photograph the grid condenser may be mounted directly upon the grid terminal of the socket. This will conserve space. The 0-500,000 ohm variable resistance which is used as a volume control is mounted on the panel at the extreme right, and is connected in the circuit across the grid and bias connections of the first audio transformer. It is not shown in the schematic drawing, but is in the pictorial. Another means of cutting the volume of the receiver lies in the manipulation of the RF plate rotor so that its winding is at right angles to that of the secondary. Which of the two is preferable remains for the individual set user to determine.

Neutralization of the first tube is not difficult, the knob permitting any value of capacity within the range of the neutralizer to be used. This receiver has been used with A and B batteries and with A and B elimination, performing satisfactorily in either case. For congested areas like Chicago and other metropolitan centers, it should appeal to fans who have had difficulty in tuning out interfering stations.

<table>
<thead>
<tr>
<th>LIST OF PARTS</th>
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<tbody>
<tr>
<td>1 Samson antenna coupler</td>
</tr>
<tr>
<td>1 Samson double rotor coupler</td>
</tr>
<tr>
<td>2 Samson .0005 mfd. variable condensers</td>
</tr>
<tr>
<td>1 Samson 2-1 audio transformer</td>
</tr>
<tr>
<td>2 Samson dual impedances</td>
</tr>
<tr>
<td>2 Samson 85 ohm chokes</td>
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<tr>
<td>1 Samson neutralizing condenser</td>
</tr>
<tr>
<td>2 Samson vernier dials</td>
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<tr>
<td>5 Eby UX cushion sockets</td>
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<tr>
<td>10 Eby engraved binding posts</td>
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<tr>
<td>3 Radial 1½ Amperites</td>
</tr>
<tr>
<td>1 Radial 4-A Amperite</td>
</tr>
<tr>
<td>1 Sangamo .001 mfd. condenser</td>
</tr>
<tr>
<td>1 Sangamo .0001 mfd. condenser</td>
</tr>
<tr>
<td>1 Sangamo .0005 mfd. condenser</td>
</tr>
<tr>
<td>1 Durham 2 megohm grid leak</td>
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<tr>
<td>1 Carter &quot;Imp&quot; battery switch</td>
</tr>
<tr>
<td>1 Centralab 0-500,000 ohm variable resistor</td>
</tr>
<tr>
<td>1 7x26x3-16 panel</td>
</tr>
<tr>
<td>1 8½x25x½ baseboard</td>
</tr>
</tbody>
</table>

Schematic circuit of the Dual TC receiver from which the set may also be wired.
Pictorial representation of the Samson Dual TC Receiver which may also be used as a wiring diagram by those who are not accustomed to schematic sketches.
Clough 7 Tube Super Result of Much Research

Several Novel Features Make it Highly Desirable

By F. A. HILL
(Associate Editor)

C onsiderable research work has been done in the past few years on the superheterodyne, principally by independent engineers who have seen in this type of receiver the culmination of all ideas concerning distant reception, freedom from interference and, lately, excellent audio quality in the loud speaker.

With this in mind we take pleasure in announcing a recent design by Kendall Clough, of the Research Laboratories of Chicago, of a seven tube superheterodyne in an exceedingly compact form which has given, under Radio Age laboratory tests, perhaps the highest account of itself of any of the types of similar receivers of the same number of tubes. In addition the quality of the audio end of the receiver is excellent, and surpasses anything we have yet tested.

These remarks may seem rather radical for a magazine of conservative tendency, but the facts speak for themselves. We are always on the lookout for something better than the ordinary for our readers and in this case we believe we have found it.

Inspection of the schematic circuit of this set will not disclose any trick stunts. Instead the reader will observe that it is the conventional superheterodyne with a shielded first detector, a shielded oscillator, and antenna coupling instead of a loop. These features (the first two), make for decreased local pickup of stray energy, while the latter permits the use of the receiver in a congested locality where a loop's directional propensities would be set at naught due to the construction of the building in which the receiver was located. It also permits using a very small energy collector, an antenna of from 4 to 25 feet in length.

However the feature to which most importance should be attached is the method of feeding the oscillator a positive grid bias to a point where the plate circuit of the oscillator will take the same space current with the tube oscillating as it does with the tube not oscillating. When this point is reached (as will be explained further in this article) the even harmonics of the oscillator will have been eliminated, leaving only the odd ones which will be greatly robbed of their energy.

Peaking the Filters

A nother point to be considered in this particular superheterodyne is the fact that a great deal of work was expended on the intermediate stages by Mr. Clough who had felt there was much to be desired in peaking long wave filter circuits and who set about designing a new method of doing this work. Besides the accuracy of peaking in the intermediate stages, the question of field intensity of the transformers themselves was fully investigated with a view to finding the effects of coupling between the intermediate transformers; the presence of shielding; the effect of non-uniform tube capacities and a host of other problems with which the
FIG. 1 FRONT VIEW

RADIO AGE SUPER-HETERODYNE
DESIGNED BY KENDALL CLOUGH

COPYRIGHT 1927

RADIO AGE INC.
Fig. 2 Top View
Radio Age Super-Heterodyne
Designed by Kendall Clough

Copyright 1927
Radio Age Inc.
average experimenter is not prepared to cope.

As a result of months of work this especial design has been found to be an ideal one both for the experimenter and the listener. By means of the oscillator biasing system there are only two points on the oscillator dial where a station appears, this being a normal function of this kind of receiver. In some localities this feature is highly necessary to permit reception of a distant station either on the higher or the lower beat of the oscillator. In some cases where interference is encountered in the upper beat, the lower one will bring the desired station through without a trace of interference. With the even harmonics eliminated much of the short results. Then carefully begin fishing for the distant stations. Do not make too great capacity changes in the oscillator circuit when hunting DX for on many occasions you will entirely pass over the desired long distance signal. The midget capacity shown as RF gain will help in making the set sensitive to signals. If the potentiometer (volume control), on the panel is thrown all the way over to the negative it will throw the intermediate stages into oscillation. This control should be operated at a point just below that where the intermediates go into oscillation.

Elsewhere in these columns there will be found a log of the performance of this receiver on nights other than Monday—this particular night being “silent” in Chicago and not a good evening to test a receiver against the local barrage.

In a forthcoming issue of Radio Age we hope to have more data of an operative nature on this receiver. Those of our readers who build this set will confer a favor on us by reporting their results for the benefit of other experimenters.

In the audio end the plate circuit of the second detector is supplied with a 276 rf choke which serves to keep out any rf from the audio primary. This coil is spanned, from plate to negative filament, with a .002 mfd condenser. The grid return on the first audio is to negative filament, whereas the grid return of the second audio is to the 6-7½ volt tap on the C battery. The output transformer is shown, 221, this serving to completely isolate the dc component from the loud speaker.

Use Good Tubes

HAVING gone over the component parts of this super, which is clearly shown in the schematic, we will go into its operation. First of all, regardless of the expense entailed, get six standard Radiotron or Cunningham 201-A tubes, and one UX112. Since the intermediate stages and the filter are designed to work with tubes having minimum tube capacity, it is imperative that 201-A tubes of the type mentioned be used. We had a couple of trick tubes in the set and nearly lost all of our religion wondering what was wrong. If you are going to the trouble of making up a good job like the Clough super by all means use the best tubes it is possible to secure.

Take a fresh 7½ volt C battery and insert at the terminals shown Osc+C and Osc—C. This is a separate C battery from the one used for biasing the audio and the second detector. On account of the positive bias applied to the oscillator this battery will not last as long as the other since it draws about one milliampere. After connecting in the oscillator C battery (having put in all tubes, hooked up the antenna and ground and plugged in the loud speaker) take a voltmeter or milliampmeter (any low reading one will suffice since it is also a milliampmeter) and plug it into the jack marked “meter.” Then take a short length of wire with a clip at each end, and short out terminals 3 and 4 of the oscillator coil. While doing this watch the meter. If the reading of the meter goes down as you short terminals 3 and 4 change the potentiometer knob on the subpanel to add more C bias. If the reading on shorting terminals 3 and 4 goes up, then less C bias should be supplied. The simplest way to do is to attach one clip on terminal 4 of the oscillator and then with other end tap on terminal 3. Alter the potentiometer value as you tap until you reach a point where the meter needle remains steady regardless of whether the terminals are shorted or not. In this condition the oscillator takes just as much space current when the grid circuit is shorted and the tube stops oscillating, as it does when the tube is fully oscillating. Here the even harmonics will have been eliminated and the odd ones greatly reduced in strength. If the 7½ volt C battery is not sufficient, hook another one in series with the first one.

Get Proper Voltages.

ANOTHER word might not be amiss. The voltages shown in the diagram, namely, 45, 90...
and 135, should be assured. If using a B eliminator, test your voltages to see that the proper values are secured. In using dry batteries be sure to use the heavy duty type, since the receiver when using a power tube, takes from 30 to 50 milliamperes. In actual operation and with everything going full blast our test set ran 35 milliamperes.

Inside of the 111-A coils there will be found small rotors. These rotors govern the pickup from the antenna, and the pickup from the oscillator. It would be a good idea for the set builder to experiment with different inductive relationships of these rotors. The rotor in the antenna coupler should be varied until a good signal strength is secured with a given length of antenna, while the oscillator rotor may also be varied until the best results are secured.

Tune in a local station first and get the set adjusted for best wave transmission which might ordinarily be heard on the super, is likewise done away with. In the audio end with the falling characteristic of these transformers many of the shrill whistles heard on another set are cut off to a point where they are not noticeable. In the lower register we found tones from the well known “oompah” of the Sousaphone, the throbbing cello and a number of the pedal notes of an organ that we did not believe were in existence before. One of our radio wags suggested the audio transformers used in this receiver should be sold to a great many of the broadcasting stations for line transformers.

In another portion of this story we will give the results of our tests. At present we will confine ourselves to a description of the circuit, section by section.

The Description

**FIGURE 1** of the blueprints shows the front view of the panel, which is 7 by 21. On it are located the jack for the meter, volume control, selector one, RF gain control, selector two, filament control, and the filament switch. The drawing gives the detailed dimensions.

In the second blueprint, Figure 2, are shown, reading from left to right, the three intermediate stages, the shielded first detector, the shielded oscillator, and the two stages of audio with output transformer. The stage shields are available so that any one can duplicate this feature of the design.

Figure 3 shows the under side of the subpanel on which a majority of the connections are made, most of these connections being run together across the bottom of the subpanel.

Schematically the Clough superheterodyne is shown in Figure 4, which is the diagram from which the set should be studied and wired. All markings are shown on the diagram so that even a novice should not hesitate to make up a set.

Referring to the schematic circuit, we will dissect it for our readers. The first detector circuit is located inside the stage shield. It comprises the coil socket, 515, the plug-in coil, 111-A, the tube socket 511, the variable condenser 316, the grid condenser and grid leak. Ground is common with the stage shield, the negative filament terminal 4 of the coil, the rotor of the variable condenser, the rotor of the midget condenser (.000025 mfd) and one side of the bypass capacity which is across the 45 volt lead.

The oscillator circuit is likewise shielded with a stage shield, which is common with the negative connection of the potentiometer, the negative of the filament. A strap is shown below the ground connection which serves to join the two stage shields and place them at ground potential, thus limiting

Photograph of the completed Clough superheterodyne with the stage shields removed from the first detector and oscillator.
considerably the local pickup of the circuits. A one mfd bypass is shown between terminal 5 and the negative filament, the 275 choke being in series with the plate section of the coil, the meter jack and the 45 volt line.

The intermediate, or long wave section, of the circuit is self explanatory. Two long wave, iron core transformers are used, the first one using 45 volt plate potential, and the second one 90 volt potential. A potentiometer is placed across the positive socket terminal and the negative of the filament battery, its center arm going to the two grid returns of the iron core transformers. The air core filter coil, 211, has 90 volts applied to the plate, while the grid return goes to the 1 1/2 or 3 volt negative terminal of a C battery. The capacity Cx placed across the primary of the air core transformer, peaks this transformer at the desired frequency—in this case 55 kilocycles. The condenser is supplied with the transformer.

Observing the log shown as a result of tests on the Clough super, readers will note a slight deviation from a uniform curve for both the oscillator and antenna settings. These, we believe, are due to the changes we made during the logging, of the antenna and oscillator rotor inside of the plug-in coils. Where greatest interference from local splash was encountered, it was necessary to alter the inductive relationship of the antenna rotor to bring back sharpness. In such a case a slight irregularity shows up in the plotting of the condenser settings. The same holds true for alteration of the oscillator pickup rotor, and a difference in the positive bias applied to the oscillator will likewise bring a slightly different oscillator condenser setting. It is suggested before a permanent log is made of the receiver, all possible combinations of rotor settings be tried, especially in the vicinity of stations like WQJ against WJZ. If the rotor adjustments are made on the WQJ-WJZ band (separated by 10 kilocycles), and the degree of selectivity fixed, this degree will remain true for the balance of the broadcast channels. It is not advisable to be constantly changing the antenna settings since it would entail considerable bother in making up a standard set of logging figures.

Particular attention should be paid to the filament setting of the tubes. With a voltmeter, adjust the filament circuit until the reading is exactly 5 volts. From this point all other adjustments may be made. However if the filament voltage is constantly shifted there will be a slight deviation in the oscillator readings.

---

**LOG OF CLOUGH SUPER**

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*Lower beat used instead of upper.*
Permanent Attachment Place For Radio

When Miss Elizabeth Zandonini of Washington, D. C., received a radiogram from a friend in Italy recently she was somewhat surprised to note that the message had been filed in Italy only an hour before she had received it in this country. A check-up on the routing showed that an Italian amateur had sent it on short waves direct to an American amateur in Philadelphia, who in turn passed it on immediately to an amateur in Washington, the latter completing the fast delivery by telephoning to Miss Zandonini's residence.

James W. Wigginton, watchmaker and jeweler at Larkspur, Calif., has a homespun single tube regenerative set with which he prowls the ether lanes in search of DX. Mr. Wigginton is located at the brow of Mt. Tamalpais, 8 miles northwest of San Francisco. In our dreamy moments we pine for such a location for our pet set.

For those fans who want the best, in their radio installation, there is nothing better than a row of plugging in places in the baseboard, where connections to everything can be conveniently made and just as easily disconnected. The sketch shows how this can be accomplished in a simple way.

At the left is the antenna receptacle, which is only an ordinary electric light receptacle. In connecting this one, only one of the contact screws are used, and in the cap both of the screws are jumped with a piece of wire as shown, so it will make proper connection, whichever way it is inserted. The group of four fittings consists of a push button switch to start and stop the charger when desired, and the others represent three more receptacles, the first is the same type as the antenna uses, and the other two are "polarity" type, which mean that they can only be inserted one way, which insures the right battery polarity. This whole assembly gives connection to antenna, ground, charger switch, "A" battery, "B" battery 22v. and 90v., all brought up through the cellar directly underneath, a location being selected where the partition can be easily entered by boring holes up from the cellar to admit the wires.

The usual switch box is used, cut in flush with the baseboard, to encase the receptacles and the switch. For the group of four, the boxes are joined together into one, by removing the side walls as required and the screws provided, will clamp them all together. The single brass finishing plate is easy to purchase anywhere, but the four "gang," may have to be made for you, out of a piece of 1/4" brass.

In operation, the charger switch is left "off." When it is desired to charge the battery, you simply push the switch "on," making sure all the rheostats on the set are off to avoid possible injury to the tubes, leaving it charging until it is desired to operate the set again, if necessary. This being all located in the baseboard, it makes tramping to the cellar unnecessary, and all unsightly batteries out of sight.

—H. P. Stroud.
ONE of our readers, whom we take to be a telegraph operator (from his signature), tells this department of his scheme for using a telephone as an aerial. J. N. Bacon, at Oshkosh, Wis., writes as follows:

"I am located on a corner with street cars on west and south sides of me, power line carrying 8 wires (power to car barns) 60 feet west of and parallel to my antenna, high power line carrying 66,000 volts 300 feet east of and parallel to my antenna and all approximately at same height. Reception spoiled by incessant crackling and when street cars are passing reception is entirely drowned out.

"It was inconvenient to change the antenna to right angle to these power lines, and the results would have been doubtful even then, so I tried the stunt of using the telephone as a "pick up" with the result of an apparent increase of signal intensity, reducing the crackling to almost absolute quiet, and unless I am looking for the street cars, would not know they were passing, except when forcing the tubes, then I get a slight crackling, but when the R. F. and detector tubes are being worked on the correct amount of filament battery, no noise is noticed. Am using a Browning-Drake hook-up, and while I have only had both coasts, the Gulf and Canadian station, as well as anything intermediate so far, with this new 'pick up,' I am in hopes that I may possibly get a little farther later on.

"While the wife was not looking, I 'acquired' an aluminum pie pan from the kitchen cupboard and attached a wire to it for a lead-in to the antenna post on the set, cutting off the outside antenna entirely. I then placed the pan on the one desk and placed the phone upon the pan.

"Do not attach the wire to the phone, nor allow it to come in contact with the metal part of the phone or the trouble shetter will be trying to locate trouble on your lines.

"If it broadens your tuning, as it did mine, cut a .0005 fixed condenser in series in the lead-in. This will bring it back to very sharp tuning again.

"If you think this would help out some one who might be similarly situated, pass it along. There is no interference from the phone, whether it is working or not, neither does the ringing of the phone interfere, only a slight 'click' of the make or break, as the receiver is lifted off or replaced on the hook."

Trees as Sources of Radio Inductive Interference

By JAMES MONTAGNES

IN some sections of the country radio inductive interference is the bugbear of radio fans. Electrical appliances and electric lines are the cause of this, and it takes radio inspectors and supervisors much time to hunt the trouble in order that the broadcast listener may be rid of this pest.

The little town of Orillia in Ontario at the head of Lake Simcoe, recently sent in a complaint to the Toronto radio inspector that terrific radio interference was making radio reception almost impossible. The radio interference car was quickly prepared and Inspector S. J. Ellis with his assistant left for Orilla, about eighty miles north of Toronto.

On coming within view of the town, Mr. Ellis was greatly impressed with the vast number of trees in and about the community. In fact Mr. Ellis fervently believes that there isn't another town with such a distinguishing entry. The trees proved to be more than that.

Usually inspection for this sort of interference is done on foot; where a long road has to be investigated the car is used. A receiver, loop aerial and phones are carried by the hunter, the receiver being slung over the shoulder by means of a strap and the loop carried in the hand. Then as a noise is heard in the phones it is tuned in and hunted till it is loudest. This vicinity is then thoroughly searched and the source of the trouble quickly found in this manner.

Following this system Mr. Ellis began hunting for inductive interference on reaching Orilla. He did not have far to go. Coming under some of the trees a faint sizzling was heard in the earphones. With-
European Scientists Study Ghostly Temperature Drop

SCIENTIFIC circles in Europe are experiencing a distinct revival of interest in the supposed phenomena produced by mediums and in other so-called psychic manifestations. Most scientific men have been disinclined to investigate these phenomena seriously on the ground that many mediums are known to be frauds and that fraud is probable in the whole realm of the psychic. Outstanding exceptions to this view have been Sir Oliver Lodge, in England, and Dr. Charles Richet, in Paris. These pioneers are now beginning to have imitators among other scientific men. Few of these scientists share the spiritualistic beliefs. They prefer the idea that if any of the phenomena are real these are to be explained by new forces of nature which we do not yet understand. The most important single experiment yet reported in the field of actual scientific investigations of mediumistic phenomena appears to be one in which the temperature of the seance room dropped suddenly while a seance was in progress.

The whale may have swallowed Jonah, but in 1926 here is what swallows the whale. In the strange blunt prow of this modern whaling vessel, is a waterproof door which is opened when a whale is caught, and in goes the whale, where the try-work scannery and full equipment for using every bit of the big sea beast is located. The ship shown here is the C. A. Larsen, one of the biggest whalers afloat.

Be sure to order your February copy of Radio Age now.

Mother of Airplanes at Sea

The airplane carrier "Langley" off San Diego during recent maneuvers of the Pacific fleet. The ship, under the command of Captain John Reeves and in charge of the aircraft squadrons, has been in operation since 1924 and naval aviators have landed their planes 2500 times without a single major accident. One thousand seven hundred of these landings have taken place since last November and all have been made at sea while the Langley was engaged in tactical maneuvers with the fleet or in training of the pilots. The arresting gear on board the Langley, which permits the plane to come to a full stop within the length of the deck, is one of the few jealously guarded secrets of the American Navy.
Keeping Pace with Science

Eyes and Ears of the U. S. Coast Artillery

Cosmic Rays Have Been Traced to Milky Way

Two discoveries have been announced concerning the remarkable cosmic rays which continually bombard the earth from outer space. One announcement comes from the American physicist, Dr. R. A. Millikan, who detected these rays last year by sinking his apparatus deep in the water of a snow-fed lake high up on the California mountains. Dr. Millikan has now repeated these tests in the water of another mountain lake on top of the Andes Mountains in South America. The results are the same. The reality of the cosmic rays can no longer be doubted. The other announcement comes from Dr. Werner Kolhoerster, of Berlin, a German scientist who has been studying these rays for several years. Assisted by Dr. Gubert von Salis, he tested the intensity of cosmic rays on the top of one of the mountains in Switzerland. This intensity was found to vary from hour to hour, depending upon what part of the sky was overhead. More of the rays appear to come from the Milky Way than from other parts of the sky, with two other apparent sources perceptible; one in the neighborhood of the great Andromeda nebula and the other in the constellation Hercules. What produces these cosmic rays is unknown. Many scientists think that it is some transformation of the atoms of matter. The rays resemble X-rays but are much more penetrating. If they can be identified as coming from some particular class of celestial objects that may yield a clue to their origin and thence to how they can be produced and studied here on earth.

First Plane Catapulted From Turret of U. S. Battleship By Powder Explosion

The U. S. Navy added another chapter to the history of aeronautics when a 5,100 pound amphibian plane was shot from the top of a turret of the U. S. S. West Virginia in Los Angeles harbor. A charge of powder equivalent to that used in an 8 inch shell was exploded. Lieut. D. S. Fahnrey piloted the plane in the experimental take-off which is the first time it has ever been done.

Help us make Radio Age bigger and better—become a subscriber.
Everyday Mechanics

Skill With Knife Wins Scholarship

CREATING electric currents by shaking the electrons inside a bar of copper, as peas might be shaken inside a baby's rattle, is the striking scientific experiment recently accomplished by Dr. Richard C. Tolman and L. M. Mott-Smith at the California Institute of Technology, at Pasadena. The new experiment concludes and strengthens a series of similar tests begun by Dr. Tolman nearly ten years ago. Its result confirms the modern idea that both electricity and matter are fundamentally the same. The electrons with which Dr. Tolman's experiment dealt are the tiny electric particles which operate the vacuum tubes of a radio set and which constitute electric sparks and electric currents. These same electrons are believed to form parts of the atoms of matter. A bar of metal contains millions of them. Ordinarily these electrons are tightly held inside the metal, escaping only under the action of intense heat or of electric forces. Nine years ago Dr. Tolman was able, however, to shake a few of them out of a moving copper rod by stopping it quickly, in the same way in which one shakes pills out of a bottle to which they adhere. Now he has used the different method of making his cylinder of metallic copper twist back and forth on a spring. This sets the electrons inside the metal to swinging.

Germ Personalities

THAT even the tiniest germs possess personalities and individualities is the conclusion reached by a German biologist, Dr. F. M. Lehmann, from long-continued studies of a variety of microscopic, one-celled animal called the Paramecium. Creatures of this kind are plentiful all over the world and may usually be seen under the microscope in a drop of water from any stagnant ditch or pond. Dr. Lehmann has studied the effects of such things as temperature, food, fresh water and so on on individual creatures of this species. He finds them to differ almost as markedly among themselves as human individuals would do under parallel circumstances.
Smoke-Eating Apparatus

C. W. Ringer, chief engineer of the Minneapolis Fire Department, demonstrating his new apparatus for sucking out of burning buildings clouds of suffocating smoke which impede the efforts of firemen.

Coach Using Electric Drive

Recently Chicagoans witnessed demonstrations of the Versare coach which utilizes electricity for its motive power, the current being furnished by a generator driven by a gasoline motor. The coach is equipped with a 125 hp, six cylinder engine recently developed by the Versare and Waukesha companies. The engine is connected to a 40 kw Westinghouse generator by means of a disc type coupling. Two Westinghouse 28 hp., motors take current from the generator for driving. Braking is accomplished by air brake, electric resistance braking and the conventional hand brake. Speed determined by the electric controller, there being no gear shifts. A number of these coaches are now in operation, one similar to the coach shown above being used by the Alton Transportation Co.

General Electric Has
15 Transmitter Licenses

Fifteen radio licenses have been issued to the General Electric Company by the Department of Commerce, to assist engineers of that company in their comprehensive inquiry into the mysteries of radio transmission.

To the average listener fifteen radio licenses sound like a lot of interference and there might be some atmospheric difficulties in the vicinity of Schenectady if all the transmitters represented by the fifteen licenses were on the air at the same time with voice and code. This is not the case however, as rarely more than six transmitters are working at once and these are so widely spaced that there is no chance of one transmitter encroaching on the air lane of another. Furthermore all of the Schenectady transmitters, no matter in what stage of development they may be, are controlled by crystal quartz which holds them on the desired frequency.

The licenses issued to the General Electric Company and the wavelengths for which they are issued are: 2XAW, 3 to 20 meters; 2XO, 2XAF and 2XAD, 10 to 50 meters; 2XH, 2XK and 2XAC, 50 to 150 meters; 2XAK and 2XAZ, 100 to 200 meters; 2XAG (50 kilowatts), 380 meters; 2XAH, 1000 to 4000 meters; 2XI, general experimental license; 2XAM, 110 meters. The fifteenth license is for broadcasting purposes and is for WGY, licensed for 379.5 meters.

Station 2XAF is now being used on 32.79 meters and it was this transmitter which carried the signals of WGY across the Atlantic and the Pacific, early this spring.

2XAD is now being used for transmission on 20 and 26 meters, and 2XK, heard previously on 109, 100 and 65 meters is now operated periodically on 140 meters. 2XAH, at one time operated on 1590 meters, later on 1480, is now transmitting signals on 1400 meters for rebroadcasting by WCAD of St. Lawrence University, at Canton, N. Y. 2XAM and 2XAE are used by the General Engineering laboratory of the General Electric Company for communication between the main laboratory and the standardizing laboratory in the town of Glenville, about eleven miles away.

The Magazine of the Hour

Build It Yourself
Parts Complete $1415
Including Unit

In one evening and for 1/5 retail cost you can build the finest 3 foot Cone Speaker. Marvelous tone quality; every instrument in an entire symphony orchestra is clear, musical and distinct, even the very lowest. And the cost for ALL the parts—3 sheets Aluminum Con-Tex, Penn Dark Rings, Unit Mountings, special Alum Bridge and genuine Cone Speaker UNIT designed especially for 3 foot Cone Speaker—just 84c. Penn Cone Speaker Unit is adjustable to the audio output of any set. Unilateral, 90.90. If your dealer cannot or will not get the parts for you, we will ship on receipt of price. Pamphlet, "How to Build a 3 foot Cone Speaker for $8.15" sent for 10c., stamps or coin.

PENN RADIO SALES CO.
104 Fifth Ave. Suite 201 New York City
Power Under Water

San Francisco is the richer for 15,000 horse power of electricity being generated in the mountains of California, brought down and under San Francisco Bay by cable. The length of cable laid across the bay was 8 1/4 miles, valued at $225,000 and represented the culmination of 8 months of toil. The cable measured 4 3/8 inches in diameter. Contained within its outside insulation of wrapped wire were three insulated groups of heavy copper wire to carry the 11,000 volts needed to meet the demands in San Francisco. The coils of cables were 41,000 foot lengths and were spliced together. The cable barge is shown dropping the last coil of cable into the Bay.

What's Wrong With Broadcasting

(Continued from page 12)

Every city which supports more than a thousand inhabitants will have that many before the snow flies.

When programs and licenses were considered a part of the equipment of a broadcasting station many a voice was stilled despite the knowledge of its owner that millions of people wanted to hear it. Now neither programs nor licenses are required and most of the birds who used to build receivers are now building transmitters. It seems quite likely that within the next two or three months nobody—that includes Mr. Edison—will be left to listen to the broadcasting stations. And what of it?

All in all Mr. Edison's preference for the phonograph seems to prove just one thing: He may be afflicted with insomnia but his ears are all right.

SEND FOR THIS RADIO FOLDER

Contains seven hookups for B-Eliminators published in a prominent radio magazine.

When You Build a B-Eliminator

Use Bradleyohm-E for the Variable Resistors and Bradleyunit-A for the Fixed Resistors

ALWAYS insist that Bradleyohm-E and Bradleyunit-A are included with your B-Eliminator kit, if you want to be assured of perfect voltage control. The leading manufacturers of B-Eliminators have long since adopted these Allen-Bradley variable and fixed resistors as standard equipment for their B-Eliminators. In fact, Bradleyohm-E is used almost as universally as the Raytheon tube, itself. You cannot afford to risk the use of inferior substitutes for the scientifically treated discs used in Bradleyohm-E. This remarkable variable resistor handles the strenuous requirements of B-Eliminator service without the slightest strain. Ask your dealer for Allen-Bradley Perfect Radio Devices, today.

MAIL THE HANDY COUPON

Allen-Bradley Company
259 Greenfield Avenue
Milwaukee, Wisconsin

Please send me, FREE, your radio folder with seven B-Eliminator hook-ups.

Name ____________________________
Address __________________________

Please Mention Radio Age When Writing to Advertisers.
Washington Monument Does a Radio Shimmy

(Continued from page 17)

Continuous waves were transmitted, these being chopped by a commutator connected in the filament center tap.

"As a result of these observations," summarizes Mr. Dunmore of the Radio Laboratory of the Bureau of Standards, "it appears that there is induction or radiation from most metallic objects so that a radio direction-finder placed in the immediate vicinity gives an erroneous indication of the direction of the transmitting station. The magnitude of this distortion depends greatly upon the wave length.

"For this reason, it is always advisable to detune or open circuit any antennae which are in the immediate neighborhood of a direction-finding station. It also seems doubtful whether burying wires near the receiving station is sufficient to avoid all distortion.

"In general, the distortion decreases to a negligible amount at a distance away from the disturbing object about equal to its largest dimension.

White Paint Cooler

The Bureau of Standards, Department of Commerce, was recently requested to devise a method for preventing the excessive heating of gas balloons in sunlight, it has been announced. Previously, it was pointed out, the Bureau had conducted tests showing that radiators in homes radiated more heat when painted with certain kinds of paint and, conversely, tents painted with different kinds of paint would bar heat from the interior.

The information gained from these early tests, stated the Bureau, was an aid in solving the problem of devising a method for preventing the super-heating of gas balloons. The outer surface of the top and sides of the balloon, should be painted white.

Can't tune 'em out?

Try a Micadon 601 in series with the antenna of your set, if you find it hard to "tune out" nearby stations.

The Micadon will have the same effect as "loose coupling," and the selectivity of your set will be greatly improved. Capacities from .001 to .005 mfd. may be used—you will find a full explanation in our 32 page booklet, "Seventeen Ways to Improve Your Set."

Micadons, because of the patented principles of low-loss insulation and protection against variation in capacity which they embody, are a vital element in the improved reception of thousands of radio sets. The tone, the efficiency, and the satisfactory operation of your set depend on the quality of the fixed condensers used.

If you want to be sure that your set will do all it was meant to do, be sure that the fixed condensers bear the name of Dublier.

Send 10c in stamps or coin for your copy of "Seventeen Ways to Improve Your Set."

Dublier

CONDENSER AND RADIO CORPORATION

4377 Bronx Blvd., New York, N.Y.
When Radio Turns Navigator
(Continued from page 14)

A dyne receiver is employed in connection with the radio direction finder, neatly installed in the metal cabinet which forms the base of the equipment. The tuning controls, exposed to view by a drop cover, consist of two station selectors, a volume control, a filament control, and a switch for obtaining "Line" and "Sense" readings. The batteries are also in the base of the equipment, and are connected with a trickle charger.

SO IMPORTANT is the direction finder in navigation that radio beacons, like lighthouses and lightships, have come into existence along our coasts as infallible guides to coastline and transoceanic and lake navigators. These radio beacons, operated by the U. S. Lighthouse Service, now extend up and down the Atlantic and Pacific coasts, along the Gulf of Mexico, and on the Great Lakes, as well as in Alaska and Hawaii.

Operated on regular schedule, the radio beacons are also pressed into service when weather conditions warrant steady operation. They are likewise started on request. Operating on 1,000 meters wavelength assigned for such radio transmission by international regulation, the ICW or interrupted-continuous-wave transmitters employed send out signals that vary in note and in character, so that each beacon may be readily identified. Herefore, all radio beacons have been operated at the same time, causing considerable and troublesome interference because of the unified wavelength. This interference has been eliminated, however.

"Invariably, navigators are enthusiastic in their praise of the direction finder, which, in many cases, has taken precedence over the time-honored sextant in determining a ship's position, even when ideal weather prevailed," according to T. M. Stevens of the Radio Corporation of America. "In foggy and cloudy weather, of course, the radio direction finder serves to solve what has hitherto been a serious predicament. Where sounding are impractical along steep coasts, because of great depths a short distance off shore, navigators have used the radio direction finder and their known speed in guiding their ships along. Delays on account of fog can now be practically eliminated.

At WGN
SANGAMO
Mica Condensers
Prevent
Shifting of Frequency Bands

BECAUSE the Sangamo condenser is solidly molded in bakelite, mechanical movement of dielectric or plates is impossible. This is one important factor in the permanent accuracy of the Sangamo. No one has greater need for condenser accuracy than a great broadcasting station like WGN. Read Mr. Leverett's comment:

"Last June I used Sangamo Mica Condensers in a multiple band pass filter. This has been in use for some time, and has given the best of results, showing no shifting of the frequency band. This permanency I believe is due entirely to the consistency of these condensers, there being no apparent change in capacity nor leakage across them. I cheerfully recommend them wherever a constant capacity is required."

(Signed) Geo. H. Leverett,
Asst. Engineer,
Station WGN Chicago

Sangamo Condenser Blocks
American-made condensers, wound under uniform tension to eliminate air or ozone bubbles that cause breakdowns.
Handy sizes:
12 mfd. tapped 8, 2, 2 mfd.
14 mfd. tapped 8, 2, 2, 1, 1 mfd.
14 mfd. tapped 4, (high voltage),
4, 2, 1, 1, 1, 1 mfd.

Also separate condensers, special capacity blocks to order.

Sangamo Electric Company
632-11 Springfield, Illinois

SALES OFFICES—PRINCIPAL CITIES
GOLD WAVE AERIAL

Guaranteed to:

1. Give you stations not previously received.

2. Bring in greater distance.

3. Improve tone and selectivity.

Or your money back

We make these claims without reservation. This

famous Gold Wave Aerial has been put to thou-

sands of tests. Recommended by all radio engineers.

For a few cents to install it will fit any receiver and

make it do the work of all similar aerials for less.

Order now, only $10.00.

World's finest loud-speaker—
Genuine "EnSCO" 3" cone kit

ONLY $10.00

The solution of the

Perfect distortion loud-speaker

ability of the hearing engineers

MAKE YOUR OWN THREE FOOT COSE SPEAKER IN 30 MINUTES

Complete parts furnished in kit form. We guarantee

this equipment equal in performance to any manu-

factured cone speaker at any price.

Order now. THREE FOOT CONE SPEAKER you hear all the tones. It brings out the true depth and

beauty of orchestral and instrumental music. Can be

operated softly for living room music or full

power for dancing, without trace of distortion.

Kit includes "EnSCO" cone unit, the only direct-

drive, distortionless unit for large cones; Al-

uminum Project in big cone plus brass spot for

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struction. All necessary parts furnished in this

wonderful speaker under our absolute guarantee.

It's your money back if you are not com-

pletely satisfied at any price. It works on any set, with

ordinary tubes or with Power Output.

Send No Money !

Write your name plainly as indicated below, then

mail certified check or money order payable to

us. We will forward to you at once. This offer a

limited number of kits only.

No returns.

ENGINEERS' SERVICE CO.

25 Church St., (Desk A), New York City

The Magazine of the Hour

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Kit includes "EnSCO" cone unit, the only direct-

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uminum Project in big cone plus brass spot for

...
WORLDS RECORD SUPER 8
RADIO'S GREATEST RECEIVER

6,000 to 8,000 Miles
Consistent Reception on a Loop!

SELECTIVITY
The following is a report of tests made by Radio Age Magazine with a Worlds Record Super in Chicago.

"The Worlds Record Super is extremely selective. . . . KDKA comes through clean and sharp without any interference from WGN below or WGES above that channel. Three stations between WJAZ and WGES (WSMB-KOA-WSAI) come in without the slightest difficulty of an overhang from either WGES below them or WJAZ above them. The same applies to KHTS being received without interference from WJAZ.

A little higher on the band WDAF at Kansas City is brought in without a trace of WEHG, and above the latter station, KTHS may be held during their entire program without a break-over from Edgewater. WGY, WTAM, WOAI, who lie between WEBH and WHF may be separated easily.

Against WQJ-WMAQ the Radio Corporation WJZ comes through with excellent volume and no hangover from the adjoining local station. KFNY, KFI, WRC, WBAP all come in nicely between WQJ below and WCFG above. WHO is copied solid for over an hour without any disturbance from KYW."

TONE
The Worlds Record Super possesses a tone quality of surprising naturalness at all volumes. It is a veritable revelation in realistic reproduction that amazes engineers and amateurs alike.

DISTANCE
No other receiver has approached the marvelous DX Records that the Worlds Record Super has established, and it is safe to say none will for years to come.

VERIFIED
WORLDS RECORDS
The authenticity of the startling achievements of the Worlds Record Super (as listed below) is based upon hundreds of verifications by leading Broadcasting Stations and Publications from coast to coast.

1. On March 17th established new World's Records for LOOP AERIAL RECEPTION—8,375 miles with Loud Speaker Volume.

2. On the night of March 29th, established new World's Record with the reception of SIX FOREIGN STATIONS 6,000 or more miles distant.

3. Established new World's Record for GREATEST NUMBER OF BROADCASTING STATIONS heard that are located 6,000 or more miles away.

4. Established new World's Record for MOST CONSISTENT RECEPTION, night after night, of Stations 6,000 miles or more distant—117 programs from 19 different Foreign Stations, heard between December 27th and April 10th.
WORLDS RECORD
RADIO'S

Parts Used and Recommended by
Radio Age Magazine for its Worlds Record Super 8

THORDARSON R-200
AMPLIFYING TRANSFORMER

The choice of the Thordarson R-200 amplifying transformer for the Radio Age Worlds Record Super 8 is significant. Among amplifying transformers the R-200 is supreme in musical performance, and is now standard equipment on such quality receivers as Zenith, Howard, and Kennedy. Ideally adapted for use with cone type speakers.

Price Each. $8.00

SELECTONE TRANSFORMERS

R-400
SELECTONE Tuned Transformer—R-400—has specially designed closed tap case, which limits inter-tap coupling and is impregnated in a vacuum so that all characteristics of coil remain constant. The coil design gives an extremely high amplification. Can be used in any circuits requiring a loop wave transformer.

PRICE $6.00

R-410
SELECTONE Tuned Tank Transformer—R-410—has no taps. Each transformer is matched to within one turn from each to the next. The matching of these filters is so perfect that where extreme selectivity is desired, two can be used and are guaranteed to match perfectly.

PRICE $6.00

Scott Transformer Co.
7620 Eastlake Terrace
Chicago

6,000 to 8,000 Miles Consistent Reception on a Loop!
SUPER EIGHT
GREATEST RECEIVER

Parts Used and Recommended by
Radio Age Magazine for its Worlds Record Super 8

Hammarlund, Jr.
(Midget)
A high ratio, shielded midget condenser with all the distinctive earmarks of Hammarlund design and workmanship. Many uses are shown in circulars packed with each condenser. Made in four sizes: 16, 32, 50 and 75 mfd. Price, $1.80 to $2.00.

Among the other new kits of this season for which Hammarlund Precision Products are specified are: Cockaday's "LC-27"; Lacaud's "LR3"; St. James Super; the new Harkness; "Henry-Lyford"; Morrison's "Vari- ton"; Victorian Superheterodyne; Laf- tin & White; Pacent "Ultimax"; Browning-Drake; Popular Science Monthly "Powerful"; Hammar- lund-Roberts "Hi-Q."

Hammarlund Mfg. Co.
424-438 West 33rd St., New York City

Variable Condenser
.0005 mfd.
Twin Rotor Construction. 360 degree rotation of dial gives extremely fine adjustment. Both sections of condenser insulated from shaft—therefore no body capacity whatever.

630 .00035 SLW with dial $5.00
631 .0005 SLW with dial $5.00
638 .00035 SLW less dial 4.50
639 .0005 SLW less dial 4.50
648 .00035 SLF less dial 4.50
649 .0005 SLF less dial 4.50
659 .0001 SLF less dial 4.50

ANYONE can build an exact duplicate of the Radio Age Worlds Record Super Easily and Successfully

With the parts here listed, anyone can build an exact duplicate of this remarkable Worlds Record Super with a screw driver, pliers and soldering iron. Building instructions make it almost impossible to err in construction and if followed carefully, assure the builder of a receiver that will duplicate the tremendous performance of the original model. Build the Worlds Record Receiver and you will have at small cost the finest Radio Set obtainable today.

SEE
List of Parts and Diagrams in the Construction article in this issue

6,000 to 8,000 Miles Consistent Reception on a Loop!
The Radio Age
Worlds Record Super 8
Radio's Greatest Receiver

6,000 to 8,000 Miles Consistent Reception on a Loop!

Accessories Recommended by Radio Age For Its Worlds Record Super 8

The Quali-Tone Loop was used exclusively on the Worlds Record Super and was in great part responsible for the marvelous records that remarkable receiver established. Note adjustment feature that keeps wires taut always. Get the Quali-Tone for better reception.

See and hear Quali-Tone's new Drum Type Speaker—

The Troubadour, $30

SEND for literature describing Quali-Tone's complete line, which includes the Junior Speaker—$7.50, Quali-Tone No. 2 Speaker—$10, Quali-Tone No. 3—$15, Quali-Tone No. 4—$25 and Quali-Tone Radio Units at $6 and $7.50.

Duro Metal Products Co.
2651 North Kildare Avenue
Chicago

MAJESTIC "B" Current Supply
Delivers pure direct current from your light socket

Majestic Super-B
Recommended for the Worlds Record Super 8

Capacity one to twelve tubes, including the use of power tubes.
45 mlls at 150 volts $35.00
West of Rocky Mts., $37.50 (As illustrated)
No Hum—Superior to Any Source of Power

The voltage can always be accurately adjusted to meet the varying conditions of every city and on any set. Economical—costs a fraction of a cent per hour. No acid or liquids; Uses Raytheon Tube; No filament to burn out.

See your dealer today.

Grigsby-Grunow-Hinds Co.
4584 Armitage Avenue
Chicago, Ill.

THE ABOX FILTER

Real "A" elimination at last. Filters current direct from charger to radio set. It is the first device of its kind ever offered to the public.

Price

$19.50

East of the Rockies

The Abox Filter contains no batteries. It is a filter circuit consisting of a choke coil and two of the new Andrews electrolytic condensers which operate on a new principle and permit enormous capacity with small space, cost and weight.

The Abox Filter handles as much as five amperes and renders the current absolutely smooth and suitable for proper operation of the tubes. It is always ready for immediate use, even after long idleness. It cannot run down or wear out.

The Abox Company
218 N. Michigan Ave.
Chicago

Read—

Construction article in this issue for complete data on The Radio Age Worlds Record Super 8—Radio's Greatest Receiver. For full verification of Worlds Records write: Mr. E. H. Scott, 7620 Eastlake Terrace, Chicago.
EVERYBODY, including experienced radio engineers said — it cannot be done. But we did it — produced a high grade, long distance single dial control radio to operate a loud speaker to retail for $25.00 — and yet allow liberal discount to agents.

This marvelous instrument is the result of five years hard work by an organization of trained radio engineers. It is no experiment — thousands are in use — the results speak for themselves.

There Will Be a Radio In Every Home
Thousands have been waiting for just such a radio — a real long distance, powerful instrument but at a price they can afford.

It is here, and live wide awake salesmen will recognize their opportunity immediately — they won’t lose a single minute writing for full information.

Just as there are 100 Fords to one high priced car, just so will there be 100 Vikings to every $25.00 and $100.00 radio — think what this means to men who get in on the ground floor right now.

A $25 Radio Which Will Equal a $75 Radio
Put a Model 599 Viking which retails for $25.00 alongside any radio retailing for $75.00 and even more. Compare them for one of tuning — only one dial to tune on the Viking — distance received, volume and tone. The results will make any man say, I’ll save that $50.00.

Radio is today the biggest and quickest selling line — thousands are being sold — salesmen have made unheard of profits. But here is a far greater, a far more interesting radio proposition than anyone ever dreamed of.

You Should Make $100.00 a Week Easily
You can’t help it — many will make more. Some will control a county — others will control many counties. We have the biggest radio selling plan of today — instruments of all prices — a radio price to fit every pocketbook.

Any man who will follow our teaching cannot help but add big money to his present income and start to do it immediately. If you want more money here is your chance but you’ve got to act quick — others will jump at this chance.

You can’t help it — many will make more. Some will control a county — others will control many counties. We have the biggest radio selling plan of today — instruments of all prices — a radio price to fit every pocketbook.

A Regular Radio at a Price Unheard Of
Uses five No, 199 tubes, operates on three ordinary dry cells. Only one dial to tune — a feature generally only found in the highest priced instruments. Any child can tune the Model 599 VIKING — simply turn the dial. Cabinet is extremely attractive, 12 inches long, 8 inches high and 6 inches deep. The wood is covered with Keratol, embossed in a very attractive design. On the front are two very old gold colored, colonial designs inserted in two panels. The base and ends are finished in a rough gold and black colored finish which together with the rich seal brown Keratol of the balance makes a cabinet that would be an ornament in any home.

The tuning is arranged so that it is accomplished by the use of one special low loss condenser and a helical wave coil. Sockets, rheostat, potentiometer and base board are all of bakelite. Three transformers give an abundance of volume for loud speaker. Fords will equal the average $75.00 or $100.00 radio instrument — only enormous production could possibly bring about this low price.

Territory is Going Fast — Better Write Today
Someone is going to get the big profit on the sales of these instruments in your community — is that someone going to be you? Write today for our 100 page book which fully describes not only this wonderful instrument but exhaustively full line of radio at all prices. It’s FREE for the asking.

SEND FOR 100 PAGE FREE BOOK

Please Mention Radio Jan when Writing to Advertisers.
An Absolute Necessity!

FRESHMAN AUTOMATIC CHARGER

Complete with TUNGAR Tube Cord and Plug.

YOUR "A" BATTERY TROUBLES ENDED Requires No Attention

This remarkable device keeps quietly working for you all the time that your set is not in operation. It is controlled by the switch of your set which disconnects the charger automatically when you are using your radio. And, when you turn off your set it immediately resumes charging the "A" battery again.

Foolproof and Dependable

Whether it is a radio dance that you are giving or an excited assemblage listening to the results of a World's Championship sporting event you never need have fear of the broadcasting fading away through rundown "A" batteries; a condition which has happened so many times in the past to practically all owners of radio sets.

Our new 48 page book illustrating all Freshman Products is now ready. Write for it—Free

CHAS. FRESHMAN CO., INC. - Freshman Bldg., New York

The Magazine of the Hour

Hypodermic to Trail Cell's Life Secrets

NEW facts about the chemical conditions inside the tiny living cells which compose the bodies of men and of all other animals were disclosed by Dr. Robert Chambers, of Cornell University Medical College, in a recent address to the New York Academy of Medicine.

Although many of these living cells are so tiny that they cannot be seen at all except by the help of a good microscope, Dr. Chambers has been able to inject much tinier drops of chemicals into them without killing them, much as a physician injects drugs into his human patients by means of the hypodermic needle. Inside each living cell is a central portion which scientists call the nucleus. This is supposed to be the seat of the most active phenomena of life. By injecting colored chemicals into this innermost seat of the life forces, Dr. Chambers has been able to see changes in the color of the injected material. These changes prove that the tiny living granules in the nucleus are different from the surrounding portion of the cell, being much less acid.

Yale GROUND HOG DOUBLES POWER AND DISTANCE

Marvelous newly-invented ground given instantly improved reception. Doubles power and distance using same. Reduces leakage. Stops jangling even in midsummer. Results never before equaled. Satisfaction guaranteed or money back at once. Proven absolutely essential for clear, powerful distance reception. Draws and holds moisture indefinitely. Highly sensitive to radio energy. SEND NO MONEY—To introduce, we offer to those who act at once, regular $5.00 price for only $2.00. Send name today and pay $2.00 plus 14c postage on delivery. Or send only $2.00 with order and save postage. FREE—Full description of Ground Hog and details of amazing low priced battery offer on request—worth today.

Empire

Matchless in Performance
DE LUXE Double CONE SPEAKERS

Two free edges, full floating diaphragms. Beautiful design. In r.h.i. mahogany wood stand.

10" De Luxe...$125.00
12" De Luxe...$145.00
Standard...$115.00
Special...$95.00

DEALERS! Inquire today

Empire Elec. Products Co. 132-134 Greene St. New York

Please Mention Radio Age When Writing To Advertisers.
Not only

the most reasonable

but proved by 40,000 users to be also the most convenient, unfailing and satisfactory "B" Eliminator

New High Voltage Model

for extremely large sets, or sets using power tubes, now perfected. Delivers up to 180 volts. One control adjusts voltages on all taps.

Equal to any "B" Eliminator regardless of price—not only in operation, but in workmanship, quality, durability and appearance

Money Back Guarantee

Stop paying out money for costly, unreliable battery service and repairs. Permanent excellence can be built into economical "B" service. 40,000 users of the good FERBEND "B" Eliminator agree. That is why during the slack summer season we worked at full capacity to meet orders. That is why hundreds of unsolicited testimonials prove beyond the shadow of a doubt its splendid, enduring performance.

Ask Your Dealer—or Send Direct

Shipment made direct on receipt of price, or C. O. D. if preferred. Use for 10 days to convince yourself—if unsatisfactory write us within that time and purchase price will be refunded. Use Coupon NOW.

FERBEND ELECTRIC COMPANY
431 W. Superior St., Chicago, Ill.

FERBEND ELECTRIC CO.
431 W. Superior St., Chicago, Ill.

Send $12.50 model. Send $17.50 model.

Send at once. Payment enclosed.

Send C. O. D. Send literature.

Name

Address

City State

---

They Want YOU to Know

Montreal, Canada

I am pleased to ask that the FERBEND "B" Eliminator is now

approved by the foremost Radio Laboratories in America,

"B" ELIMINATOR

Approved and passed by the rigid Laboratory Tests

of the two foremost Radio Laboratories in America

Radio News and Popular Radio

Please Mention Radio Age When Writing to Advertisers.
Try Out Hour for Radio Performers
(Continued from page 13)

B-T POWER — SIX
Those who know the B-T record for leadership realize that "best B-T receiver" means best of all.
A multitude of set builders have learned to depend on B-T parts and circuits. Those who were fortunate enough to learn of B-T superiority in the early days, have had the best in radio year by year.
So it means something when Gerald M. Best, technical editor and superheterodyne authority says:
"The new Bremer-Tully Power-Six is by far the best Bremer-Tully receiver yet developed. Its remarkable selectivity and simplicity of operation leads me to believe it will be one of the seasons most popular circuits. It is one of the easiest circuits to wire of any I have seen. Its engineering principle is sound. Congratulations to Bremer-Tully on this new development."
A 12-year old fan builds one. He says: (Nov. 4, 1926)
"I am only thirteen years old but thought the Counterphase Six the simplest set I had ever built. I have never heard a radio so selective combined with such amazing tone quality and volume. In three weeks I have had seventy-four stations from Winnipeg, Canada, to Miami, Florida; Los Angeles, Calif., and Springfield, Mass." R.L.
Essential parts available in kit form, price $41.50
Send for 10th Edition "Better Tuning" for full information on the Power-Six, all parts, factory built "Eight" and "Six," B-Power unit, etc. Price 10c.

Bremer		
Tully
Manufacturing Co.
520 S. Canal St. Chicago, Ill.

The Magazine of the Hour

Try Out Hour for Radio Performers

"—by far the best B-T receiver yet developed," says a technical leader.

Try Out Hour for Radio Performers

(Continued from page 13)
ever was a gift to radio, her offspring is it.
"I want you to try Johnnie's voice on the air," she wheedles. "He has such a lovely voice. All the neighbors say they never heard anything like it. He's not the least bit afraid either. Shake hands with the gentleman, Johnnie! Yes, indeed, I was just saying to my husband last night, 'I MUST take Johnnie up and let him sing for XZY. They have SUCH a good station.' I wouldn't take Johnnie any place else."

The long-suffering director or whoever happens to be trying out the talent, agrees to listen to Johnnie's phenomenal voice. Usually the poor little soul has adenoids or enlarged tonsils or an advanced case of toothlessness and could never be used under any circumstances, even on a children's program. As gently as possible mamma is told that Johnnie's voice is not suitable for broadcasting.

Mamma Gets Peeved

WHAT! Not suitable for broadcasting!" Mamma usually retorts in righteous indignation. "Why I heard a little boy sing from your station last week and his voice didn't begin to compare with Johnnie's! It didn't compare! Of course if you WON'T use him here, I'll be OBLIGED to take him to some other station."

And she sails out of the studio while the director is left to curse Mr. Volstead and all his cohorts.
I might as well insert, right here, the method used by most directors for disposing of the applicant and still keep him in a good humor. The old inevitable standby is: "Give me your name and address and we'll call you when we need you."

This does not mean that when a director tells an applicant that, the applicant is hopelessly lost. In some cases, applicants are called but they are rare, oh very rare!

I know one girl, pianist in a big studio, who tries out talent and who, when she began, used to tell the truth. She is a German girl of very frail and saintly appearance and it was her beautiful, innate sincerity that caused her to tell the applicant, simply but accurately, just what was what.

After the tryout was over and the applicant would prove unworthy, this little German girl, who speaks with an engaging accent, would say sorrowfully (and incidentally she is always sorry when someone's hopes are dashed), "It is too bad but you are not good. I am so sorry. You go home and practice for a good long time. Then when you think you are good enough, you come back and we will see what we can do."

Scheme Worked For While

THIS formula worked beautifully for several weeks while directors and studio attaches stood aghast at hearing the truth told in such a sincere, straightforward manner. But one day this little German girl's honest sincerity was betrayed. She told the plain and rather painful truth to a young man who had reached the no-hat, wide pants stage. He listened to her to the end and then smiled pityingly.

"Of course," he remarked, sweeping her small person with his eyes, "you haven't the slightest idea of what you are talking about."

And walked out of the studio.
Since that, the little German girl uses the age-old formula of Give-me-your-name-and-address-and-we-will-call-you. I think it's rather too bad.

I believe I must have, by this time, given the impression that all of the people who apply for tryouts want to sing. That isn't true. Most of them want to sing but a few of them want to do other things. There are pianists and violinists and other musicians who make application and, in rare instances, prove good enough to use. One studio reports on an applicant who came to the station equipped with everything but the kitchen stove. He had a French harp in his mouth, a violin in his hands, cymbals between his knees, sleigh bells around his ankles and
such a varied collection of other gizmos and do-dads that the
astonished studio director just
naturally couldn't keep track of
'em. I believe the gentleman
called himself a "one-man
band."

In weeding out radio talent, I
am told there is one system that
is absolutely sure-fire and one in
which the applicant does not have
to make a display of his talents.
That system is this: When they
say they don't know whether
they're good or not, they usually
are. But! When they admit
they're good, it's a safe bet they're
terrible.

Said I to a radio director after
he had told me all he could about
tryouts, "What would your ad-
vice be to anyone who wanted to
get on the air?"

His answer was this: "Listen
to the different radio stations to
find out their standards. Visit
the studio and learn, by observa-
tion, how singers or musicians
broadcast. Take your talents to
the station whose standard you
think you suit. Then, for hea-
en's sake, be willing to take ad-
vice from those in the studio."

American Electric Now
Combined with Monarch

THE radio trade will be inter-
ested in the recent incorpora-
tion of the American Electric
Company of Chicago who for
some time have been engaged
extensively in the manufacture
of Burns radio apparatus.

The extensive manufacturing
facilities and engineering expe-
riences of this company have
now been combined with the
like resources of the Monarch
Telephone & Manufacturing
Company, also of Chicago.
The organization will be
known as the "American Elec-
tric Company, Inc.," and will
continue at their plant at 64th
and State Streets, Chicago. An
extensive manufacturing and
advertising program has been
planned.

With the added resources and
increased engineering and sales
force they will be in a position
to give their trade whatever is
required in service and the best
possible in equipment.

At Last! Even Amplification
On All Wave Lengths!

RADIO engineers agree
that finest reception
is secured when signals
come in just below
the point of oscillation. In
most sets this maximum
efficiency can be secured
on a few stations—usually
from 300 to 400 meters.
But with the New Hi-Q
Receiver maximum
amplification is secured
merely on a small section
of the dial but OVER
THE ENTIRE WAVE
BAND! (Note chart
above.)

This new feature plus com-
plete shielding, a marvel-
ous circuit and finest parts
makes the new Hi-Q the
outstanding home-built 3-
tube volume receiver of
the year. Selectivity equal to
expensive "Supers." It
equals most 8-tubers. And
clear and undistorted tone
—always!

Your dealer has the Hi-Q
Foundation Unit and ap-
proved parts. $63.50 with-
out cabinet.

Fresh Florida Oranges
Fresh Sweet Florida Oranges
$3 per box of three hundred
large size. Sound fruit and
satisfaction guaranteed or money
back. We pay express charges.
A box of these makes an ap-
preciated Christmas gift. Re-
mit with order.

ACME FARMS
Gainesville, Florida

Remember...
on your present set. or the one you're build-
ing, you can't sacrifice the added convenience,
reliability and unmatched superiority of the
JONES
MULTI-PLUG
THE STAND-UP CONNECTOR
Type DM, with 4 ft. cable, price $3.50
Ask Your Dealer
HOWARD B. JONES
618 S. Canal St. Chicago, Ill.

Subscribe to Radio Age—$2.50 a Year

Please Mention Radio Age When Writing to Advertisers.
FREE! This 84 Page RADIO BOOK

The Guide to Radio prices and Radio Quality. Our vast resources and radio experience have been utilized to assemble in one gigantic magazine, the best and newest things in radio. The Randolph catalog is the greatest radio market place—a masterpiece of merchandising that befits our house—The World's Largest Exclusive Radio Mail Order House.

CATALOG CONTAINS OVER 2000 ITEMS, from the most beautiful, fully-equipped console radio set, down to the smallest part or tool for the set builder—kits, parts and supplies of every type and style. All beautifully illustrated and interestingly described. Also valuable data of today's most fascinating and most wonderful achievement—Radio.

5-TUBE SETS AS LOW AS $2.99 LATEST 1927 MODELS.
All Randolph sets are sold at amazingly low prices. No matter what kind of set you want—no matter how little you expect to pay—you get the best price. This is your opportunity to buy the best radio set at the lowest possible price.

SAVE YOUR MONEY. Because we handle radio exclusively and a full line of everything on radio, we can concentrate our buying power for the benefit of our customers./weather, etc.

SEND FOR BOOK TODAY. We cannot begin to tell you all about this wonderful Radio Book. Simply send letter or postal and this little sample of guaranteed radio sets and supplies will come to you absolutely FREE.

RANDOLPH RADIO CORP.
180 N. Union Ave., Dept. 217
Chicago, Ill.

LIVE DISTRIBUTORS WANTED

Scientist Proposes Big Rockets to Attract Lightning

A n interesting modification of Benjamin Franklin's celebrated experiment of drawing down lightning on a kite string has been proposed by Dr. C. V. Boys, famous English physicist now living in well-earned retirement after a lifetime of distinguished service as a teacher. Dr. Boys proposes that rockets be sent up into a thunder cloud to see whether a flash of lightning will then follow the track of the rocket, either downward to the earth or upward from the earth to the cloud. Experts on lightning are disagree about what starts the flashes and about what determines the path of a flash. The track of a rocket contains, Dr. Boys points out, a multitude of electrified atoms, discharged as the explosive burns and drives the rocket upward. Knowledge of whether or not lightning would instantly follow the electrified channel thus created through the air might tell us much, Dr. Boys believes, about the nature of lightning. To touch off such a rocket-borne invitation to a lightning flash might not be, Dr. Boys admits, the safest occupation in the world. He suggests a long string attached to the fuse of the rocket and pulled by a person lying flat on the ground at some distance from the point where the lightning would be likely to strike.

Kraft Radio Laboratories.

Rairy AGE for January, 1927

Please Mention Radio Age When Writing to Advertisers.
Samson Dual Impedances
give good tone quality—and volume
Without change of wiring simply replace audio transformers in your radio set with Samson Dual Impedances (Donle System) to get: Very good tone quality and unequalled volume.

SAMSON ELECTRIC COMPANY
Manufacturers Since 1882
MAIN OFFICE, Canton, Mass.

Theories of How Prehistoric Man Discovered Fire

CONFLICTING theories of how prehistoric men first learned about fire are affected by an investigation made for a quite different purpose by the United States Forest Service and just reported in the Monthly Weather Review by H. T. Gisborne. Some students of prehistoric man assume that the first knowledge of fire came from volcanoes; others ascribe it to forest fires started by lightning. The volcano advocates have urged that lightning-ignited forest fires are too few to have served as such a general cause.

Mr. Gisborne and his assistants are charged with the duty of watching for forest fires in a portion of the northern Rocky Mountains. So far from being a rare occurrence, they find that during 1924 lightning started 51 per cent of the forest fires and in 1925, 81 per cent. Lightning constitutes, therefore, the greatest single danger to the forest. Actual records of lightning fires confirm, therefore, the contention of those who have maintained that primitive man must have been continually familiar with such fires, and thus in position to observe the habits of fire and to learn, by the accidental cooking of animals in the burning forest.

Write For Booklet—It Tells How To
Build a Better Set Than You Can Buy!
Most Practical and Successful Circuit
Yet Devised—It's New Yet Not Revolutionary
Proven By Test—The Outstanding 1927 Success

HENRY-LYFORD RECEIVER


IT'S A PLUG-IN COIL RECEIVER WITH A DELIBERATELY UNBALANCED CIRCUIT

HENRY-LYFORD receiver has been tested and compared in many laboratories with practically every quality set now on the market with this result—were a manufacturer to build this outstanding circuit of the year it would easily come within the $300 class. This NEW circuit with interchangeable coils has a wide wave length range of from 37 to 550 meters permitting you to tune in where the ordinary receiver NEVER GETS. Build it and you will have a better set than you can buy.

It's As Near Perfect As They Come and EASY TO BUILD

If your dealer cannot supply you, order direct

Complete Parts
All parts fully guaranteed and neatly packed, including blue prints

$69.50

Please Mention Radio Age When Writing to Advertisers.
### Correct List of Broadcast Stations

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New Comet Will Not Hit Our Earth

Three comets are now visiting the neighborhood of the earth. Two are old friends, having been with us before on their periodic returns to the central part of the solar system. The third is apparently new, no comet of similar orbit having been detected before and none having been expected exactly in the position of this one. It was discovered on Nov. 6 by Profesor Comas Solà of the Astronomical Observatory of Barcelona, Spain, which discovery has since been verified by a score or more of observatories both in Europe and America. According to preliminary computations of the comet’s orbit made by the Copenhagen Observatory, it will be with us for several months, reaching its nearest point to the sun on May 14, 1927. As yet the comet is very faint, being visible only in large telescopes. Comets are believed to be clouds of solid particles with some gas surrounding them. There is no probability the new comet will come especially close to the earth, but even if it hit us it probably would do no harm. Our air would protect us from the flying particles of the comet, causing them to burn up just as do the meteors or “shooting stars,” thousands of which hit the earth’s atmosphere each day.

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**CLOUGH SUPER**

- St. James
- Qualitone
- Short Wave
- Browning-Drake
- Hammarlund Roberts HI-Q
- Radio Age Super 9
- World’s Record Super 8
- Aero-Dyne

In writing us SPECIFY just what hook-up you are especially interested in and we will promptly place our prices before you.

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**NEWARK ELECTRIC CO.**

“Nothing But Radio”

**226 West Madison Street**

**TELEPHONE, MAIN 4627**

CHICAGO ILLINOIS

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<td>Akron</td>
<td>W.A.D.C. Allen T. Simmons</td>
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<td>W.A.D.F. Albert P. Parfet</td>
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<td>Royal Oak</td>
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<td>Richmond</td>
<td>W.A.H. A. H. Grebe</td>
<td>Richmond, N. Y.</td>
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<td>Taunton</td>
<td>W.A.I.T. A. H. Waite &amp; Co</td>
<td>Taunton, Mass.</td>
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<td>Columbus</td>
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<td>Columbus, Ohio.</td>
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</table>
The latest model Windsor Cone Loudspeaker has astonished the world of radio. In convenience, quality of reception, and extremely low price, it far surpasses anything yet offered. The cone is 22 inches in diameter and is mounted on a sounding board which, in turn, is supported by an easel back. It can be hung up on the wall, as in the picture above, or stood upon any flat surface as shown in the picture below. It contains the famous Windsor loudspeaker unit noted for the extreme clarity and fidelity of reproduction.

Model 210—22-inch Cone Loudspeaker with sounding board and easel back.

$15.00

(West of Rockies $18)

(Pat. Applied For)

Model 302 (Shown below)
With Moulded Composition Horn Loudspeaker and 18-inch Cone Loudspeaker.

(Pat. Applied For)

In this Windsor Console is combined both the Windsor Moulded Composition Horn Loudspeaker and the 18-in. Windsor Cone Loudspeaker. The top is 30 in. x 17 in. and stands 29 in. high. Plenty of battery and equipment space is provided by large shelf in rear. Price, finished in Mahogany or Walnut $48.00

(West of Rockies, $55)

Model 200—22-inch Cone Loudspeaker

Price, $29

Console with Cone Loudspeaker
Ready for Set and Batteries
(West of Rockies, $35)

Model 100
With Moulded Composition Horn Loudspeaker or 16-inch Cone Loudspeaker

(Pat. Nov. 18, 1924)

Above is shown a beautiful Windsor Loudspeaker Console, finished in either Walnut or Mahogany, which provides ample space on top for any radio set. The battery shelf beneath will accommodate all necessary equipment. Equipped with either Moulded Composition Horn or 16-inch Cone Loudspeaker. Size: 38 in. x 18 in., and 29 in. high. Price

$40.00

(West of Rockies, $42.50)

To the right is shown the newest Windsor Loudspeaker Console. It is equipped with a 22-inch Cone Loudspeaker and cabinet suitable for 7-inch radio panels up to 26 inches in length. Battery shelf provides ample space for all equipment. Beautifully finished in either Walnut or Mahogany. Price (without receiving set)...

$44.00

(West of Rockies, $55.00)

Note to Dealers: Write or wire today for details of the highly profitable Windsor line.

WINDSOR FURNITURE COMPANY
1416 Carroll Avenue • CHICAGO, ILLINOIS
Los Angeles Branch—917 Maple Avenue

Please Mention Radio Age When Writing to Advertisers.
Atmosphere of Mars
Believed Dust-Filled

Recent studies of the planet Mars have led to no recent pronouncements of importance. Several observers report further changes in the appearance of dark or bright areas on the planet’s surface but such changes have been observed often before and yield no new information. There has been published in Germany, however, a new paper discussing photographs made of Mars two years ago. Dr. B. G. Fessenkoff, the Russian scientist who made this study, believes the Martian atmosphere to be extremely dusty, probably as much so as the air of a terrestrial desert during a sand storm. This is the most probable explanation, he believes, of the different appearance of the planet as photographed by red light and by violet light. Continental dust storms on Mars probably would not interfere with the existence of life there, although it would make things rather uncomfortable for creatures organized as we are; which the Martians, if they exist at all, probably are not. The two planets reached their closest approach for many years on October 27 and are now slowly drawing apart.

RADIO’S
LEADING
PUBLICATIONS

The CITIZEN’S RADIO CALL BOOK is Radio’s Greatest Publication. Circulation 300,000. Contains all the latest information of construction so simply told anyone can build superhetrodynes as easily as laboratory men. Large rotogravure section contains beautiful photos of leading station announcers and entertainers. Also contains the most complete list of the World’s broadcasting stations—every one—their transmitting schedules, wave lengths, slogan and plenty of space under each to list that station for future reference. Really Radio’s Greatest Publication. You’ll be delighted.

Price only 50 cents postpaid.

The Citizen’s Radio Call Book
508 S. Dearborn St.
Chicago, Ill.
The speed of light is now accurately determined.

At the meeting of the National Academy of Sciences, at Philadelphia, November 8, Professor Albert A. Michelson, recognized dean of American physicists and professor at the University of Chicago, announced the most accurate figure ever obtained for the speed of light through space or in a vacuum. The figure previously accepted by scientists for this speed was 186,326 miles per second. As the result of a three-year investigation carried out on top of two mountains in California, Professor Michelson has corrected this figure slightly. The new figure for the speed of light is 186,284 miles per second.

The final measurement of this value was accomplished by means of a rapidly-revolving sixteen-sided block having mirrors on each of its sixteen sides. A ray of light from a powerful arc lamp was focused on this revolving mirror-sided block, so that the succession of light flashes reflected as each mirror passed by was sent out of the laboratory on Mount Wilson and off toward another mountain top twenty-two miles away. On this other mountain top was a stationary mirror which reflected these light flashes back again to their original sources.

While the light was on its journey to the distant mountain-top and return, the revolving set of mirrors at the source moved slightly, due to the rotation of the mirror-sided block. Accordingly, the light flash returning from the distant mountain was not received on the same mirror-face from which it departed, but on the next face; this next face having been brought into line by the rotation of the mirror-faced block. The speed of rotation of this block could be altered by means of a throttle controlling the compressed air turbine which drove the block. By adjusting this speed so that the second mirror-face came to occupy for the returning light ray exactly the same position that the preceding mirror-face had occupied when the ray departed, it was possible for Professor Michelson to calculate the length of time (a little less than one four-thousandths of a second) that the light-flash had been on the way to the distant mountain-top and return. In order to make this calculation, the speed of rotation of the mirror-faced block was measured accurately. Also, the United States Government engineers carried out a special and extremely accurate survey to determine the exact distance between the laboratory on Mount Wilson and the distant mirror.

To the layman, and even to some scientists, it may seem remarkable that so much labor and money should be expended on a single scientific experiment, especially when the only result expected from that experiment was the attaining of a slightly greater precision for a figure already known with a considerable accuracy. That the experiment was considered worth doing and important is due to the fact that the speed of light in space is felt by physicists to be the most fundamental of all the constants of nature. This speed enters importantly into the calculations of the Einstein theory as well as into practically all modern theories of the nature of matter, of energy and of the universe.

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FREE—164-PAGE RADIO GUIDE

Everything for the Experimenter

Something new has happened in the radio world. The revolution that has taken place in radio is a silent one, but nevertheless a decided one. The changes are really radical, even though they have not been heralded from the housetops. Hook-ups that are the last word in long range, selectivity and tone clarity can now be built by anyone, so simple are these newer ideas. One dial control, one condenser, one changeable coil, with from four to six tubes, the most simple hook-ups imaginable, will give you radio reception such as you have only dreamed of but never heretofore realized. All these and more are available to you at tremendous savings in the new Barawik Catalog and Guide. A new amateur section, directed by F. J. Marco, OZ4, will appeal to all fans.

Send the Coupon for Free Copy Today—Now!

You need this book before you spend another cent on radio. Just mail the coupon and free copy will be sent you. Also please include name of a friend interested in radio to whom we can send free copy.

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BARAWIK CO.
540-544 Monroe Street
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dealers and set builders, write for our new catalog and special discounts. Please address us on your business letterhead.

CHICAGO RADIO APPARATUS COMPANY

415 South Dearborn St.,

CHICAGO

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THE PERFECT POTENTIALMETER

Uses graphite disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mountings. Finish and knobs match Bradley set. Made in 200 and 400 ohm ranges.

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Milwaukee, Wis.

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The Magazine of the Hour

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**Short Wave Phone Broadcasting**

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Radio Age, Inc. 500 North Dearborn Street, Chicago

Gentlemen: Please enter my subscription for RADIO AGE, the Magazine of the Hour, for one year, beginning with the _____________ issue, for which I enclose $2.50.

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The classified advertising rates are but five cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, making rate of 4 1/2, 4 and 3 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the February issue must be in by December 25.

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WANTED, AN ACTIVE MAN TO TAKE ORDERS FOR

The required; shrubs and roses, Native nursery plants, N-tjono| practical, bargains.

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Aerial Nursery Company, Davis and Davis Ave., 3231 Broadway, Dept. 61, Chicago.

MAN in each town to slate auto,再去, both features, leaflets, and booklets by new method; 50 dly; no capital or expert required;写信询问: write Geo. Compton, Avenue, Ave., Desatur, Illinois.

Sells for 87.95. Plenty ad on wrapping paper, catalogues, leaflets, and booklets for sample work. Automatic Ad-Stimmer, Jasper, Mo.

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How long have you postponed making that favorite hookup of yours because you couldn’t find reliable and clear diagrams? We have laid aside a limited number of back issues of Radio Age for your use. Below are listed hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

November, 1924
-Blueprints of a Single Tube Loop Set and a Capacity Feed-back Receiver.
-3-Tube Low Loss Regenerator.
-Mastering the 3-Circuit Tuner.
-January, 1925
-A Six-Tube Super-Het.
-An Efficient Portable Set.
-A Tuned Plate Regenerator.
-Making a Station-Finder.
-Blueprints of a 3-Tube Reflex.
March, 1925
-A 5-Tube R. F. Receiver.
-How to wind Low Loss Coils.
-A Short Wave Receiver.
-Blueprints of a Two-Tube Ultra Audion and a Regenerative Reflex.
April, 1925
-A 3-Tube Portable Set.
-"B" Voltage from the A. C. Socket.
-An Amplifier for the 3-Circuit Tuner.
-Blueprints of a Five-Tube Radio Frequency Receiver.
May, 1925
-A "Quiet" Regenerator.
-How to Make a Tube-Tester.
-An Unique Super-Het and an Improved Rehnartz.
-A Six-Tube Portable Receiver Illustrated with Blueprints.
June, 1925
-Reducing Static Disturbances.
-A 7-Tube Super-Heterodyne.
-Browning-Drake Receiver.
-Overcoming Oscillations in the Roberts Receiver.
July, 1925
-Learning Tube Characteristics.
-How Much Coupling?
-Blueprints of Conventional Radio.
-Symbols and Crystal Detector Circuit.
August, 1925—50c per copy
-How to Attain Smooth Tuning.
-Alternating Current Tubes.
-Improving a Portable Super.
-And a big 60-page blueprint section.
September, 1925
-Thirty-one ways to prevent self-oscillation.
-Tuning efficiency with two controls.
-Ideal Audio Amplifier CI results.
-Blueprint section.
October, 1925
-Auto-Transformer Coupling.
-Some Facts about Quality.
-An Improved Slide-Wire Bridge.
-Blueprints of Circuits Using Single and Dual Controls.
-November, 1925
-A Good Audio Oscillator.
-An Efficient Short-Wave Transmitter.
-Blueprints—Adding R. F. Stages.

December, 1925
-Tuned R. F. and Regeneration.
-Radio Age Model Receiver.
-Inductive Gang-Control Receiver.
-Mastering with Chart Curves.
January, 1926
-Radio Age January Model Set.
-A Four-Tube Toroid Set.
-Supply Device—Blueprint Feature.
-Finishing Your Radio Cabinet.
February, 1926
-February Radio Age Mode. Set.
-Plug-in Coil Receiver.
-Universal Teardown—Blueprint.
-Eliminating Audio Distortion.
March, 1926
-Improving the Browning-Drake.
-Rheostatic Tubes in a Set.
-Which Type Intermediate?
-How to Make a Wavemeter—Blueprint.
April, 1926
-Shielding Your Receiver.
-Home Testing Your Tubes.
-Balanced Capacity Receiver.
-Several Sets on One Antenna.
May, 1926
-Short Wave Transmitter—Blueprint.
-Simplifying Battery Charging.
-List of European Broadcasters.
-Protecting your Inventions.
June, 1926
-Antenna Design.
-Simple Crystal Set.
-Improving the Neutrodynes.
-Golden Rule Receiver—Blueprints.
July, 1926
-Compact Portable Super.
-Short Wave Receiver.
-Shielded Golden Rule Set.
August, 1926
-Receiver, Transmitter and Wavemeter.
-Beginners 200 mile Crystal Set.
-History of Amateurs.
-Changing to Single Control.
September, 1926
-How to Make a Grid Meter Driver.
-Short Wave Wavemeter.
-Power Amplifier for Quality (Blueprint).
October, 1926
-Crystal Control Low Power Transmitter (Blueprint).
-Raytheon Design for A B C Elimination.
-What Type Loud Speaker to Use.
-Nine Tube Super Brings Back Faith.
November, 1926
-Blueprints of the Henry-Lyford.
-World's Record Super With Large Tubes.
-How to Use a Power Tube in Your Set.
-Illuminated Controls on 4 Tube Receiver.
December, 1926
-Starting Radio with Crystal Set.
-Six Tube Shielded Receiver.
-Types of Rectifiers Discussed.

Radio Age, Inc., 500-510 N. Dearborn St., Chicago
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**THORDARSON**

**RADIO TRANSFORMERS**

**R-200 Amplifying Transformer**
The transformer for the musical epicure. Has unusually faithful reproductive powers. Specified on such quality receivers as Zenith, Kennedy and Howard... $40.00

**Standard Amplifying Transformer**
A good reproducing transformer suitable for the requirements of the average ear.
- 2 to 1 ratio ........................................ $5.00
- 3 to 1 ratio ........................................ 4.00
- 6 to 1 ratio ........................................ 4.50

**Autoformer**
All Frequency Impedance Amplifier
Amplifies every note in the musical scale. An impedance with a step-up ratio, giving the even amplification of the impedance with the amplification increase of the transformer. $5.00

**R-210 Power Compact**
A complete foundation unit for power amplification and B-supply. Contains a power supply transformer and two chokes for power amplifier using UX-210 power tube. $20.00

**R-171 Power Compact**
Similar to the R-210 type but designed for UX-171 power tube and Raytheon rectifier. Contains buffer condensers as well as power supply transformer and chokes. $15.00

**R-397 Power Supply Transformer**
A Power Supply Transformer designed for B-supply using the R. C. A. UX-213 type full wave rectifying tube. Will supply up to 180 volts B. $700.00

**R-196 30 Henry Choke**
Designed either as a filter or an output choke. Completely shielded. Current carrying capacity 80 MA. Inductance 30 hen- ries. D.C. resistance 280 ohms. $5.00

**R-76 Speaker Coupling Transformer**
An output transformer designed as a protective device to keep the high direct current voltage of power amplification out of the speaker unit. $6.00

**THORDARSON ELECTRIC MANUFACTURING CO.**
Transformer Specialists Since 1895
World's Oldest and Largest Exclusive Transformer Makers
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.
Swifter, finer tuning action—

Illuminated

Responsive—

to your lightest touch

ORDINARY dials seem clumsier than ever. Still more inadequate to meet modern conditions. After one experience with the new MAR-CO control. Nothing approaches its swift, searching response except the celebrated MAR-CO vernier dial itself, 500,000 of which have replaced old type dials. But the new control develops the “friction-drive” principle to the utmost, banishing any suggestion of “backlash” or play. And when you switch on the light, a soft radiance illuminates the moving numerals, adding swifter readability to the scale... and fascinating beauty to the panel.

MAR-CO controls fit all condensers. Scales read 0 to 100, or 0 to 100, as preferred. The template supplied reduces panel mounting to a simple ten-minute diversion, whether you are building a new set, or remodelling an old one. The special Mazda lamp runs on your regular “A” battery or on a separate “C” battery. Send for booklet. Martin Copeland Company, Providence, R. I.

MAR-CO illuminated Controls, $3.50 each
MAR-CO 4 in. vernier dials
(fit any set) nickel plated, $2.50
Gold plated, $2.75
New MAR-CO rheostat dial... 75c
The Complete Foundation Unit for Home Constructed Power Amplifiers

HERE is what you have been waiting for—a silent and efficient power amplifier and eliminator that will equal anything on the market—one that you can build yourself in less than an hour.

The Thordarson Power Compact is the complete foundation unit for power amplification. It contains: (1) a power supply transformer, (2) two filter choke coils of 30 henries, and (3) a power tube filament supply, tapped at the exact electrical center (an exclusive Thordarson feature), all in one compound filled case.

Two types of Power Compact are available: R-171 is designed for use with power tube UX-171 and Raytheon BH rectifier. Type R-210 is designed for use with power tube UX-210 and UX 216-B rectifier. Each type of compact supplies the proper values of current for maximum efficiency operation of its corresponding power tube.

Packed with each compact is a complete set of instructions which can easily be followed, even by the man with no radio experience.

Remember that when you buy a Thordarson product it is guaranteed and backed by over thirty years’ manufacturing of reliable transformers.

For Sale at Good Dealers Everywhere or Direct from Factory

THORDARSON
Power Compact

THORDARSON ELECTRIC MANUFACTURING CO.
World’s Oldest and Largest Exclusive Transformer Makers
Chicago, U.S.A.
I Will Train You At Home to Fill a Big Pay Radio Job

If you're earning a penny less than $50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at $25 or $35 or $45 a week, when you could earn $50 to $250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you?

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Chats With the Editor

BUILDING activity has been greater than ever before if the volume of correspondence from our readers is any indication of the virility of the parts business and the human urge to accomplish something constructive and yet entertaining. Especially is this true of the eight tube super which was featured in November and January. For March we are preparing another feature in supers—this one to be known as the Ideal World's Record Model. It is made, tested and described by the staff of the RADIO AGE laboratory. Be sure to get your March copy either by subscribing for the magazine or else putting in your order with the newsdealer.

Speaking of supers we have another treat for experimenters with this type of set in a forthcoming series of articles from the pen of D. S. Breitenbach, who is describing the various forms of oscillator tuning, first and second detector detection, intermediate oscillation control and other items dear to the heart of the super experimenter. Watch for these articles in an early issue of this magazine.

Cone speaker enthusiasts will find a construction article of interest on page 11—you'd be surprised to see how easy it is to build a good three-foot cone. And if the wife thinks she is left out of the picture, tell her she may have the pleasure of decorating the face of the cone with an attractive water color design. Or she may even resort to the use of the familiar decalcomanias with which we, as children, adorned our school books.

In the blueprint section of this issue will be found instructions for building the Browning-Drake in power form; that is, using a 171 power tube supplied from a power compact which produces the A, B and C voltages for the 171 and the B voltages for the rest of the receiver.

Frederick Smith
Editor of RADIO AGE,
Eveready Layerbilt
"B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

This is the Heavy-Duty Battery in which the new Layerbilt construction provides greater economy

There's an important discovery in radio economy awaiting all users of loud-speaker sets who have been buying the smaller Light-Duty "B" batteries instead of the large Heavy-Duty size required by such sets. Because the Light-Duties cost somewhat less to buy they seem like an economy, but the surprising fact is that the Eveready Layerbilt No. 486 lasts more than twice as long though it does not cost anywhere near twice as much. It is, therefore, much more economical—we believe it to be the most economical "B" battery ever built. Certainly it has proved this by laboratory tests and the service it has given to radio listeners in their own homes during the past eighteen months.

Eveready Layerbilt's remarkable life is due to its unique construction. All other dry cell "B" batteries are assembled of cylindrical cells, with much waste space between them, and many soldered connections bridging the gaps. Several years ago we struck boldly out, away from this tradition, seeking a better method. We wanted to avoid waste space, minimize soldering, and get more current and longer life from a given quantity of active materials. The Eveready Layerbilt is the result.

This patented, exclusive battery is built in layers of flat current-producing elements, making automatic connection with each other. Every available inch inside the battery is occupied usefully. You get more battery for your money, and that battery is more efficient.

Remember this about "B" batteries: All loud-speaker sets require Heavy-Duty batteries, and the Eveready Layerbilt has proved time and again to be the longest lasting and most economical Heavy-Duty "B" battery.

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- WJAO—Boston
- WEEI—Boston
- WTAG—Worcester
- WMT—Philadelphia
- WOR—Buffalo
- WCAE—Pittsburgh
- WRSK—Cincinnati
- WTRA—Cleveland
- WJR—Detroit
- WOC—Chicago
- WHO—Des Moines
- WEEO—St. Paul
- WBBM—St. Louis
- WOC—Washington

**Canadian Stations:**
- WMC—Montreal
- CJO—Toronto
- CJCO—Buffalo
- CJSC—Cincinnati
- W lender—Cleveland
- WBN—Detroit
- WOC—Chicago
- WOC—Des Moines
- WEEO—St. Paul
- WBBM—St. Louis
- WOC—Washington

Thank you for your interest, and please mention Radio Age when writing to advertisers.
RadioEditorials

PRE-EMINENT in many other ways, the Chicago Tribune appears to have taken the lead in the radio broadcasting field. It probably was inevitable that the paper should have set the pace after it awoke from its long indifference to radio. The explanation for the excellent programs regularly offered by the Tribune lies in the fact that it has devoted intelligence and money to the effort—plenty of both.

The Tribune does not copy other newspapers in any of their or its departments. It sets a policy, based on careful consideration of readers' wants and interests, and then adheres to that policy. Therefore, when it began broadcasting it did not fall into step with the unfortunately popular idea that all a radio station needs is a ukelele picker, a whiny tenor weeping for a lost pal 'o his, a triple-action saxophone jazz outfit and an announcer who cracked jokes about hip liquor and baby dolls.

The outstanding distinction of WGN is that its programs are sufficiently diversified to appeal to everybody. The radio features may be likened to the various religious beliefs. As the old negro expressed it "They may not touch all 'round, but they all touch somewha'ar."

The Tribune, in short, made a decision which we devoutly wish all other broadcasters had made before they started operations. The newspaper decided that unless it was to put on programs that were better than the other fellow's programs, there was no use in broadcasting at all. A newspaper which spends great sums of money in developing programs of surpassing merit and which does not too obviously intrude upon the listener with advertisements of its own high quality as a newspaper is entitled to the generous support of radio fans everywhere.

SPEAKING of newspapers in the broadcasting fields, it would be positively unfair not to mention the Chicago Daily News. Miss Judith Waller, director of WMAQ, doesn't take a back seat for any man director when it comes to obtaining good features and putting them on with professional skill and spirit. She has won the gratitude of many thousands of listeners by her production of sport-news features and she has a sure sense of what the public wants in musical numbers. The American Bar Association suggests that the over-supply of broadcasting stations be remedied by eliminating the "non-essential" stations. We hope that when the authorities swing their snickerse, if they ever do, they will leave untouched such stations as WGN and WMAQ.

ROBERT Casey, writer extraordinary, is a member of the editorial staff of the Daily News. He is the author of those whimsical and delectable comments on everyday incidents known as the "Vest Pocket Anthology." He is also a radio experimenter and a widely-followed writer on experimental radio. Recently he wrote an article in the News in which he referred to a hook-up which Fred Hill had described in Radio Age. Mr. Casey confessed that he at first paid little heed to the rumors heard about the "hokum corners" that the set actually worked. Mr. Casey says he doesn't have much faith in the general run of comment on new circuits. But he tried this one and it worked. If you want to see the set call on Lou Straus at the Newark Electric Co., Chicago, or write us about it.

THE folks are turning more and more to super-hets. In that connection it is pleasant to be able to announce that the next few issues of Radio Age will have a generous supply of super-het material. Mr. Hill is working on various developments in this magazine's laboratories at Hinsdale. You will want to follow his descriptions and constructional articles.

THE Radio Manufacturers' Association will hold a show for jobbers and dealers in the new Stevens Hotel, Chicago, the week of June 13. Models for the 1927-1928 season will be on display and we believe the exhibition will do a great deal toward eliminating the seasonal aspect of the radio industry.

THOSE stations which are trying to build up good will by reaching distant listeners would do well to remember that the announcer who assumes that the listener knows it is his station and himself announcing without having been told so between numbers is going to lose more good will than he accumulates. It does make a feller sore to wait for an orchestra to complete a number and then have the announcer glibly go on with another number without giving the station call letters. Why do they do it? Will some announcer please explain? Let's make the logging of distant stations a bit more satisfactory by cutting out the mystery.

ONE of our readers has solved the problem of what is to become of the vast array of miscellaneous radio parts which every experimenter accumulates in his quest for the world-beating circuit and set. In his own neighborhood this reader found a number of crystal fans who did not feel parts for a tube set were within the reach of their purse. Our reader, remembering the thrill he felt when changing over from crystal to tube, and especially when he brought in his first DX station, foraged around in the dusty collection of coils, condensers, sockets and the like until he had found enough material for three one tube receivers. These supplies were turned over to his neighbors who are now enjoying distant reception (compared to their crystal sets). Other readers may find a tip in the foregoing that will give them pleasure and swell the ranks of the experimenters.
Two Tubes and Regeneration

By ARMSTRONG PERRY

Before advising anyone to build a regenerative receiver, it is only fair to issue a warning that regenerative sets became such a nuisance, soon after broadcasting attracted the general public to radio, that the United States government called conferences in which serious recommendations were made (by manufacturers who were building other types of receivers!) that the manufacture, sale and use of regenerative sets should be prohibited by law. Such a prohibitory law might be enforced more easily than another one that has been quite a live topic of conversation for the past few years, for a government inspector with a radio compass can locate a blooper more easily than an enforcement agent can find a still.

The principle of regeneration is as sound in radio as it is in religion. It must be, for one man is said to have been paid a million dollars for a patent on it and another man spent thousands in proving to the satisfaction of the courts that the fellow who got the million only copied his invention. Superregeneration will amplify energy so tremendously that a receiver using it will pick up a whisper from a man a hundred feet away and throw it back with the volume of a cannon's roar, or make the footsteps of a fly on a bald man's head resound like the ambling of an elephant on a tin roof.

Regeneration is a method of salvaging some of the radio-frequency energy that passes through a radio tube—which has no useful effect on the side where the phones or loud speaker are—and feeding it back into the grid circuit so that it increases the energy that controls the volume of the sounds we hear. Even a novice, by doing a little experimenting, can learn to use regeneration successfully.

Having made the plunge into the field of multtube set construction, as far as two tubes, the constructor asks himself which tube shall be the detector and which the amplifier. If the first tube, counting from the antenna, is the amplifier, the set will have one stage of radio-frequency amplification. If the first tube is the detector and the second the amplifier, then the amplification will be of the audio-frequency variety.

The builder who wants to pull in the far-away stations will find that radio-frequency amplification will give him the best chance, for the R. F. amplifier increases the weak signals more than the stronger ones. If he wants more volume on stations that can be heard with one tube, then the second tube should be used as an audio-frequency amplifier.

The beginner will have better luck if he tries audio-frequency amplification at first, making the first tube the detector. Radio-frequency amplification is more difficult to handle because the filament and plate, and filament and grid, form small condensers whose capacity, small as it is, has effects that may be hard to overcome. There may be inductive effects that are troublesome also. The tube may howl at the slightest provocation and for no reason that the novice can discover. If radio-frequency amplification is attempted, it should be remembered that a potentiometer, otherwise known as a stabilizer or voltage divider, will be of great assistance in steadying the action of the tube. It should be connected across the

For receiving long waves without tuner or detector
terminals of the "A" battery of the amplifier tube. The device is similar to a rheostat but has terminals at both ends and a sliding contact in the middle which is connected with the lower end of the secondary coil of the first transformer, or to the ground.

There is one advantage in using a radio-frequency amplifier with a regenerative detector; namely, it may stifle the howls of the detector tube before they goad the neighbors to the point of committing justifiable homicide.

The safest recommendation for the average fan who is just striking out into multtube construction is to make the first tube a regenerative detector, with a variocoupler between it and the antenna, use the second tube as an audio-frequency amplifier, and be careful in tuning to keep the tube from howling. Single-circuit regenerative receivers are almost sure to become a nuisance to listeners for blocks around, but with coupled circuits between the antenna and the tube, careful operation usually will prevent any serious disturbance.

As selectivity is important in these days of multiplying broadcasters, it is better to spend a little more money and secure more satisfactory results than are likely to be obtained from the simplest and least expensive outfit. Secure a good variocoupler and two variometers adapted to the wavelengths to be covered. It is almost if not quite impossible to cover the entire broadcasting band efficiently with one receiver, so it is good policy to aim to bring in one station with maximum strength and clarity and then take whatever else comes along for good measure. A station can be selected that has programs you like to hear, and whose wave is near the middle of a waveband that includes other good stations. The receiver that will bring in the one station satisfactorily will probably reach well up and down the scale and miss only those whose wavelengths are at the extremes. There will be enough in any case.

To complete the outfit, secure two tubes, good sockets, an audio-frequency transformer, batteries, rheostat, phones, grid leak and condenser of the correct resistance and capacity values, and jacks for the phone plug.

A loud speaker is not likely to work satisfactorily with so small a set, but a horn to which the phones can be attached may make it possible to hear programs from the near-by stations without wearing the headgear. A crystal detector can be added, so that the local stations can be brought in when the battery is being charged or when the tubes are out of commission for any other reason.

A Simple Circuit

Circuit by circuit, the following two-tube hook-up is easy to understand. See figure 2. The aerial connects with the stationary plates of the variable condenser. The rotor of the condenser connects with the primary coil of the variocoupler. The other end of the primary connects with the ground. That completes the antenna circuit.

Run a wire from the secondary of the variocoupler to a variometer, and another wire from the other terminal of the variometer to the grid leak and condenser, which usually are mounted with common terminals. The other terminal of the grid leak and condenser connects with the grid terminal on the tube socket. The other end of the secondary of the coupler connects with one filament terminal on each of the two tube sockets, the terminals that are not connected with the rheostats. Whether these are positive or negative terminals will depend on whether the positive or negative end of the "A" battery goes to the negative end of the "B" battery. Some tubes require a polarity specified in the directions, and some may be connected either way. The "B" battery connection, however, is always with the positive terminal toward the plate. The above connections complete the grid-filament circuit of the detector.

The plate is connected with the second variometer and the other terminal of the variometer goes to a positive terminal of the "B" battery. Nearly all "B" batteries have several positive terminals, provided with convenient clips, so the voltage may be adjusted easily after the testing begins. The negative terminal of the "B" battery goes to the first jack, whose other terminal connects with the two filaments and the secondary of the variocoupler. This completes the detector plate circuit, which is closed when the phone plug is placed in the jack.

The detector jack is provided with two terminals that should be connected with the two ends of the primary coil of the audio-frequency amplifying transformer. The secondary of the transformer connects with the grid of the amplifier tube on one end and with the filament on the other. The filament terminal used should be the same that connects with the secondary of the variocoupler. The plate of the amplifier tube connects with one terminal of the second jack. The other terminal of the jack goes to the positive terminal of the "B" battery. This completes the wiring for the set, unless a crystal detector is connected between the detector grid lead and phone jack, with a

![Regenerative detector and first stage of radio frequency amplification, with crystal detector for use when tubes are cut out](Please turn to page 49)
Building the Hammarlund-Roberts

PART I
By LESLIE G. BILES

HAMMARLUND-ROBERTS' new design known as the "Hi-Q" is an entirely modern radio receiver, non-oscillating and incorporating the latest approved features. The most important of these includes dual tuning, stage shielding, automatic coupling variation, high detection efficiency and a high power output.

Tried and proven fundamentals have been adhered to; but they are applied in new and different ways that produce greater selectivity, clearer tone, simpler tuning. This design is the united achievement of ten of the leading radio engineers in this country; all concentrating on producing the most advanced and efficient receiver—regardless of cost.

Anyone can build this receiver.

All the research, the selection of parts, the exact placing of units, has been worked out in advance. And you have a receiver that will equal an eight-tube set—simplicity of design and operation.

Here is a receiver of five tubes, which employs two highly efficient stages of tuned radio amplification, a non-regenerative detector and two stages of high quality transformer coupled audio amplification, the second stage of which is so arranged the new power tubes may be used.

Tuning has been held down to two major controls. Scientific shielding of the radio frequency units produces a receiver of unusual selectivity, sensitivity, quality and volume.

In theory this receiver is comparatively simple. It combines the sensitivity and selectivity of two stages of radio frequency amplification with the inherent stability and distortionless characteristics of a non-regenerative detector. While it is admitted that a regenerative detector provides a considerable degree of radio frequency amplification it is well known that amplification secured in this manner has many drawbacks. Chief among these is the tendency to cut "side bands," a type of tone distortion which has a very disagreeable effect when passed on to the loud speaker. In order to avoid this and other types of "regenerative" troubles without sacrificing sensitivity, the two radio frequency stages have been designed to insure an extremely high degree of amplification.

Quality Output

AFTER providing for a high quality audio output from the detector a two stage transformer coupled audio amplifier is used to step up the signals to loud speaker intensity. The transformers used in the audio amplifier have a high primary impedance, insuring faithful reproduction of the lower musical and speech tones. The secondaries are wound by a special helical process which reduces distributed capacity to a minimum.
so that the higher audio frequencies and their harmonics are passed on to the loud speaker without loss. This results in the reproduction of the higher musical tones of such instruments as the violin with full life and brilliance, and aids very materially in removing the dull and muffled effects so commonly associated with loud speaker reproduction.

Although the receiver has three radio frequency circuits the tuning controls have been reduced to two by placing the second and third variable condensers on the same shaft. A small compensating condenser in parallel with the third variable condenser has been provided to compensate for the small difference in circuit capacity of the third tuning circuit chiefly due to the detector grid condenser. This compensator needs no adjustment after its setting has once been determined.

A volume control has been provided which is exceptionally smooth and gradual, allowing the operator to adjust for a powerful local or a weak and distant station with equal facility.

This volume control is a 10 ohm rheostat regulating the filament brilliancy of the two radio frequency amplifier tubes. To eliminate the possibility of applying more than the rated voltage to the filaments of these tubes, a 2 ohm resistance unit is used in series with the radio frequency tubes and rheostat. The filaments of the remaining tubes are held at their proper operating temperatures by separate automatic resistances.

Voltages induced in the antenna ground system are magnified by the action of the first stage of radio frequency amplification and passed on to the second radio frequency stage where their intensity is still further increased.

Since the second radio frequency stage and the detector stage are shielded unwanted signals are weeded out due to the filtering action of the three tuned circuits through which they would have to pass in order to reach the detector tube. This shielding also prevents direct pick-up by the second radio frequency and detector circuits.

The use of stage shielding also eliminates any interaction between circuits, thereby stabilizing the radio frequency amplifier and greatly increasing its over all efficiency.
No shield is necessary on the first radio frequency stage although the receiver is designed so that a shield can also be used for this stage if desired.

The output of the second radio frequency stage which is a highly amplified copy of the original signal picked up by the antenna, is then fed to the non-regenerative detector where it is demodulated or converted into audible frequencies. These audio currents, or electric sound waves are then further increased in strength by the two stages of transformer coupled audio frequency amplification and passed on to the loud speaker.

**R F Amplifier**

Two stages of radio frequency amplification used in this receiver present some rather new and novel features in the design of the antenna coupling coil and the interstage radio frequency transformers. The design of these coils is based on two fundamental laws of radio engineering that are as old as radio itself. The first of these laws is this: Up to a certain point an increase in the coupling between two coils affords an increase in energy transfer and a decrease in selectivity. The second law is this: The energy transfer between two coils such as the primary and secondary of an ordinary radio frequency transformer increases rapidly as the frequency increases. In other words, the energy transfer is much greater at high frequencies (short wave lengths) than at low frequencies (long wave lengths), and the relative selectivity is less at high frequencies and greater at low frequencies. Conversely, a constant transfer of energy and constant selectivity can be maintained by loosening the coupling as the frequency is increased.

Successful broadcast receivers must be capable of receiving wavelengths from 200 meters (1500 k c) up to 545 meters (550 k c). This represents two extremes in frequency corresponding to a range of about three to one. These requirements together with the two laws stated above make it evident that some means of variable coupling must be provided if we are to obtain equal energy transfer and selec-

**LIST OF PARTS**

2 Samson transformers, type HW-43 (3-1 ratio)
3 Hammarlund .00035 mfd. midline condensers
3 Hammarlund auto-coupled coils (set of 3 coils)
1 Hammarlund Jr. condenser, 9 plates, 32 mmfd.
2 Mar-co No. 192 Vernier Dials.
1 Benjamin No. 9040 sockets (with bases)
2 Benjamin No. 9049 sockets (without bases)
2 Amperites No. 1A
1 Amperite No. 112
1 Carter No. M-10-S combined rheostat and filament switch 10 ohm
1 Carter No. 1 short jack
1 Carter No. 12 Imp aerial switch
1 Sangamo .00025 mfd. fixed condenser
1 Sangamo .001 mfd. fixed condenser
1 pr. Sangamo grid-leak clips
1 Durham metallized resistor, 3 megohms
1 Hammarlund-Roberts foundation unit (containing drilled and engraved Westinghouse Bakelite-Micarta panel, drilled Bakelite, Micarta sub-panel, two complete shields, two equalizers, extension shaft, resistance unit, wire, screws, nuts and all special hardware required to complete receiver.

(Please turn to page 51)
“Noise Doctors” Cure Inductive Static

By GEORGE A. BARCLAY

I t ALWAYS makes you feel better if there is someone you can complain to when things are going wrong. That is especially true if you are a radio fan. So when the Canadian government decided to institute a department for combatting preventable static, it was employing good psychology. When the loud speaker begins to scream like a locomotive and the reception sounds like a load of coal, radio fans in the Dominion simply telephone the nearest government interference station and register their complaint. Soon a corps of trained “noise doctors” are on the case diagnosing the trouble and preparing a remedy.

Canada has taken a step ahead of the United States in trying to improve radio reception for its listeners. The radio branch of the Federal Department of Marine and Fisheries conceived the idea of organizing a body of experts to suppress preventable interference. Government stations were established at Ottawa, Toronto, Vancouver, Montreal and Halifax. C. P. Edwards, a commander in the British navy during the World War, was placed in charge of the service. The stations are equipped with automobiles fitted with special instruments and apparatus. When a complaint is received, the experts start out in their cars to locate the source of the interference and, if possible, to correct it.

“Every population center has a noise level due to preventable causes,” Commander Edwards told me. “Every time an electrical switch is opened it creates a static noise. Research by the department disclosed that in one moderately sized town there were sixty-seven sources of preventable noise. Faulty street car wires, telephone wires rubbing against trees, short circuits, power plants out of order, motors of all kinds, and defective switches are the principal offenders.

“The difficulty of locating noises increases with the size of the city. In a small population center it is possible to isolate noises with comparative ease. But in a big city where there are thousands of power plants, interference may be felt by radio listeners as far as ten miles from its source. Whenever a defect in an electrical plant is corrected, a permanent source of radio noise is removed. For instance a transformer may have been slightly out of order for ten years without being detected. When it is fixed there is that much less noise on the air to deal with.

Thermostatic Static

“SOME of the queerest things cause trouble. At a soldiers’ hospital in Hamilton, Ont., the patients had a terrible time with static. The authorities called in our ‘noise doctors.’ Every bed in the hospital was fitted out with electrical footpads equipped with automatic cutouts. When they tuned in on a big city station and the orchestra began to play jazz numbers, the patients would tap their feet in bed in time to the music. This threw the switches off, creating a static that ruined the reception at the hospital until our experts discovered it.

“In another instance our service not only corrected static, but saved some lives as well. In a fairly large city in Eastern Canada there was a street railway company operating a converter which supplied 700 volts of current to its terminal lines. There was a strong inductive interference in the district. Radio fans were complaining constantly. Our experts investigated. They believed the noise was caused by the car line’s power plant. They interviewed officials of the company. They examined the machinery. But they could find nothing wrong and engineers at the station laughed at them. Finally they induced the company to shut off power at noon one Sunday. The inductive noise stopped immediately and radio fans got wonderful reception on the afternoon concerts. At four o’clock the plant started again. The noise appeared at once.

“Our ‘noise doctors’ were not satisfied. They began checking up on the frame of the converter. Then they found something startling. A wire from the armature was touching the frame. It had charged it up to 600 volts. Workmen of the plant knew nothing about it. Yet if one of them had touched the frame it would have meant instant death. The short was corrected and the converter is still operating. It is as safe as can be now but you could not pay a workman to approach it without rubber gloves. All the inductive trouble it caused has ceased.

“Another case was baffling. There was a noise in a Toronto office building. It was spoiling reception for four city blocks around. Our experts tested and tested without success. They visited the place fifteen times and still could not find the cause. The noise was like a phantom. It came and went. Finally the experts isolated the noise down to a dentist grinding teeth in the building. The motor of his drill was defective. It caused enough electrical disturbance to ruin the reception of scores of radio listeners.”

Canada is spending $100,000 a year on this special service. Revenue for operation of the work is derived from a license fee of one dollar on every radio receiving set. The Dominion is the only country in the world carrying on an organized campaign of noise prevention.

Radio has had a remarkable

(Please turn to page 47)
Building a 36 Inch Cone at Home

BUILDING a thirty-six inch cone speaker at first blush appeared to our staff to be a very difficult job and one that the average experimenter or handyman would not tackle. But Columbus took a chance. So we figured if that venerable gentleman could discover this country the worst we could do would be to wreck about fifteen dollars worth of parts, and with that alibi in mind we tackled the task. Much to our surprise the matter was comparatively simple, requiring only a little patience and a careful adherence to instructions.

Two diagrams are shown with this article which will give a great deal of the detail necessary. Parts for the construction of such a cone may be secured from a number of manufacturers who supply the integral parts in kit form.

Material for the cone comes in 38 by 38 inch sheets, two being required. This is a special product which leading cone speaker manufacturers are using. One sheet is used for the front of the cone and the other for the back. The upper diagram on page 12 shows the manner of cutting the front cone. To properly scribe the 36 inch circle it is suggested the builder make up a beam compass, consisting of a ruler, or slat about 24 inches in length, with a tack driven through at one end and two small holes drilled 18 and 17½ inches from the tack, the holes being for a pencil to mark the circle. The end of the ruler with the tack in it is placed in the center of the sheet (after you have marked into quarters the 38 by 38 sheet and found its center) a pencil inserted in the hole 18 inches from the tack, and the circle drawn. For the second cone, B, the hole 17½ inches from the tack is used since the diameter of disc B is only 35 inches compared to the first one, disc A.

Consult the top drawing on page 12. Line 1 is now cut from the lower edge of the cone to the exact center. Measure 5½ inches (at the bottom edge) to the dotted line 3. Place a ruler at this point inward to the exact center and draw a dotted line. Be careful not to use too much pressure on the pencil or you will tear the material. Then measure off three-quarters of an inch to the left of the dotted line at the bottom edge and at the center. Here draw a full line which will be the line you cut, line 2. The dotted line, 3, is the three-quarters of an inch lap which the cone will have when its bottom edges are pulled together. A quarter inch hole should be punched out at the exact center.

The back cone, disc B, is made in the same manner except its diameter is 35 inches instead of
36. It also has a 16 inch diameter circle which is later cut out for cementing of the cone to the back rings (these rings come with the parts). In the diagram on page 11, upper, the rings D and C have been cemented on the back disc B. Disc A is placed in a round hatbox, or a smooth rim vessel so it will be self-supporting. Disc B is then placed over the disc A, and a special cement poured at the edges. This cement dries very fast and the builder will have to work quick. This type of cement is furnished with the parts. Let the cones dry overnight to harden the cement thoroughly. The lower left diagram shows the two cones joined, while the lower right sketch shows the mounting of the cone movement to the back rings and the nose piece of the front cone. In cementing the large brass disc on the inside of disc A and the smaller brass disc on the outside of the disc A, it is suggested a small bolt be run through these discs to keep them tight against the inside and outside of the disc A. This will insure a good cement job since the brass discs will not be able to move while the cement is setting.

After all cementing work has been finished and is thoroughly set, insert the cone unit, line it up right and see that threaded nose piece goes through the cone to the driving rod which it engages. Two small set screws are provided, one for the connection to the driving pin which goes into the end of the nosepiece. The other is for a set screw going into the side of the nosepiece to prevent the center screw from turning while the cone is in use.

Results with a speaker of this type are quite surprising provided a good amplifier is used in reception. No cone can make beautiful music out of a poor amplifier so be sure you have a good amplifier and use a power tube in the last audio stage. Low tones are pronounced on a 36 inch cone that might not be observed on a smaller unit. Full building instructions were included with the unit used in building this speaker.
How A Variable Condenser Affects Your Set Tuning

**Shape of the Plates Determines Its Characteristics**

By KIRK B. MORCROSS

HOWEVER much involved the subject of condensers with variously shaped plates may become, there are two outstanding points for consideration at the outset of a discussion of this subject an understanding of which will form the nucleus of all ideas subsequently considered.

The first of these points reminds us, simply, that the method of allocating broadcasting stations gives them uniform kilocycle separations throughout the band available for broadcasting. An explanation of why this is the ideal method is outside the purport of this article. You must take this statement on faith, if you need be. (This question is discussed in an article by this writer in *Radio Age* for December, 1926.)

Having satisfied ourselves as to this first point, we obtain an introduction to the second point by referring to the dials on our receiving sets. The relationship of these dial settings to the frequencies of the various broadcasting stations, a matter of intimate concern to all of us, is most conveniently shown by means of curves plotted with dial settings against frequencies. And this brings us squarely to the second point.

This tells us that for any type of condenser—"type" meaning here the shape of plate employed—a curve may be plotted, frequency values against dial settings, which indicates the relative spacing of stations on the dials. Three curves, each representing a particular type of condenser, are shown in Fig. 1. As indicated, these curves show the tuning characteristics of the "straight line capacity," "straight line wavelength" and "straight line frequency" types of condensers. If your set is equipped with the straight line capacity condenser the frequency to which your circuit is tuned will change rapidly as the condenser is varied near the lower end of its scale then less rapidly on up until at the higher dial settings the frequency change is relatively slow.

In other words, since broadcasting stations are (with few exceptions) evenly spaced in kilocycles this condenser spreads them out at the high dial settings and crowds them together at the lower end of the dial. The same is true for the straight line wavelength condenser but to a lesser degree. The "curve" for the straight line frequency condenser is in reality not a curve at all, equal angular rotations of the dial at high or low settings producing equal frequency changes regardless of the dial settings and consequently stations are equally spaced over the dial.

In studying the curves of Figure 1, which, incidentally, deserve preservation for the radio notebook, you will avoid confusion by bearing in mind that all three curves are plotted with frequencies along the vertical axis. With the exception of the straight line frequency condenser the names near the curves have nothing to do with the units used in plotting.

It is very difficult in practice to produce a truly straight line frequency characteristic. A shape of plate can be designed mathematically which should give an almost truly straight line, to be sure. But in actual use, owing to distributed capacity in the circuit and particularly to distributed capacity in the coil associated with the condenser, a truly straight line is difficult if not almost impossible to obtain. All of the three curves in Figure 1 are in practice somewhat distorted near their ends, that is, near the maximum and minimum capacities attainable on the condensers. For the discussions in this article, however, these curves and others subsequently considered may be assumed to be as shown.

A simple rule is of assistance...
in understanding the definitions of the three types of condensers. The first part of the definition for each of these three condensers refers to the character of “curve” when the curve is plotted with units along the vertical axis named in the last part of the definition, it being understood that the units along the other axis are dial settings. The straight line capacity definition is thus illustrated in Figure 2. (The curve for the straight line frequency condenser in Figure 1 illustrates the rule for that type of condenser.) Applying the rule to the straight line wavelength condenser, we suspect this gives a straight line when plotted with wavelengths against dial settings as is the case in Figure 3.

**ATTENTION** may be called here to definitions sometimes used, namely, “straight capacity line,” “straight wavelength line” and “straight frequency line.” These are perhaps to be preferred because they are more nearly self explanatory. The other definitions have, however, become well established.

Although it is an undisputed fact that for use in a receiving set, a condenser giving an approximately straight line frequency effect is generally to be preferred, it is by no means true that such a condenser is necessarily any more effective at eliminating interference. Let us demonstrate.

Suppose you tune two receiving sets to the same broadcasting station and suppose that these two sets are identical in construction except that one is equipped with straight line capacity condensers while the other has, say, straight line wavelength condensers. Assuming equal resistance in the two types of condensers, in other words equal losses, an equal amount of interference from other broadcasting stations will be noted on each set. The fact that the tuning in of stations at low dial settings on the straight line capacity condenser is accomplished with a small amount of rotation is of course a disadvantage from the mechanical viewpoint but this condition does not determine selectivity. A fine adjustment knob will make it possible to vary the capacity of that condenser quite accurately. It is an advantage though to have stations uniformly spaced on the dials, and normally the straight line capacity condenser falls very far short of accomplishing that end. A way of securing this result with a straight line capacity condenser is to equip it with a dial to give slower and slower rotation of the condenser plates when the dial is rotated uniformly in such a direction that the condenser capacity is decreasing.

The straight line capacity condenser has its advantages in the laboratory. For instance when it is used as a standard of capacity it is convenient to have a calibration curve plotted with capacities against settings of the condenser dial which is essentially a straight line. Again, as many experimenters know, who have used oscillators in obtaining numerous frequencies by means of harmonics, the use of straight line capacity condensers in the oscillators is an advantage. To double the frequency, one-fourth the dial setting is used.

The straight line wavelength condenser would have a good bid for the ideal condenser in a receiving circuit if broadcasting stations were allocated with equal wavelength separations. It is doubtful, however, if such a condition will ever prevail and consequently that type of condenser will always group the stations somewhat more closely as the dial settings are decreased.

**The Magazine of the Hour**

One sometimes hears the expression “straight line tuning” applied to a condenser. That term may be most correctly assumed to refer to the straight line frequency condenser. It is interesting to note a degree of flexibility inherent in the definition, however, for if broadcasting stations were reallocated with equal wavelength spacings the “straight line tuning” term would fit the straight line wavelength condenser.

The straight line frequency condenser is theoretically the most nearly ideal type for the receiving set although as mentioned previously a truly straight line effect is seldom obtained. Peculiar and interesting difficulties are encountered in the design of the plates of this condenser and, in general, their shape represents a compromise between pure theory and the necessity for a reasonable degree of compactness.

One can not easily conceive of a necessity for designing a condenser giving a characteristic differing from one of the three standard types. A condenser giving a sufficiently straight line characteristics to ensure that there will be no great variations in the spacing of stations over the range of dial settings, and which offers the possibility of slightly greater compactness than the straight line frequency type, is sometimes desirable. As already intimated some so-called “straight line frequency” condensers do just that; a more specific example is found in the Hammarlund “midline” condenser. But no new type of condenser of which we can conceive will give radically different results—at least in the light of present radio knowledge.

In the design of condenser plates, one is not limited to a single means of securing a given characteristic. Sometimes the fixed plates are given a special shape; or again, both sets of plates may be made movable. Still another idea is embodied in the Cardwell straight line frequency condenser which uses rotating plates semi-circular in shape but of increasing thickness from one edge to the other.
Power Six Is Elaboration of the Counterphase Six

Popular Circuit Changed to Include New Heavy Duty Tubes

So thoroughly has the radio public been sold on the question of power amplification through the use of the 112, 171 and 210 types of power tubes that manufacturers today are all including arrangements for operation of a power tube in the last stage.

Bremer-Tully's popular circuit known as the Counterphase Six (described by Ray G. Piety on page 23 of the May, 1926, issue of Radio Age) has been altered in a few circuit respects and provision made for the use of a UX112 or UX171 in the last stage. (For the UX210 the filament supply would be AC and furnished by a step-down transformer.)

Pictorially and diagrammatically we are showing in this article the "Power Six" which consists of three stages of tuned radio frequency amplification, non-regenerative detector, and two stages of audio amplification. Filament control is by a master rheostat.

Experimenters will note, on close inspection of the circuit diagram on page 16, one departure from the Counterphase Six in the addition of three 1500 ohm fixed resistances, one placed in each of the three radio frequency grids to allow the sensitivity of the tuning to be maintained at an equal value over the entire broadcast band. Another point of difference is the use of a single unit 500,000 ohm variable resistance instead of the dual type used previously. Antenna coupling has been changed from the tapped coil in the previous design to the inductive form in the present receiver with a switch permitting change from short to long antenna. Jacks have been inserted in the first and second stages of audio to allow the listener to cut the volume at will. Neutralizing condenser design has been changed to a simpler and better form. Individual radio frequency chokes are placed in each of the three RF plate leads. It is not recommended that this set be shielded since that job alone is an exceedingly tough proposition unless the reader has had considerable experience. In the new coils some of the connections have been made inside the forms whereas in the older type these connections were made by the builder himself. The 1500 ohm fixed grid resistances together with the 500,000 ohm variable resistor in the 90 volt lead of the set serve to maintain the amplification of the receiver practically constant over its range. The variable resistor is simply a volume control. Grid biasing is used on both the radio frequency and audio grids. This sums up the alterations made in the later model, changes being made to bring the set to its highest efficiency.

On page 15 is shown a rear view of the completed receiver. Either binding posts or a plug connection may be used by the constructor.
view of the completed receiver. Circuit diagram, and the front panel view are shown on page 16 while the pictorial representation of the set (for use by those unable to read a schematic diagram) is printed on page 17, where also the list of parts used in making up this set may be found.

Connections Simple

OSCILLATION control in the Power Six is the well known system used by Bremer-Tully and called the "Counterphase." Wiring of the set may be done with No. 14 tinned, round bus wire. All sockets used are the cushion type while the detector socket has a snubber attachment which will eliminate microphonic action in that tube. The biasing battery should preferably be placed inside of the cabinet. In the circuit diagram on page 16 it will be seen that all connections to the filaments are very simple ones. Only one rheostat is used and this is in the negative filament lead where the filament switch is also located.

Assuming that all wiring has been finished, go over the work again to make sure that no wrong connections have been made. Then put in tubes, connect loud speaker and turn on batteries, previously having adjusted all the mikro-mike condensers to about half way down. Tune in a station of moderate volume to exact resonance, this being done with the condenser dial and the trimmer. Adjust the volume control to greatest volume without oscillation. This means greatest volume secured without a whistle or beat note secured when the condenser dial is rotated back and forth across the incoming signal. Disconnect either the positive or negative filament connection to socket of tube number three. The signal will still be heard. Turn adjustment screw of mikro-mike number twenty (see pictorial representation for all numbered parts) carefully until a point is found where the signal diminishes in volume or disappears entirely. Now rotate right hand dial for loudest signal, also rotating trimmer condenser to exact resonance. Again adjust mikro-mike to the setting which gives weakest signals or at which signal disappears. If signal remains weak or disappears over a setting of several turns of the mikro-mike screw, adjust to the middle of this weak or silent band. This will be the proper setting for mikro-mike number twenty. Replace the filament connection to tube number three and retune the set carefully using the trimmers. Remove filament connection of tube number two and determine setting of mikro-mike number nineteen exactly the same as before. Retune both dials carefully before making final adjustment of mikro-mike. Signal may become weak or disappear altogether over a band of one or more turns of the mikro-mike. The proper setting is half way between the settings where volume starts to increase. Replace filament connection to tube number two and retune the signal carefully. Remove either positive or negative filament connection on tube number one and adjust mikro-mike number eighteen exactly the same as the previous ones, first finding approximate setting, then retuning carefully as before to find the final setting.
On this stage the reduced volume band is very small and the mikro-mike should be rotated very carefully. As soon as position of reduced volume is found retune carefully for loudest signal and rotate mikro-mike carefully to setting where signal becomes weakest or disappears. Then replace filament connection on tube number one. If careful wiring has been made slight oscillation may be secured in the vicinity of 350 meters, when volume control is full on, this being desirable for greatest sensitivity.

Both the left and right hand dials on the panel will run fairly close together as far as settings are concerned. In the Bremert-Tully dials both the numerical values of the condenser degrees and the approximate wavelengths are shown.

Parts necessary in the makeup of this receiver are given in the following list:

**LIST OF PARTS**

1. B-T type TA torostyle transformer
2. B-T type TD17 tandem condensers
3. B-T mikro-mike condensers
4. Carter 500,000 ohm variable resistance
5. B-T radio frequency chokes
6. Carter 1500 ohm fixed resistances
7. B-T 2 to 1 audio transformer
8. B-T 4 to 1 audio transformer
9. B-T tuning controls
10. B-T type UXA sockets
11. B-T type UXD socket
12. Carter double circuit jack No. 104
13. Carter single circuit jack No. 101
14. Carter filament switch
15. Carter 3 ohm rheostat
16. Carter SPDT jack switch
17. X-L Pushposts
18. Eveready 4½ volt C batteries
19. Sangamo .001 mfd condenser
20. Sangamo .00025 mfd condenser
21. Sangamo .006 mfd condensers
22. Dubilier 1 mfd condensers
23. Durham 2 megohm grid leak
24. Formica 7 by 24 panel
25. Wood baseboard 9¾ by 23½
Keeping Step with SCIENCE

How the Lonely Astronomer Is Fed

Four Faint Comets Are Now Visiting Us

The telescopes and with sensitive photographic plates, are having difficulty in detecting the movements of our four visitors, so faint are these bodies.

All four of the present comets are believed to have visited us before. Finley's comet, the most familiar of the four, was here in 1886, 1893, 1906, and 1919. The comet named Giacobini-Zinner, the names referring, as usual, to persons associated with the discovery, visited the neighborhood of the earth in 1900 and in 1913. Neujmin's comet was here only once previously, in 1916. The fourth of the ones now visible, that named for Professor Comas-Sola, of the Barcelona Observatory, is suspected of being identical with a comet first seen in 1890, named Spitaler's comet and never seen again.

As far as is known the presence of comets in our heavens does not have any effect upon radio reception, although of course this is a subject upon which there is little data.

Elsewhere in this issue the case of sun spots affecting reception by causing fading, is discussed and may prove of interest to readers.

Land Indicated By Tides

Scientific predictions, made from studies of the tides, which led the arctic expeditions of the Norge, of Commander Byrd and others to seek a supposed continent in the polar regions, now turn out to be wrong, even from the tidal data. Such is the report of Mr. H. U. Sverdrup, just published by the Washington Academy of Sciences. As the daily waves which produce the tides move around the earth under the influence of the gravitational attraction of the moon,

What Neptune Does to Propellers

Three of Uncle Sam's gobs inspect the barnacled port propeller on a destroyer in dry dock at San Diego, Calif., before setting to work to cleanse the screw.

they are stopped and deflected by the continents. If scientists knew as much as they now do about tides but were ignorant of the existence of the American continent, it would be possible to detect the presence of this land mass from the tidal data alone.

Slow Movies of a Cat's Fall

Everyone knows when a cat falls it will turn over in the air and land on its feet, usually without injury. Recent scientific studies of the reflexes tell how this useful accomplishment is brought about. An English physiologist, Dr. F. M. R. Walshe, took slow-motion motion pictures of the fall. These show the cat's head is the first part of its body to take on the new and safer posture. The head twists with reference to the body, so the head is right-side-up. Righting of the head has been traced to a nervous reflex originating in the three small liquid-filled semi-circular tubes in the inner part of the cat's ear. These same tubes serve as "levels" for the human
The body, warning us whenever our head is tilted. A nervous impulse from these three tubes notifies the cat's head it is upside down. The neck muscles instantly twist it around. Another set of nervous reflexes begun by the tension of the neck muscles start the body muscles into motion, so the whole body of the cat is righted and lands right-side-up. These nervous reflexes are involuntary, unconscious and practically instantaneous.

**Melted Rock Crystal Urged for Telescopes**

NEW material for the construction of large astronomical telescopes was suggested by Dr. E. R. Berry, of the Lynn, Mass., works of the General Electric Company in a recent address to the New York Electrical Society, the oldest electrical society in America. This material is clear fused quartz, a substance which Dr. Berry and his associates first succeeded, a year or two ago, in producing in quantity and at reasonable cost. Fused quartz is rock crystal, like that found in many rocks, melted at an enormously high temperature and with the bubbles removed from it by the alternate application, while it is still very hot, of vacuum and of pressures up to thousands of pounds per square inch. The fused quartz is not suggested for telescope lenses, although small lenses have been made of it. What Dr. Berry urges is the use of fused quartz for the great mirror-blocks used in the largest of modern telescopes. These instruments collect and concentrate the light by large concave mirrors, not by lenses. The glass now used for these mirror-blocks expands when slightly heated and contracts when cooled. The body heat of a person standing near one side of a glass-block mirror may heat the glass sufficiently to distort the image formed in the telescope. Fused quartz expands and contracts only very slightly when heated and cooled. Mirror telescopes made from quartz blocks would be easier to build and could be used with fewer precautions.

The giant naval dirigible "Los Angeles" leaving the naval air station at Lakehurst, N. J., for its recent flight to Philadelphia in honor of the American Legion. Photo shows the land crew walking the ship out for the take-off.

**Use Mica Particles for Insulators**

MICA particles which hitherto could not be used, are now utilized as an insulating material for the production of radio high-frequency insulators. The new insulation is a composition of ground mica and lead borate.

Mica previously presented a difficult problem because of the enormous amount of waste. Obtained in India and Canada in large sheets, there was considerable waste at the mines, it being estimated that only about five per cent of the material taken from the mine could be used. In manufacturing, there were still further wastes of small pieces of mica, but some years ago it was found that these mica flakes, mixed with a binding material and compressed under heat, made very good insulation. Such sheets of prepared mica are used by the General Electric Company in manufacturing processes.

The new material has better insulating properties than has porcelain, and several applications for it have been developed by engineers of the General Electric Company. The substance, light gray in color and with a metallic ring, is being used in the manufacture of bases for radio transmitter tubes, for aerial insulators in high frequency work, and for numerous similar applications.

Chief among its characteristics are that metal parts may be inserted or combined with Mycalex during the process of molding; and, although a hard and stone-like product, it can be subjected to ordinary machining methods.
Everyday Mechanics

Accurate Sun Dial

Father Terray, of Assumption College, Worcester, Mass., who has just perfected a unique sun dial which gives extremely accurate readings of minutes of the day as well as hours.

Diagram of the radio-starting of St. Louis' new $8,000,000 lighting project, which was inaugurated December 16. The voice of Mayor Victor J. Miller picked up by a microphone produced a low-frequency wave from Station KDKA which set in motion the train of automatic operations which illuminated the streets of St. Louis.

Radio Starts Lights

No Trouble For This Car

A new innovation in the automobile line is this "Wheel-Cum-Track" combination of automobile and tractor, exhibited at the recent tank demonstration at Camberley, England. The body is that of an ordinary touring car, and the change from to wheels to rack can be made by engine power in less than a minute.

Microphonic Air-Gap

Soon after the invention, by Emile Berliner, of the loose contact transmitter, or microphone, scientists tried to explain its delicate action. That air was a factor in microphonic action was indirectly proved by Berlinger and his assistant W. L. Richards in 1879 when they put a Blake transmitter contact into a tight chamber and pumped the air out. Regularly the normal electric resistance of the contact was reduced on exhaustion and as regularly restored when again admitting air into the chamber.

Recently it occurred to Mr. Berliner to consult Roy M. Allen of Bloomfield, N. J., formerly the President of the New York Microscopic Society and who is very skillful in the making of photomicrographs. Mr. Berliner furnished Mr. Allen with a mounted telegraph key the contacts of which consisted of elongated, conical iron pins, which could be adjusted by a small relay spring. They were fashioned so as to permit the close approach of a high power microscope that had a photographic attachment.

The mounted key could be readily adjusted so that it would by microphonic action transmit the ticking of a watch and the whirring of its wheels. Mr. Allen's problem consisted in photographing the contact while listening to the ticking of the watch which was transmitted by the delicately adjusted key where an air-gap was supposed to exist; this air-gap Mr. Allen was trying to enlarge and photograph.

The invention of the microphone started with a telegraph key improperly manipulated by Mr. Berliner and it is mentioned in his patent document of April 14, 1877 describing the microphone. The details appear in Frederic William Wile's biography of Mr. Berliner recently published.

We shall be glad to have the comments of our readers on this feature, and the one on science which we are running each month. Are you interested in the pictures? Does the type of news matter give you any needed information? Let us hear from you. — Editor.
Head First Toward the Ground

Corporal Archie Atherton, Marine Corps parachute jumper, leaving a bombing plane head first with a parachute strapped to his back. As yet the parachute has not opened but Archie has lived through several hundred experiences like this and he knows that it will, sooner or later. He hopes it won't be much later. Taken over the city of San Diego, Calif., recently.

Test Tank Duplicates Altitude Conditions

Some of the sensations of an airplane ascent 30,000 feet in the air can now be experienced without leaving the ground. Thomas Templeman, aeronautical instrument expert at the Bureau of Standards, is shown inside of the steel cell, the interior of which is designed to duplicate conditions in the upper atmosphere. The changes of atmospheric conditions can be regulated by the "pilot" and the cylinder is also used to test instruments used in altitude flights.

Engine Tug-of-War

Storage locomotive plays tug-o-war with steam locomotive in the Chicago & Northwestern R. R. yards, at Chicago. Demonstration proves the storage battery locomotive far superior in many different types of duties. The storage battery locomotive is 17,000 pounds lighter than the steam locomotive.

President and Engineer

The famous Toonerville Trolley of the cartoons has a rival in the 5-mile railroad in the Ozarks of Southwest Missouri, said to be the shortest railroad line in the country. Dave Dingler, of Cassville Mo., is the president of the "Cassville and Exeter Railroad Company" and also is the line's only engineer. Mr. Dingler says he owes his success to having risen from the ranks. He is part owner of the road with J. C. Ault who is auditor and secretary. Mrs. Dingler is vice-president, while Mrs. Ault is treasurer. In all, there are eight employees of the road. Photo shows Mr. Dingler in the conventional overall attire, standing beside the locomotive of his line.

Studying Mars

Some forms of animal and plant life probably exist on Mars, is the conclusion of Dr. W. W. Campbell, president of the University of California and a director of Lick Observatory shown at the telescope. He is regarded as one of the world's foremost astronomers. Dr. Campbell bases his conclusions on the fact that studies of the ruby planet, now but 42,000,000 miles distant, show that there are indications of vegetation there. The fact that the surface of Mars takes on a dark hue in spring and a lighter color in the fall, comparable to seasonal changes on earth, indicates to Dr. Campbell that there is a strong possibility of plant and animal life there. Two factors necessary for the existence of life, he explains, are the presence of water vapor and oxygen. Almost conclusive evidence of the presence of these two vapors is seen in the findings of Dr. W. H. Wright of Licks observatory, who has made many investigations of the Martian atmosphere.

What kind of pictures would you like to see in this section? We are always glad to please our readers if we know their desires. Moral: Write us your wishes. —Editor.
Words--
Without
Music

By

DOROTHY BRISTER
STAFFORD

If you get as much of a
"kick" as we do out of this
fascinating new advertising
known as "whisper copy," you've
surely seen the two distinguished
gentlemen—immaculate in eve-
nings clothes—who apparently are
present at every fashionable gath-
ering, discussing one of their
fellow-guests behind his back; (in
this case not the instance where
they are expressing pity for the
poor chap for his social ostracism
because no kind friend has
had the courage to tell him to brush
the dandruff off his coat collar
or gargo his throat,) but the one
where approval beams from their
expressions and they are saying.
"By George, that chap Jones is
certainly interesting. He is never
at a loss for something to say and
I can't see where he gets time to
pick up so much general informa-
tion. He has no more time to
read than we have yet he can talk
better than any of us."

And if, intrigued by the possi-
bility that you, too, may become
a social knockout, or learn how to
talk back to the boss in confer-
cence, you read on, you'll find that
Information Harry has climbed
to this lofty pinnacle where he is
the envy of all his associates by
zealous study of some little book
that contains the best thoughts
of the greatest minds, and all the
general information that a poor
boy trying to get along needs in
his business.

We are sure our corpsbruder
of the Corona won't mind much
if we steal his carefully prepared
thunder and trot out our own par-
ticular hobby as an answer, in-
stead of his little book. For
everybody knows that the best
informed people we come in con-
tact with these days, whether it
be at a social gathering or in the
business world—those who are
right up to the minute with
knowledge and information on all
subjects of current interest, poli-
tics, news and sports, are those
far-seeing souls who own radio
sets and listen to what comes over
them. That we are all subcon-
ciously absorbing a wide knowl-
edge of music and cultural sub-
jects on the side is an old story.
What we are talking about in
this lesson is the tremendous
news and informative value of
radio. If Burke, who named the
press the Fourth Estate, were
living today he would surely nom-
inate Radio as the Fifth, and as
its information is so often in the
present tense, it can truly be re-
garded as the most important of
all.

A man said the other day that
he would just as soon think of
going along without a radio set
as a telephone.

"The entertainment and music
appeal to the family," he said.
"To me it is as necessary as the
newspaper. I use the market re-
ports in my business and of
course I get them long before they
are printed. And as baseball
and football are my hobbies, I
wouldn't think of missing the ra-
dio accounts of the important
games."

And since it seems that so
much of moment in the way of
epoch-making events has tran-
spired in the past few months in
this phase of broadcasting, it
might not be amiss at this period
of the year to review some of it.
Hearing the Series

HANDLING of the World's Series the past fall will be marked with a white milestone in the progress of broadcasting. For although in previous seasons, we of the outlying districts have had the excellent Associated Press accounts of the games broadcast by our local stations, this year was the first time in history, when, by reason of the network of hook-ups, millions of baseball fans in practically every state in the union heard not only the detailed accounts of the games at the instant they were transpiring, but of the roar of the crowds witnessing the struggle, in several instances the crack of the bat, and with the aid of the vivid word pictures of Graham McNamee, were able to follow the game with as breathless interest as those actually witnessing the contest. And while personally we felt that we had never heard a more dramatic or colorful description of anything either by McNamee or any other radio speaker than the account of these games, it is significant that the New York Times considered this announcing so important and epochal, that in the sacred first column of its first page it printed the verbatim radio account of the first game, and continued at length to five full columns, relegating its own important sport writers' accounts to the sporting section. This policy was followed daily throughout the series. It seems to us that this was not only a high compliment to the ability of the announcer, and the National Broadcasting Company, as we must now learn to call the WEAF-ers, but establishes radio as something entirely legitimate and standard, and places broadcasting not only alongside the newspaper as a distinguished public servant, but a little bit ahead of it. We wonder if the baseball public would ever again be satisfied with a telegraphic account of the games. The best a ticker can do is the past tense, "It was a strike." But listen to Mac,

"Alex-an-der pitching. Two balls, two strikes! His arm comes up—here it comes!" A mighty howl from the crowd. "It's a strike! Struck him out!" The listener doesn't have to be told that "it was a strike. He hears it, it is a strike.

And there comes the thought that the newspapers and the expert writers thereon are going to regard radio as a bit more of a menace to their profession. Of course the dyed-in-the-wool baseball bug who delights in post mortems still wants to read everything he can find printed about the game, but the average person who has listened to the striking description of every play, and for who the event was history when the last man went out, is he likely to dash out and buy a paper? We think not. We know there were mighty few sport extras sold around our neighborhood after any of the games.

And as we watched the tense faces about the loud speakers and heard the comments of the listeners, we thought of the unique experience of this man whose voice was becoming familiar to millions all over the land. Surely no such privilege has been enjoyed by any other speaker since the beginning of time. And while naturally in such a heterogeneous mass of individuals as is represented by the radio audience there are as many opinions as there are types of minds, to us it seems that Mr. McNamee's technique is just about what it should be. A crowd of rabid baseball fans doesn't want to hear the dignified McNamee of the Atwater-Kent concerts, and we wonder what the disgruntled listener who wired him that he talked too much expected him to do while the pitcher is stalling for time or the umpire is settling an argument. This same listener would be the first to howl if he had to listen to the hum of the wire between plays, and we note in the New York Times' accounts all the extraneous chatter was included. And how many of the self-appointed critics could keep up a running fire of comment for two hours and a half, give an accurate description of the game and equal Graham McNamee's batting average?

Colorful Announcing

THIS inevitable criticism of the announcer's methods brings to mind some of the funny comments we heard regarding Major Andrew White's able delineation of the Dempsey Waterloo down in Philadelphia. Here again was a first time on any stage performance. Never before had the fifteen millions—which seems to be the popular current quotation on the size of the radio audience—been given the opportunity to listen to the description of a championship prizefight direct from the ringside—the clang of the gong, the conversation of the vast multitude soaking in the downpouring rain and the thud of the gloves. Some of the psychological effects of bringing a sluggling contest into the sacred precincts of the home were humorous to say the least. For instance the white-haired grandmother, (a real grandmother, this time with her soft silk gown trailing about her and her glasses slightly askew in her excitement,) who rushed into the hall and informed the tenants in the next apartment, whom as she explained afterwards she didn't know "from Adam's hat-band," that Jack's nose was a complete wreck and one of his eyes was closed! Possibly there were some God-fearing souls in the radio audience who shut off the set and didn't listen, but we don't know any of

Clyde R. Randall, announcer at WSMB, deserves honorable mention for yeoman's service at the time of the Florida hurricane.
them. It is interesting to conjure up a vision of the listeners far away on lonely farms, in prim little villages, the type who have had no contact with anything in the world of sport, let alone a thing as revolutionary as a prizefight, drinking in the vivid account of that battle. And the crowning event to many of them as it was to the eleven-year old whose father allowed him to stay up for the finish was the opportunity of boasting to less fortunate ones. “And I heard Gene Tunney speak himself.” A night or two later the small boy was able to say, “And I heard Gertrude Ederle,” though personally the only thought we were able to carry away from Miss Ederle’s discourse was that Channel swimmers seem to exist entirely on chicken.

But to return to Major White and the fisticuffs. One of the most absurd criticisms we heard was from a man who said:

“I couldn’t understand that announcer. He sounded like he was excited.” Well, my word! and a couple of sentences! Who wouldn’t be excited? We know the air in our living-room was fairly electric, and we couldn’t see the contest. When psychologists tell us how extremely difficult it is for the average human being to give an accurate description of even an unimportant happening, and how in criminal trials three supposedly reliable persons will give three totally different versions of the same event, doesn’t it seem a little remarkable that a man can think so quickly and put his thoughts into intelligible words in the fraction of time it took the agile Tunney to sidestep one of Dempsey’s lunges? It requires a little more than a quick eye and a gift for gab. A pretty agile mind, working on all six seems to be the chief requisite for reporting a championship ring battle, and anyone who listened to Major White knows that he possesses it.

Back of the Scenes

One doubts if a dozen of the listeners to this great broadcast even gave a thought to the tremendous mechanical and technical work involved in its success. The radio audience has had so many marvelous things done for it that it accepts everything as a matter of course, and the attitude of some of our blasé friends of the dial-twisting fraternity leads us to believe that if we were back in 1917, and some enterprising station corralled the rights to broadcast from the western front, the listeners wouldn’t bat an eyelash, but someone would probably complain that the machine guns were too close to the microphone. But whether the listeners were impressed or not, the broadcasting of the fight was quite an achievement. Held up until the eleventh hour because of the difficulty of finding an advertiser willing to pay the exorbitant fee Mr. Rickard demanded for the privilege, it was only on the Monday preceding the fight that the contract was closed with Mr. Smith which made the broadcast possible, and all the mechanical difficulties had to be solved in three days. And there were many. In addition to the WJZ hook-up, there was the complicated WEAF chain, to say nothing of dozens of independent stations clamoring to get in on the big event. But under the direction of Carl Dreher, chief engineer of the R. C. A. stations all the technical complications were met and overcome, and the fight went on the air, and into thousands of living-rooms, where the unique spectacle of father, mother and the children all listening to the account of two huge men pummelling each other to the accompaniment of considerable spit gore probably gave the reformers much food for thought.

And then this past fall there was that event, decidedly impromptu in nature, that for the time being represented to thousands of people the most important.

(Continued on page 55)
BUILDING BROWNING-DRAKE POWER RECEIVER

Quality Reproduction Assured With Compact

By J. E. COOMBES

Radio's public today, whether it be the experimenter or the listener, has become quite fastidious in its taste for quality in all forms of reproduction. With the improvements made in the nature of the programs broadcast last year, the radio set has become almost a vital necessity in the home of the music lover as well as the individual who keeps track of news developments via the air. The receiving set described in this article is designed so that its reproductive powers will be readily appreciated by the severest music critic. Considerable care has been used in selecting the proper apparatus so the finest musical performance will be obtained without sacrificing the other elements for successful reception. From the standpoint of simplicity of construction the Browning-Drake design was used, since this arrangement is deserving of, rather than in need of, publicity. For over two years this design has remained unchanged and has gained popularity constantly because of its ease of construction, comparatively low cost and efficiency of operation in service.

One stage of neutralized radio frequency amplification is used with a regenerative detector, thus getting all of the energy possible out of a small number of tubes. As for selectivity and distance getting ability the receiver is quite commendable, but it is primarily for its freedom from distortion in the radio frequency and detector circuits that it has been selected for use as a self contained power operated receiver. The only deviation from the standard Browning-Drake construction practice is the introduction of an optional antenna inductance for greater selectivity. This inductance consists of from two to four turns of insulated wire wound on the outside of the antenna-coupler at the filament end. One end of the extra coil is attached to the common ground-filament connection while the other is brought out to an additional antenna binding post. This reduces the coupling from the antenna to the secondary of the first coupler and sharpens up the tuning considerably. This was done for work in Chicago where the average experimenter and listener is beset with two dozen or more broadcasting stations. In sections removed from metropolitan districts there will not be the necessity for the added antenna coupling since interference there will not be anywhere near as bad as in the city. If it is desired the added antenna coil may be left on and the degree of selectivity governed by changing from one binding post to another as conditions warrant such a change.

Reason for Power

Power amplification requires but little introduction to the radio public for no single feature of the improvement of the methods of reception has earned more publicity from radio magazines and journals than this comparatively recent development. The reason for power amplification is not difficult to find. Bass notes require a considerable expenditure of energy if they are to be amplified faithfully. When we reason back and realize how much more mechanical energy it takes to sound the pedal diapason of the organ than the note of the violin it is not hard to appreciate the fact a correspondingly
FIG. 2 TOP VIEW BROWNING-DRAKE POWER OPERATED RECEIVER
greater amount of electrical energy must be spent for the full reproduction of these deeper tones. Consequently a radio tube with a capacity just sufficient to amplify comfortably the music of the violin cannot be expected to do justice to the tones of the heavier bass instruments.

It is significant that the power tube UX171 used in the last stage of this receiver has an undistorted power output approximately forty times greater than that of the ordinary amplifying tube. This power tube gives full sway to the bass notes which have heretofore been squeezed through the audio channels of the receiver with diminished and strained quality and volume.

**Choose with Care**

Much care has been taken in selecting the apparatus for the audio frequency end of the power operated Browning-Drake set. Upon the construction of the audio amplifier depends the success or failure of the receiver as a musical instrument. Thordarsons R200 audio transformers were chosen as giving the smoothest amplification obtainable. These transformers will handle all notes from 30 cycles up past the upper range of the human ear.

The use of the power compact (R171) makes it possible to build a very compact power supply and B eliminator into the set itself. This power compact contains the major portion of the complete unit. Within its compound filled case are to be found the power supply transformer, two filter chokes of 30 henries inductance with a current carrying capacity of 80 milliamperes; two buffer condensers of .1 mfd. each (to go across the Raytheon elements) and a filament supply for the 5 volt power tube. This power supply unit is designed to supply complete A, B and C power for the power stage, and in addition, the plate supply for the rest of the receiver. With the power supply unit constructed in accord with the diagrams shown in the blueprint section of this article there is not the slightest trace of a hum in the loudspeaker. The 60 cycle pulsations in the house lighting current have been carefully filtered out, leaving a smooth direct current flow to the plate of the tubes.

One of the features of the power compact used in constructing this set, is the perfectly balanced filament winding. The mid-tap is taken from the exact electrical center. This center position is not obtained by tapping a continuous winding, but is taken from the common lead of two individual perfectly balanced coils, wound side by side. The C bias for the power tube grid is brought to the center tap through a 2000 ohm resistor which gives about 50 volts grid bias. It is only with a perfectly balanced grid return that the AC hum may be completely obliterated. As will be observed, the power supply unit is placed at the radio frequency end of the receiver. This is done because the tuning circuit is less apt to pick up the 60 cycle hum of the light circuit than is the audio amplifier.

In looking at the schematic circuit, Figure 4, the 2000 ohm resistor is shown, at one end, common with the negative B and the negative A, and common with all the grid returns of the set. Since the power tube filaments are lighted from raw AC and since that circuit is not a part of the regular filament circuit, the C bias connection will be at zero potential to the balance of the receiver, but will be 50 volts negative to the power tube grid.

Another feature is the absence of variable controls. The voltages delivered to the set by the

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**LIST OF PARTS**

These parts were used in the model shown here. Other parts of equal merit will serve.

1. Bakelite panel, 7"x30"x3/16"
2. Wood baseboard, 9"x29"
3. Panel brackets
4. National Browning Drake kit, consisting of coils, variable condensers, and vernier dials.
5. X-L Neutralizing condenser Carter resistor, 2 ohms RU2
6. Carter resistor, 50 ohms RU50
7. Sangamo grid condenser, .00025 mfg.
8. Durham grid leak, 2 Megohm
9. Thordarson R-200 amplifying transformers
10. Thordarson speaker coupling transformer
11. Thordarson power compact R-171
12. Raytheon rectifying tube, type BH
13. 5000 ohm resistor, 40 MA capacity
14. 3000 ohm resistor, 40 MA capacity
15. 2000 ohm resistor, 40 MA capacity
16. 1 Carter A battery switch

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Separate diagram of the power compact. This may be made up as a separate unit if desired and used for all receivers.
power device are automatically controlled by means of fixed resistances. The first three fixed resistances in series divide the voltage in proper values for the receiver. Two hundred and fifty volts are delivered to the plate of the power tube. The 5,000 ohm resistor cuts this down to 90 volts for the first audio tube. The two 3,000 ohm resistors divide this last voltage in half and deliver 45 volts to the plate of the detector tube and 50 volts to the radio frequency tube. These resistances should be capable of carrying a current of 40 milliamperes.

The importance of having these voltages predetermined will be appreciated when we realize the average voltmeter in possession of the home constructor is of a comparatively low resistance. These low resistance voltmeters, while they give a fairly accurate reading of voltages from batteries, are not suggested for reading the voltages supplied by power devices. The voltage output of the power supply devices varies with the amount of current consumed in the output device. When these voltmeters are used a comparatively heavy current is caused to flow through the low resistance windings of the instrument, increasing the total current consumption and causing a considerable drop in voltage.

For loud speaker coupling the transformer method has been chosen since under this arrangement the speaker windings do not carry the direct current voltage, but rather handle only the alternating current pulses from the plate of the power tube. The speaker coupling transformer R76 is inserted in the plate circuit of the power tube and its output delivered through a secondary winding to the loud speaker.

In the blueprints, Figure 1 shows a rear view of the receiver. The wiring for the filament of the power stage is twisted as shown and leads from the power tube filament terminals on the compact along the baseboard and over to the last audio tube. The compact itself is shown with the accompanying condenser bank beside it so that all leads may be made as short as possible. The location of the socket for the Raytheon tube is shown in Figure 2 at the left end of the panel. Since the newer type Raytheon tubes have the long prongs on the tube, the standard UX base socket may be used in the receiver. The fixed resistances are shown in Figure 1 at the right of the baseboard. These plans merely show the location of the parts, which however should be wired according to the schematic circuit, Figure 4. Flexible, rubber covered wire should be used for hooking up the set, although bus bar wire may be used providing spaghetti is used on all sections where there is any possibility of short circuiting.

Filament control for the 199 tube used as the radio frequency tube is through a fixed fifty ohm resistance. Filaments of the detector and the first audio are handled in parallel through a fixed two ohm resistance. With these resistance values the filaments secure their allotted current rating and manual control is obviated. The bypass condenser shown across the primary of the first audio transformer may be either a .001 or a .002 mfd. fixed condenser. Grid return of the first audio transformer is to the negative filament, there being no C battery used in this position. Biasing of the power tube grid is automatic through the 2,000 ohm fixed resistor in series with the center tap of the filament winding of the power compact. In Figure 4 the parts which are included in the power compact itself are shown within the dotted lines. The filament switch is placed in the negative lead.

For neutralization purposes the small neutralizing condenser shown in Figure 2, is located between the first socket and the front panel, being connected between the grid of the radio frequency tube and the neutralizing tap on the detector inductance. This should be adjusted with a wooden or bakelite rod and should be manipulated so that with the set in a non-regenerative condition (tickler backed away from oscillation point) the first dial may be rotated back and forth across a station's signal without the first tube going into oscillation and squealing. A little practice with the neutralization adjustment will determine the best position. The neutralization should be made on a signal about the mid position in the broadcasting channels.

Rear view of the completed Browning-Drake power operated receiver, parts for which are shown in list on the opposite page
FIG. 4 SCHEMATIC CIRCUIT BROWNING-DRAKE
POWER OPERATED RECEIVER

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HOW long have you postponed making that favorite hookup of yours because you couldn't find reliable and clear diagrams? We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

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- Illuminated Controls on 4 Tube Receiver.

December, 1926
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- Types of Rectifiers Discussed.

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- Full Data on Worlds Record Set.
- Dual TC Receiver.
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Radio Age, Inc., 500-510 N. Dearborn St., Chicago
NE of our readers, W. D. Devore, an electrical contractor, writes very interestingly concerning power transmission by radio. Because his letter holds a novel viewpoint we are printing it for the benefit of our readers.

“In reading your September issue I noticed an article by Armstrong Perry in which he severely criticizes the idea of power transmission by radio.

“As the transmission of sound by radio has reached a very good stage of development and as we are about exhausted with speculations in that direction we only naturally turn our thoughts and direct our experiments towards that which will open up new and larger spheres of activity.

“Foremost of these newer ideas is the transmission of power with no interconnecting means. Whether or not the term radio should be used to express this form of transmission is open to discussion, but we will use this term to convey the idea.

“Many engineers claim this means of power transmission is wholly without foundation and dismiss the thought as absolutely impossible. For example, one engineer calls to mind the statement that a very small amount of energy, three trillionths to be exact, is the amount of the original broadcast power picked up by a receiving set. We will grant this statement without argument. We can readily understand what an inconceivably great power would be required to transmit enough power to light a small lamp only a short distance from the transmitter. But before we dismiss the idea as wholly impractical let us consider a few different angles of the situation.

“Radio as we are familiar with it today consists of but one thing, the transmission of sound waves, nothing more and nothing less. How well this has been accomplished you can answer for yourself. Does it then seem fair and reasonable to think that to transmit power it would be necessary to send out a stronger sound wave and convert this sound wave into a heat wave or a light wave? Certainly not. If you turn on your radio and wish to receive a good concert it is necessary that some broadcasting station be transmitting a concert. You would not think for a moment of using your lamp socket for a telephone or trying to heat your home and illuminate your parlor with the telephone. But that is the idea those persons surely must have when they come out and say point blank and say that power transmission by radio is an absurd idea.

“How is the feat going to be performed? We do not know, neither did we know, just a few years ago, how the radio telephone was to be made practical. These same men who today so quickly condemn power transmission were among those who said that practical radio telephony was only visionary. Some of you old timers go back with me just for a moment. Do you remember how we used to try to modulate a direct current arc circuit, how the microphones would fuse almost as soon as the power was turned on, how we sometimes used a dozen or more of them in series (and paralleled) to withstand the high current? And then, the one wonder working invention that made all our dreams come true. The three electrode tube. The wonderful little lamp that could be used as a detector, an amplifier or as a generator of undamped oscillations. This alone made radio telephony practical and some day some little device is going to make power transmission possible.

“Do not misunderstand me. When we receive power, power must be transmitted. When we receive heat, heat must be transmitted. We cannot expect to convert a sound wave at radio frequencies and get any use from it in the form of heat or light. Some day a station will broadcast a heat wave which will be picked up and amplified in the same manner as our present sound waves.

“In the preceding paragraphs I have named three possible kinds of transmission, power, heat and light. We need not consider the power and light problems because they will only involve unnecessary arguments.
Whenever we can transmit heat at a radio frequency we have conquered the entire radio universe because with the transmission of heat will come power and with heat will come light and from light we will get vision. So if you are told your receiver only picks up three trillionths of the broadcasters power do not become downhearted because some day if you can pick up three trillionths of heat. Broadcasters power you will not only will be able to heat and light your home but you will be able to see important events as you now hear them.

"In conclusion I might add these statements for the benefit of those who will criticize this article and thus rob them of some of their arguments. Sound wave transmission as we know it today is of course transmitted by electricity but the sound wave must be changed in character so that it will blend with the carrier wave. In short the simple term for this is modulation. This is accomplished by a simple microphone which of course must have its attendant speech amplifiers in order to modulate the powerful oscillator. With some such an idea we may hope to change the form of a heat wave so as to cause it to blend into a carrier and be amplified. Such an accomplishment is not only possible but very probable, so before we condemn the idea lets give it a chance and maybe someone will come forth with a device that will render our present system as obsolete as the ancient coherer."

WE HAVE had quite a few laughs in our existence, but this letter from A. Rufus Applegarth, Jr., of 86 South Long Beach Ave., Freeport, N. Y., gives us quite a chuckle, although we will admit it is serious business for our correspondent. He says: "I built one of your circuits called the 'ultra-audion' described in the August, 1925, issue. I have had wonderful results from the set, but my neighbors are loading their shotguns." We can readily appreciate what his neighbors think, but the cure is simple: go over to one stage of neutralized RF; something like the circuit shown on page 21, January, 1926. This set is a great distance getter and if properly constructed will not radiate. Tell the neighbors you are building one of this type of sets and watch them trade their shot guns for bouquets. We are sending a DT button on account of the excellent log which Rufus has furnished this department. We'll bet the neighbors didn't get as good a log!

A SURVEY of the United States by the Department of Commerce shows the following proportion of listeners:

New England 8.025 percent; Middle Atlantic states 18.998 percent; East North Central states 27.068 percent; West North Central states 19.242 percent; South Atlantic states 5.750 percent; East South Central 3.489 percent; West South Central 8.046 percent; Mountain states 2.876 percent and the Pacific states 6.526 percent.
February Evening Skies
Mars and Jupiter Only Planets Seen This Month

By JAMES STOKLEY
(Science Service)

This month sees an end of the evening display of one of the plants of the autumn sky, for Jupiter has passed close to the sun. On the first of March it will be in opposition, which means that Jupiter and the sun will be in the same straight line from the earth. But Mars is still with us, shining with its ruddy glow in the southwest, just to the south of the Pleiades, the famous loose cluster of stars in Taurus, the Bull.

On February 25, Mercury, a planet which few people have ever seen, will be in a position where it will be visible low in the western sky at dusk, ready to be picked up by a keen eye. As it revolves around the sun in a year of 88 days, it is sometimes seen to the west of the sun, and sometimes to the east, when it is said to be in either western or eastern elongation. On the 25th, it will be in eastern elongation, which means that the sun sets a little while before Mercury. It is only a third as far away from the sun as the earth, so that it is never seen more than 28 degrees from our orb of day—a distance about the same as that between Betelgeuse and Sirius, two of the bright stars now in the southern sky. Its orbit is not circular, but elliptical, and as a result it seldom reaches the maximum elongation on the average getting only about 23 degrees away from the sun. Twilight lasts until the sun is about 18 degrees below the horizon, so Mercury can never be seen for very long after complete darkness has arrived. This month the opposition is not as great as the average, being only 18 degrees, so that it can be seen at best only as a bright star in the evening twilight.

But the February evening sky makes up in stellar attractions for what it lacks in the planets. The winter sky is now in all its glory, for at no other time of the year can as many first magnitude stars be seen at once. In the whole sky there are twenty stars brighter than one and a half in the astronomical scale of magnitudes. Five of these are in the southern hemisphere and are never visible above our horizon. This leaves fifteen which we can see, and of these, eight are now in the sky at once, six of them forming a hexagon with another at the center.

Almost directly overhead is the yellowish-white Capella, astronomically alpha Aurigae, as it is the brightest star in the constellation of Auriga, the Charioteer. This is so bright that it is very easy to identify, for only Sirius, of the stars we can now see, exceeds it in brilliance. To the southwest of Capella is the orange-red star, Aldebaran, or alpha Tauri, the brightest star in the constellation of Taurus, the bull, and which was represented on the ancient star maps as the bull’s eye, glaring at the nearby warrior, Orion, South, and a little east of Aldebaran, is a representative of Orion itself, in the form of Rigel, or beta Orionis, for it is the second brightest star in Orion. Rigel has the distinction of being one of the most brilliant stars.
Save $50 to $100!

Imagine a radio without oscillation, without variation of volume on different wave lengths! Imagine a 5-tube receiver with the power of most expensive 8-tube sets! Imagine knife-like selectivity even in crowded areas! And tone quality as clear and pure as the natural unbroadcast signal!

That describes the 1927 Hi-Q Receiver designed by ten of America's leading Radio Engineers!

You can build this wonderful receiver yourself at home and save at least $50 over a factory-made set of anything like the same efficiency. Get the "How to Build" book and approved parts from your dealer today and construct the receiver designed by Radio's Master Minds.

SEND FOR THIS BOOK—
The simplest and most complete instruction book ever printed. Covers every detail. 25c.

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*High ratio of reactance to resistance.
High ratio—Great selectivity—Loud Signals.

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Wall Box Plug

HOWARD B. JONES of Chicago, manufacturer of the Jones Multi-Plug line for battery connections, announces a new type W. B. (Wall Box) Multi-Plug, consisting of the standard seven contact socket mounted on a switch box cover and the regular plug and cable.

By installing this socket in the baseboard of the room, the batteries with their messy wires and unsightly appearance can be removed from the living room entirely and placed in basement or adjoining closet.

A connection from the batteries or power supply unit can then be made in the same manner as the ordinary floor lamp.

Hope to Solve Mystery of Dengue Fever

SIXTY-FOUR soldiers who voluntarily submitted themselves to the bites of infected mosquitoes have enabled officers of the U. S. Army Medical Department Research Board at Manila to clear up the previously unsolved problems of dengue fever.

Lt. Col. J. F. Siler told the American Association for the Advancement of Science meeting at Philadelphia that medical science is now in a position to wage war on dengue with the same assurance of success that has attended the campaigns prosecuted against yellow fever.

Dengue, or break-bone fever, is a common disease of the tropics and is one of the chief causes of sickness in the U. S. army in the Philippines. Five years ago an epidemic swept through the southern states from Texas to Georgia, attacking about 2,000,000 people.

The research board investigating the disease found, said Lt. Col. Siler, that it was transmitted by the same mosquito and in exactly the same way that yellow fever is carried from person to person.

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City State
February Evening Skies

(Continued from page 35)
of known stars, referring to its intrinsic brightness. In general the brightest stars are very close, but Rigel is at the respectable distance of 540 light years, one light year being the distance that a beam of light will travel in twelve months, going at the rate of 186,000 miles a second, or about 6,000,000,000,000 miles.

Compared to Rigel, Sirius, to the southeast of it, and the next star in the hexagon, is next door to us, for we see it tonight by light that left it in 1918, instead of in 1387, which was the year that the light reaching us from Rigel left on its long journey. Sirius is the brightest of all the stars we see in the sky, partly, of course, because it is so close. Alpha centauri, the nearest known star, is at a little less than half the distance of Sirius, but it is one of the southern stars not visible from northern latitudes. Sirius, however, appears brighter than alpha centauri. It is the "dog star," as it is in the constellation Canis Major, the great dog.

The great dog is one of the two that accompanied the mighty hunter Orion, the other one being represented by the next star in the hexagon, yellow-white Procyon, northeast of Sirius. This is in the constellation Canis Minor, the lesser dog, and is also very close, for it is only 10 light years distant. They look close together in the sky, and in fact they are but a relatively short distance apart—about four and a third light years, closer to each other than either of them are to the earth.

Completing our hexagon, we come to the orange colored Pol-
lux, northwest of Procyon and southeast of Capella. Pollux is one of the two stars that form the twins, Gemini, the other member of the pair being the fainter Castor, just above Pollux. The ancients considered the Twins propitious to navigators, and the Romans swore by them, as they were two of their most popular gods. The remains of the temples to Castor and Pollux at Rome, and at Girgenti, are among the most famous of the Roman ruins. The Roman oath by them
must have been very popular, for it has survived to the present day, in the slightly modified "by jiminy."

Finally, in the center of the hexagon is the famous Betelgeuse, or Alpha Orionis, the brightest star in Orion. This star is in the warrior's right shoulder, according to the old star maps, and in his upraised right hand he holds the club with which he is about to smite the giant bull Taurus.

The constellation Leo, the lion, now rising in the eastern evening sky, contains the eighth first magnitude star now visible. This is Regulus, or alpha Leonis, at the end of the handle of the "sickle," probably the most famous group of stars next to the Dipper and Orion. The blade of the sickle forms the lion's head.

Female Fish Fuses Mate to Body

One of the most curious living creatures ever discovered by science has been described by Dr. C. Tate Regan, of Copenhagen. This astonishing creature is named Ceratias and lives in the depths of the Atlantic Ocean, a mile or more below the surface. There are two sexes, male and female, but the male Ceratias is unable to live alone. He passes his life attached to the body of the female. The female fish is much larger than the male, being some three or four feet long while the male equals only as many inches. Dr. Regan thinks it probable the baby males attach themselves to the similarly immature females soon after the young fish emerge from the eggs. The male then loses his mouth and head parts.

Use Allen-Bradley Resistors for B-Eliminator Hook-Ups

Allen-Bradley research engineers have developed a series of variable and fixed resistors especially suited for B-Eliminator hookups. The success of their efforts is indicated by the fact that Allen-Bradley resistors, both variable and fixed, are used by more than fifteen B-Eliminator manufacturers, including European as well as the largest American manufacturers.

Bradleyunit-A

Perfect Fixed Resistor

Another triumph of the Allen-Bradley Research Laboratory is Bradleyunit-A, a perfect fixed resistor that contains no glass, requires no hermetic sealing, and can be soldered into place without the use of clip mountings. Bradleyunit-A is not affected by temperature or moisture.

The silent, smooth control of plate voltage so essential in B-Eliminator service is obtained with Bradleyohm-E. For fixed step adjustment of voltage, Bradleyunit-A is recommended.

Do not experiment with make-shift resistors when these Allen-Bradley units have been pronounced the ideal units for B-Eliminator service.

Ask your dealer for them, today!
Radio Overdoses Hurful to Plants

X-RAYS can have harmful effects on plants as easily as they can on animals, and the result of an apparently mild dose given to a plant in its youth may show up in distortions and freak growths much later, when maturity has been reached according to a series of experiments with X-ray on plants, conducted here by Edna Louise Johnson of the University of Colorado.

Miss Johnson used sunflowers for her material, raising them while they were young seedlings and even unplanted seeds. Then she let them grow up and watched for results. Most of the plants developed doubled, or "fasciated" stems, a phenomenon occasionally observed in nature, caused by injury to the growing tip. The doubling tendency extended to leaves and flowers as well, for many leaves had two blades and some of the flower heads appeared in distorted and unnatural shapes.

The effects of the X-rays were evident internally as well as externally. The stem was made coarser and woodier, its water-conducting vessels were dislocated from their usual positions, and abnormal amounts of corky material appeared in the skin. Measurements of physiological effects showed that the rate of life-processes in general was depressed. (Science Service).

American Anticipated

British "Dark Vision"

SEEING in the dark by means of the "telesi-visor," the reported invention of John L. Baird in Great Britain, was anticipated, at least so far as its fundamental principles are concerned, by an American physicist, Prof. R. W. Wood of the Johns Hopkins University. There is nothing new or mysterious about the rays which the British inventor employs; they have been known for many years and are of the same character as ordinary light rays, but due to their lower vibration rate do not stimulate the human eye and therefore remain invisible.

Gasoline of Future May Be Pink But Plentiful

MO-ORISTS of the future will be able to match the color of their cars when filling the tank, and they will not have to worry about the gasoline supply for some time to come, according to Dr. Gustav Egloff who has investigated the possibilities of getting motor fuels from various sources.

"The potential future gasoline supply will last for hundreds of years," Dr. Egloff said, "and it will come from "cracking" a wide variety of materials such as petroleum, coal tars, shale oil and wood tars. The old fashioned gasoline was simply evaporated off of the crude oil and had no anti-knock properties. The modern "cracking process" is a way by which heavy oils are chemically broken down into lighter ones suitable for motor fuels. "Cracked" gasoline has valuable anti-knock properties, and the gasoline of the future will be a mixture of the two. Motor fuels will yield double the mileage and have anti-knock properties.

But the cracking process has not only created new styles in the quality of gasolines, Dr. Egloff explained, but has also introduced a new variety of colors. Although there are still many specifications that require gasoline to be water-white, the automatic cylinder that transforms "gas" into miles has no preference for any particular shade or tint. In fact color means nothing to the motor. It does, however, mean something to the distiller, for he often tries to doctor up his gasoline to get rid of all trace of color and as a result loses some of the anti-knock properties.

"It is a happy sign to motor over the country and see not only yellow, but pink, red, blue and green as well as water-white gasoline in the visible bowls," Dr. Egloff said. "The motor is no stickler for style. It will operate as well with the yellow as with the water-white, blue, pink, or even red, gasoline. Perhaps some day the motorist will suit the color of the gasoline to that of his car."

Bacteriophage Cures Carbuncles and Boils

WILL bacteriophage, mysterious sub-microscopic subject of endless scientific controversy that has been called the disease of bacteria, become a cure for one of the oldest and most common of mankind's afflictions painfully famous ever since the days of Job?

Utilized in the past by its discoverer d'Herelle to help cure dysentery, a group of French medical workers have found that anti-staphylococcus bacteriophage is a successful agent for clearing up a whole class of infections of the sort responsible for boils, abscesses and carbuncles.

The bacteriophage was first tried out on animals.
SM

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Four-Thousandth!

A record has been established for S-M audio and output transformers—they have given satisfaction to one four-thousandth of a percent.

Each type has been sold with a guarantee that it would give better quality of reproduction than the buyer had ever before heard. With such a guarantee thousands of doubling Thomases rushed to buy, confident that they would simply try the new transformers and then return them for a refund. They were fully confident that their sets could not be beaten; but they were wrong; since they were sure a trial would cost nothing.

How did the story end? Like all big things, very simply! Among all the free trial buyers, less than one transformer from every four thousand was returned. All the returned for a cash refund as "unsatisfactory."

Have you ever heard of a record like this—of a factory claiming its products to be the "best," then backing that statement to the limit, selling thousands of transformers, and having a return percentage of less than one-four-thousandth of one percent?

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This kit consists of three matched units. The antenna coupler has a variable primary. Uses .00035 condenser. Coils are uniformly air spaced. No dope is used. Consequently, they tune into resonance on a "knife's edge."

FREE with each Kit

Eight page color circuit, layout and instruction sheet for building the super-sensitive 5 tube Aerodyne Receiver packed with each kit. Extra copies, 75e each. Instructions include insert showing how to wire up for a power tube if desired.

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Have you changed it lately?

A few people realize what a remarkable improvement they can secure in tone quality by occasionally changing the Resistors in their sets.

Remember that the characteristics of tubes and batteries constantly change. Even when you replace old tubes with new ones there is always a variance.

Most internal Receiver noises are not from faulty tubes, "B" batteries or loose connections, but are purely the result of unstable grid Resistors.

Wise radio owners keep several extra Durham Resistors of various ranges from 1 to 6 megohms, on hand and occasionally change them to meet varying conditions. Try it yourself and note the immediate improvement in tone quality.

(500 Ohms to 10 Megohms)

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Non-Magnetic Ship May Again Cruise Ocean

Will the most unique craft in the world put to sea again after resting at its moorings for five years?

Proposed cruises for the Carnegie, the non-magnetic ship of the Carnegie Institution of Washington, were recently announced by Captain J. P. Ault.

The Carnegie is a two mast hermaphrodite brig in the construction of which iron has been reduced to a minimum.

Above is shown the new Strongson self shielded copper plated tube recently marketed by the Moulded Products Corporation. A section of the copper coating is shown laid back. This tube was designed for use in radio sets where tube coupling effects are bothersome. The shielding is connected to the negative terminal of the socket so the tube's coating remains at ground potential.

Plane Excels Insects In Wing Support

That man excels some of Nature's creatures in keeping himself aloft in the air by the use of wings is the flattering result of recent tests carried out in France by M. P. Portier and Mille. de Rorthays. Modern airplanes support weights of from two to four pounds on each square foot of their wing surfaces; some of them even more. For comparison with these figures the French experimenters measured the wing areas of twenty-three kinds of insects and determined the weights supported by these wing areas. The record holder among the insects proved to be a variety of carpenter bee, whose wings supported a weight of a little over six-tenths of a pound per square foot, less than half as much as the poorest modern airplane. Many of the butterflies and other insects with large wings made much poorer showings, being able to support only a twentieth of a pound or even less for each square foot of wing surface. The actual wings are much less than a square foot in area, the figures being calculated to that ratio in order to compare them with the figures for airplane wings.

Please Mention Radio Age When Writing to Advertisers.
"Death Whisper" Waves Are Produced By Crystals

EFFECTS of the new "death whisper" investigated by Prof. R. W. Wood of the Jones Hopkins University and A. L. Loomis, in the latter's private laboratory at Tuxedo Park, N. Y., were described at Philadelphia before the meeting of the American Association for the Advancement of Science by Dr. Frank Thone of Science Service, Washington, D. C.

The "death whisper," Dr. Thone stated, is simply a nickname for vibrations similar to those of ordinary sound, but produced so rapidly that the human ear cannot hear them, just as the human eye cannot see ultra-violet light or X-rays. They are generated by means of electrically excited quartz crystals in a bath of oil. When a vessel of water containing a small fish or tadpole or other aquatic animal, or some kinds of water plants, is set on top of the vibrating crystal the waves are shot through the glass into the water, and there they kill the animal or plant, and frequently break down its structure so completely that it simply disappears.

While the waves cannot leave the liquid, Dr. Thone explained, they will pass through solids and will penetrate human flesh and bone, causing no pain at high intensities, but giving rise to no sensation but a feeling of warmth at low ones. At the lower intensities, however, they are still destructive to the red cells of the blood, and a mouse was once kept exposed to them until it had a bad case of artificial anemia without showing the least sign of discomfort.

The discovery of the possible uses of these inaudible sound waves was made by Prof. Wood during the War, as a result of a chance observation in the laboratory of Prof. P. Langevin at the great naval arsenal at Toulon, where the French scientist was experimenting with them in an endeavor to perfect an apparatus for the detection of submarines. (Science Service.)
Beam Radio System Finds Sunspots

OPERATION of the beam radio system between England and Canada has supplied new evidence of the effect of sunspots on radio. The beam system consists of radio transmitters which send virtually all of their emitted energy in one direction, toward the country which it is intended to reach, instead of spreading it broadcast in all directions. The radio energy forms a beam between the two stations, like the beam of a searchlight. On several occasions this winter what are called "magnetic storms," when the earth's magnetism is greatly disturbed, have accompanied weakening of the radio beams. It has long been known that these magnetic storms are related to sunspots, probably being caused by streams of electric particles shot out with enormous speeds from the great solar storms which we recognize as the spots. In a recent letter to the London scientific journal, Nature, Captain T. L. Eckersley, Chief Engineer of the British Broadcasting Company, suggests that the same electric particles are responsible for weakening the radio beams.

Windmills For Making Electricity

EXTENSION of radio to farms may have the unexpected result of assisting the use by man of one of the world's greatest idle sources of cheap power, the power of the wind. Modern radio receivers require considerable amounts of electricity, more than can be supplied conveniently or cheaply from chemical batteries. In cities and towns the radio fans make use of the ordinary current supply. Where no electric current is available, as on isolated farms, radio is under a severe handicap. Wind power, like that which was once much used in windmills for pumping water, has often been suggested to charge storage batteries for such isolated radio receivers but development has been retarded by the lack of suitable windmills and dynamos and by uncertainties about the amount of wind available. During the past two years successful wind-driven electric plants large enough for radio use or even for house lighting have been constructed in France and England. In the United States the engineers of the University of Nebraska have made similar tests. The uncertainty about the wind has now been studied by Harry G. Carter of the United States Weather Bureau station at Lincoln, Nebraska, where the university is located. A wind velocity of at least ten miles an hour is necessary for charging storage batteries and Mr. Carter finds that this velocity is available for at least five hours a day on three-fourths of the days of a year.

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Landing on Deck of the "Langley"

One of the naval airplanes about to land on the U. S. S. Langley, airplane carrier, near San Diego, Calif. Note the shielding wire screen to prevent plane from landing on lower deck. On the landing gear of the plane will be observed part of the secret apparatus used by the American navy to permit the planes to come to a full stop within the length of the deck.

Helium Is Found
In Ontario

WIDENING of the field of production of helium gas to include the Canadian province of Ontario has been recently announced. The Ontario government claims a deposit of helium gas has been discovered at Inglewood, about 40 miles from Ontario. Three wells have been taken over by the government and are being worked. Commercial development of helium gas on a large scale is expected to result in time. The discovery was made during the war but was kept a secret until recently when the wells were taken over by the government. (Science Service.)
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<td>KGZS</td>
<td>Northwest Radio Service Co.</td>
<td>Seattle, Wash. 98108</td>
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“Noise Doctors” Cure Inductive Static

(Continued from page 10)

growth in Canada. The Dominion’s radio bill exceeds $10,000,000 a year. Canada is buying radio equipment from the United States at the rate of $5,000,000 annually. Production of radio apparatus in Canada, including receiving sets, parts and batteries, reached a total of $5,548,659 in the year ending March 31, 1926.

More radio sets were sold to farmers in Western Canada this year than to any other class. Radio has developed into an important factor in land settlement. It has banished the traditional isolation of the farm. Radio keeps the new settler in constant communication with the outside world, gives him information on the latest phases of agriculture, keeps him in touch with market prices and furnishes his family with music and entertainment. Radio, automobiles, rural telephones, good roads and other modern conveniences give the prairie farmer all the comforts of the city dweller.

There are 134,699 radio receiving sets in operation in Canada, late government statistics show. There are 543 radio transmitting stations. Of these, 67 are radio-phone broadcasting stations and 356 are amateur and experimental stations, 67 are used to conduct regular telegraphic communication between points in the Dominion or with stations abroad, while the remaining 46 are operated to provide facilities for communication with an “aid to navigation” service to ships.

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The B-eliminator functions only when the set is turned on and the trickle charger is then disconnected, eliminating any hum from that source. Snapping the filament switch off disconnects the B-eliminator and connects the trickle charger to the house current.

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RADIO AGE for February, 1927
Two Tubes and Regeneration
(Continued from page 6)
switch for cutting it in and out. These connections should be made between the grid leak and condenser and the grid circuit variometer, and on the side of the jack opposite the "B" battery.
As there are three circuits to be tuned, the receiver is more difficult to operate than the single-control receivers that have gained such popularity during the past year. On the other hand, it is probable that some efficiency is sacrificed in any design that concentrates all controls in one knob and dial, and also probable that separate control of the tuning circuits gives the operator a chance to obtain more volume and distance with fewer tubes.
There are many other hook-ups employing two tubes and regeneration. Most of them can be constructed with the same parts suggested here, or with small additional expense.
A two-tube set can be made without either a detector or a tuning circuit. The man who wants to be a radio operator and see the world will be interested in this because such a set will bring in the long-wave commercial and government stations. These stations either use automatic transmitters that send so fast that there is no use trying to copy them without an automatic recording receiver, or else they send so slowly and with such perfect swing and rhythm that they give the beginner an ideal chance to practice receiving code.
In such a set, the antenna connects with the primary of an amplifying transformer capable of handling radio frequencies. See figure 1. The other terminal of the primary coil connects with a variable condenser of .001 microfarads capacity. The rotor of the condenser connects with the ground. One end of the secondary coil joins the grid of the first tube and the other end connects with the filament rheostat. The plate connects with the primary of another transformer, whose secondary is connected with the grid and filament of the second tube just as the secondary of the first transformer is connected with the first tube.
The battery connections are as usual: "B" positive to phones and plate of the second tube and to the primary of the second transformer; "B" negative to the filament terminal not connected with the rheostat, and to the positive or negative terminal of the "A" battery, whichever may be farthest from the rheostat. To secure the regenerative effect and maximum signal strength, a .001 condenser is connected between the positive terminal of the "B" battery and the antenna.

The amazing results obtained with power amplifiers is the radio sensation of the year. Perfect tone quality and the capacity to handle the full-volume of a brass band without distortion, has made power amplification the "last word" in radio.

You, too, can enjoy all these advantages even with your old set, and at a minimum cost, by building a power amplifier with Dubilier Condensers.

Dubilier Condenser Type 903, illustrated, is designed to withstand the high voltage surges which often occur in the filter circuits of power amplifiers. In fact all Dubilier Condensers are built with this high margin of safety, and with an indicated working voltage* that insures a long life in continuous operation.

Send 10c. for our booklet "Seventeen Ways to Improve Your Set." It gives the most recent information on power amplifiers, filters and battery eliminators.

*Working voltage means more than "test voltage." It is the voltage at which a condenser may be safely used in continuous operation.
Building the Hammarlund-Roberts

(Continued from page 9)

ivity throughout the broadcast spectrum. Since the trend in modern broadcast receivers is toward simplicity of tuning, the addition of variable coupling controls was not advisable. Therefore, the engineer-designers of the Hammarlund-Roberts developed a radio frequency transformer in which the coupling between the primary and secondary coils is automatically varied by the rotation of its associated tuning condenser. This variation in coupling is smooth and continuous and is accomplished by means of a cam on the variable condenser shaft. At the setting of zero on the condenser dial (which tunes the transformer to a wavelength slightly below 200 meters) the coupling between primary and secondary is minimum. As the tuning dial is advanced toward 100 the coupling increases gradually until it reaches maximum when the condenser dial reads 100, at which time the circuit is tuned to a wavelength of about 560 meters. The antenna coupler is designed to make use of this same efficient principle, and in addition, the antenna coil itself is tapped and a switch provided in order to afford a further coupling variation to suit different length antennas and to provide extremely loose coupling in very congested areas.

This automatic variable coupling feature made it possible to use a comparatively large number of turns in the primaries of the radio frequency transformers. This large primary allows great energy transfer and consequent loud signals on the longer wavelengths where the coupling between primary and secondary is closest.

HOWEVER, this large primary and close coupling would be totally unsuitable at the shorter wavelengths. This difficulty is overcome by automatically loosening the coupling as the receiver is tuned to the shorter wavelengths, thereby maintaining a high degree of selectivity without sacrificing signal strength. This is due to the fact that the same amount of energy transfer can be obtained with looser coupling at short wavelengths than at long wavelengths. Thus the Hi-Q receiver provides great signal strength and a high degree of selectivity throughout. (See diagram on page 8.)

In most so-called "self-balanced" circuits elimination of the tendency to oscillate has been attained at the sacrifice of efficiency. A method often used is to design the coils in such a way that the losses in the coils introduce enough resistance to prevent oscillation. This method is of course detrimental to efficiency. Some others make use of very low plate voltages in the radio frequency stages, thus reducing the tendency to oscillate, but again with a consequent lowering of efficiency.

In order to permit the use of more efficient stage coupling coils, equalization of disturbing potentials has been incorporated in this circuit, thereby allowing a higher degree of amplification with consequent louder signals and greater distance getting ability, without the usual troubles caused by self-oscillation.

Both radio frequency stages are equalized utilizing the familiar Hammarlund-Roberts equalizing system.

(The second portion of this article will appear in the March issue of RADIO AGE.)

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Haliburton...Ohio City, Okla. WLAC Life & Leisure Ins. Co. Nashville, Tenn. WLAL First Christian Church Tulsa, Okla. WLAP Wm. V. Jordan...Louisville, Ky. WLBB University of Minnesota...Minneapolis, Minn. WLBA Philadelphia School of Wireless Tel...Philadelphia, Pa. WLDC D. A. Burton...Muncie, Ind. WLBW...East Peoria, Ill. WLBF E. L. Dillard...Kansas City, Mo. WLIG R. A. Gamble...Petersburg, Va. WLJH Joseph J. Lombardi...Farmingdale, N. Y. WLBI Aloysius Yare...East Wenonah, N. J. WLBJ Henry Grossman...Cleveland, Ohio. WLBI Wisconsin Dept. of Markets...Stevens Point, Wis. WLBN William Evert Hiler (Portable)...Chicago, Ill. WLBO Frederick A. Tribbe, Jr...Galesburg, Ill. WLPP Robert A. Fox...Ashland, Ohio. WLBO E. Dale Trout...Atwood, Ill. WLDK Alfred Radio Company...Bel-Ider, Ind. WLEW...North Lima, Ohio. WLIB Liberty Weekly, Inc...Elgin, Ill. WLIIT Lit Bros...Philadelphia, Pa. WIS Sears Roebuck & Co...Cirete, Ill. WLJC Lincoln Studios...Cranston, R. I. WLTS Lane Technical High School...Chicago, Ill. WLWA Bosley Radio Corp...Harrison, Ohio. WLWL William L. Joop...New York, N. Y. WLBT Harold Wendell...Crown Point, Ind. WLBU Matthew B. Greiner...Canastota, N. Y. WLBV John F. Weimer & D. A. Snick...Mansfield, Ohio. WLBW...Combination Telephone Co...Carteret, N. J. WLBX John N. Braly...Long Branch, N. J. WLBY Aimone Electric...Iron Mountain, Mich. WLBZ Thompson L. Guernsey...Dover-Foxcroft, Maine. WMBB LeRoy Joseph Beebe (Portable)...Newport, R. I. WMAQ C. B. Meredith...Casnovia, N. Y. WMAG B. C. Lassier...Hamont, N. Y. WMAK Norton Laboratories...Lockport, N. Y. WMAL M. A. Leese...Washington, D. C. WMAT Haskett Radio Station...Columbus, Ohio. WMBO Chicago Daily News...Chicago, Ill. WMAY Kingshighway Presbyterian Church...St. Louis, Mo. WMAC Mercer University...Macon, Ga. WMAR...J. S. MacMillan...Cincinatti, Ohio. WMBC Michigan Michigan Broadcasting Co...Detroit, Mich. WMFB Fleetwood Hotel Corp...Miami Beach, Fla. WMBC Moody Bible Institute...Chicago, Ill. WMBS Mack's Battery Co...Harrissburg, Pa. WMMA Commercial Pub. Co...Memphis, Tenn. WMMA Greely Sq. Hotel Co...Hoboken, N. J. WMAR Storz-Morse's Hebrew Ass'N...New York, N. Y. WMPC First Methodist Church...Lansing, Mich. WMRE Peter J. Prinz...Jamaica, N. Y. WMSS Madison Sq. Gard. Bldcst. Corp...New York, N. Y. WMVN Edward J. Malone, Jr...Newark, N. J. WNAB Shepard Stores...Boston, Mass. WNAB Shepard Stores Bravesboro, N. H. WNAD University of Oklahoma...Norma, Okla. WNAL Omaha Central High School...Omaha, Neb. WNAT Lenning Brothers Co...Philadelphia, Pa. WNAF Dakota Radio apparatus Co...Yankton, S. Dak. WNBH New Bedford Hotel...New Bedford, Mass. WNBK American Bank & Trust...Newark, N. J. WNOS Peoples Tel. & Tel. Co...Knoxville, Tenn. WNRC W. B. Nelson...Greensboro, N. C. WNRY Dept of Plants & Structures...New York, N. Y. WOAI Southern Equipment Co...San Antonio, Texas. WOAK J. D. Vaughn...Lawrenceburg, Tenn. WOAX Frankly J. Wolf...Trouton, N. Y. WOBB Longacre Eng. & Const. Co...Chicago, Ill. WOCC Orlando Broadcasting Co...Orlando, Fla. WOCT Palmer School of Chiropractic...Davenport, Iowa. WOCL A. D. Newton...Jamestown, N. Y. WODA 'Dea Temple of Music...Paterson, N. J. WODA Iowa State College...Ames, Iowa. WOK Neutrounnder Radio Mfg. Co...Homwood, Ill. WOKO Harold E. Smith...Pecksil, N. Y. WOKT Titus-Ens Corporation...Rochester, N. Y. WOMT Mido Radio Theater...Manitowoc, Wis. WOON John Wanaaker...Philadelphia, Pa. WOOG Grand Rapids Radio Co...Fennville, Mich. WOOG Unity School...Kansas City, Mo. WOL W. Bamberger and Co...Newark, N. J. WOPE People's Pulpit Assn...Batavia, Ill. WOS State Market Bureau...Jefferson City, Mo. WOSW...W. M. Goodman of the World...Omaha, Neb. WOWO Main & Market Co...Fort Wayne, Ind. WPAB Radio Corp. of Virginia...Norfolk, Va. WPEN N. D. Ag. College...Agricultural College, N. D. WPAP (See WQAO)...Chiifside, N. J. WPGS North Shore Cong. Church...Chicago, Ill. WPXO Contours Radio Co...New York, N. Y. WPDR H. L. Turner...Buffalo, N. Y. WPFE The Radio Club (Inc.)...La Porte, Ind. WPHE Maurice Mayer...Waukegan, Ill. WPIC The Municipality of Atlantic City...Atlantic City, N. J. WPRC Wilson Printing & Radio Co...Harrisburg, Pa. WPSC Pennsylvania State College...State College, Pa. WPSC Horace A. Beale, Jr...Hermansville, Mich. WQAE...Skeens-Town, Springfield, Va. WQAM Electrical Equipment Co...Miami, Fla. WQAN Scranton Times...Scranton, Pa. WQAO Calvary Baptist Church...Chiifside, N. J. WQJJ Calumet Rainbow Broadcasting Co...Chicago, Ill. WQMF The Radio Club (Inc.)...Chicago, Ill. WRAW The Radio Club (Inc.)...La Porte, Ind. WRAI S. N. Read...Harrison, Ohio. WRAK Economy Light Co...Escaraba, Mich. WRAM Lombard College...Galesburg, Ill. WRYA Antioch College...Yellow Springs, Ohio 263 WRAY Avenue Radio & Electric Shop...Reading, Pa. WRAE...Springfield, Ill. WRBC...Ralph L. Lutz, Chicago, Ill. WRBC Immuehane Lutheran Church...Valparaiso, Ind. WRG Radio Corp. of America...Washington, D. C. WRGO Wayne Radio Co...Raleigh, N. C. WREG Wooten's Radio Shop...Coldwater, Miss. WREG...Reo Motor Car Co...Lansing, Mich. WRES H. L. Simpson...Walton, Mass. WRFH Wash. Hospital Fund...Washington, D. C. WRMH Rosedale Hospital...Minneapolis, Minn. WRK Doran Bros...Hamilton, Ohio. WRM University of Illinois...Urbana, Ill. WRMU A. H. Grebe & Co., Inc...Motor Yacht "MU-1" WRYN Experimenter Publishing Co...Coeur d'Alene, Idaho 274 WRYW Wray Industries...Dallas, Texas 246 WRRS Racine Radiio Corp...Racine, Wis. 304 WRSW The Radio Show...Chicago, Mass. 270 WRSW Radiodial Mfg. Co...Bay Shore, N. Y.
Improving and Adapting the Resistance Coupled Amplifier to the “B” Eliminator

By WILLIAM H. FINE

THOSE who have experimented with resistance coupled amplifiers are fully aware of the usual difficulty encountered in determining the most efficient values to use in both the plate and grid circuits. While it is generally recognized that resistance coupled audio amplification preserves the original purity of the incoming wave to a more pronounced degree than any other present known method, still, the final output remains more or less distorted, due primarily to the fact that ordinary fixed resistors cannot be made to take care of that small fractional part of resistance which would undoubtedly afford greater clarity and more perfect fidelity of reproduction.

Another annoying and really serious problem which has but recently been brought forcibly to the attention of resistance coupled enthusiasts, is the continuous “putting” or “motor-boating” as it is more commonly termed, which manifests itself to varying degrees of intensity when “B” eliminators are connected to this type of amplifier.

These plodding sounds, which generally rise to such intensity as to drown out the incoming signals, are caused by low frequency audio oscillations.

The information given in this article is the result of extensive laboratory experiments and not only solves the “motor-boating” problem but sets forth the use of variable resistances in a manner which tends to lift resistance coupled amplification up to a still higher plane of excellence.

In the plate circuit R-1, is a fixed resistor with a value of .75 megarohms; R-2, .5 megarohms and R-3 .5 megarohms.

In the grid circuit, R-4 is a resistance variable up to 500,000 ohms; R-5, a resistance variable up to 250,000 ohms and R-6, a resistance variable up to 100,000 ohms. If a power tube is used in the last stage a resistance variable up to 500,000 ohms was found to give maximum results.

It might not be amiss at this time to impress upon the reader the fact that the resistance in the grid circuit of the last tube is the one that actually governs the final tone quality of the receiver and therefore, only by employing a highly dependable make of variable resistor can the proper value be determined which will assure both clear reception.

The isolating condensers, C-1, C-2, and C-3, have a capacity of at least 1 Mfd. Condensers C-4, C-5 and C-6 are of the small by-pass type and are low in capacity, about .00025 Mfd. These by-pass condensers keep the radio frequency currents out of the resistors in the plate circuits and were found absolutely necessary for best results. It was found better practice to connect these by-pass condensers to minus A as they will then by-pass the batteries as well as the resistors themselves.

To eliminate all semblance of the aforementioned “putting” or “motor-boating,” it was found advisable to shunt a variable resistance across the isolating condensers C-2, coupling the first and second stages. This resistance is shown in the illustration as R-7 and should be variable up to approximately 5,000,000 ohms.

Last but not least, when building a resistance coupled amplifier, as well as any other piece of radio apparatus, it is well to bear in mind the fact that the final results of your labors depend entirely upon your own workmanship and the quality of the parts used. This is particularly true in the selection of the isolating condensers, and the resistances, especially the variable types. Metalized fixed resistors are recommended for the plate circuits because their values do not readily change. Centralab variable resistances were selected by the writer for use in his set.
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**Dominion of Canada**

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<td>CNRR</td>
<td>Canadian National Railways, Regina, Sask.</td>
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<td>CNRS</td>
<td>Canadian National Railways, Saskatoon, Sask.</td>
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<td>CNKT</td>
<td>Canadian National Railways, Toronto, Ont.</td>
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<tr>
<td>CNRV</td>
<td>Canadian National Railways, Vancouver, B. C.</td>
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<tr>
<td>CNRW</td>
<td>Canadian National Railways, Winnipeg, Man.</td>
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**Republic of Mexico**

<table>
<thead>
<tr>
<th>Call Letters</th>
<th>City, State</th>
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<tbody>
<tr>
<td>CYB</td>
<td>Mexico City, Mexico</td>
</tr>
<tr>
<td>GYL</td>
<td>Mexico City, Mexico</td>
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<tr>
<td>CZE</td>
<td>Mexico City, Mexico</td>
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**Republic of Cuba**

<table>
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<tr>
<th>Call Letters</th>
<th>City, State</th>
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<tbody>
<tr>
<td>PWX</td>
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<tr>
<td>2BY</td>
<td>Havana, Cuba</td>
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<tr>
<td>20K</td>
<td>Havana, Cuba</td>
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<tr>
<td>20L</td>
<td>Havana, Cuba</td>
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<td>5FW</td>
<td>Havana, Cuba</td>
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<td>5DW</td>
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<td>6Y</td>
<td>Havana, Cuba</td>
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<tr>
<td>6JK</td>
<td>Havana, Cuba</td>
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**Great Britain**

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<th>Call Letters</th>
<th>City, State</th>
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<tbody>
<tr>
<td>2LO</td>
<td>London, England</td>
</tr>
<tr>
<td>5XX</td>
<td>Daventry, England</td>
</tr>
<tr>
<td>5Y</td>
<td>Birmingham, England</td>
</tr>
<tr>
<td>5W</td>
<td>Cardiff, Wales</td>
</tr>
<tr>
<td>2BE</td>
<td>Bournemouth, England</td>
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**France**

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<tr>
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<tr>
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**Short Wave Phone Broadcasting**

<table>
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<tbody>
<tr>
<td>2ZX</td>
<td>Schenectady, N. Y.*</td>
</tr>
<tr>
<td>2XAF</td>
<td>Schenectady, N. Y.*</td>
</tr>
</tbody>
</table>
government, has apparently not stopped the stream of new licenses, over fifty changes being made in our present broadcast list in the form of additions to the broadcasting ranks.

Readers who are concerned with at least a semblance of order in the air (instead of the nightly chorus of heterodyne squalls caused by a multiplicity of broadcasters each picking their own channel) should write their senator or congressman and demand action that will make their pastime a pleasure instead of a nightmare.

An interim report on radio legislation by the Air Committee of the American Bar Association has recently been published, its chief feature being the suggestion that excess stations be deleted from the list and just compensation to their owners made from a tax levied upon the remaining station owners.

Chester W. Cuthel, of New York, chairman of the air committee advances the opinion the problem will be worked out only by a slow and expensive litigation even if no legislation is forthcoming. The reason advanced for the suggestions in the committee's report is that by their adoption will follow greater justification for full regulation of broadcasting.

F R E E - 1 6 4 - P A G E R A D I O G U I D E

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The new 1927 Barawik Guide for fan and set builder, the big 164-page book that hundreds of thousands of radio enthusiasts turn to when they want the latest and best in radio, is now ready for you. It's the handiest and most reliable radio reference guide you could ask for, and a big money-saver besides. Keep up to date by utilizing Barawik service. It will help you to solve many a radio problem as well as saving you tremendous sums on the very things you need and use most.
The latest 1927 Radio Catalog and Guide is helpful of the best approved standard radio sets, parts, and kits, at savings that will appeal to the thrifty. Profusely illustrated with reliable, guaranteed goods at a real saving. Be sure to get your copy before you spend another cent on radio.

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You need this book before you spend another cent on radio. Just mail the coupon and free copy will be sent you. Also please include name of a friend interested in radio to whom we can send free copy.

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540-544 Monroe Street
CHICAGO, U. S. A.

MAIL THIS COUPON NOW—FOR FREE COPY!

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ADDRESS
FRIEND
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If you have anything to buy or sell don't overlook RADIOAGE's classified advertisements.

The classified advertising rates are but five cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, making rate of 4 1-2, 4 and 3 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the March issue must be sent in by January 25.

AGENTS WANTED

AGENTS: Make $8 to $15 daily. Write Rose Polish, 500 North State St., Chicago. Offer full size sample and offer white rose distributors. Box 2511, Minneapolis, Tenn.

WANTED, AN ACTIVE MAN TO TAKE ORDERS for fifty dry goods, berry house, everything. Sugaring traps and rags. Liberal commission. Free replacement. Sales instructions and outfit free. Sign Sherman Nursery Company, attention Mr. Smith, Charleston City, S.C.

NAN in town to place auto parts, windows, fixtures, radios, mirrors, refrains, books, etc., of new, used, or exchange. Cash required, no sales for cash. Write today.

GENTS: Send $4.00. Money order, cashier's check, or U.S. Postage Stamp, care Rosemount, Ill; 135, E. 28th Street, N. Y. V.

HELP WANTED

SET BUILDERS! We furnish jobs for you. (No fee) connected men wanted today in every community to build LC-27 and Hammond-Hobart sets. Big money for you if you can qualify. Refine now in painting, plastering, fixtures, furniture. Reference, Alien-Hogers, Inc., 118 W. 28th Street, New York, N. Y.

PERSONAL

LOVELY HEARTS: Exchange letters; make interesting friends in my club. Particulatly favors Evan Mears, Box 604, Universal Telephone, Chicago, Illinois. Remedies give you results or money refunded. Square deals. Write PROF. GUIH, BOX R-16, HUNTINGTON, IND.

AMERICAN ACCESSORIES

FREE CIRCULAR—INSTANT COLD WEATHER stories. Please send Recent and Stir owners—P. O. Box 1575-E, Denver, Colorado.

BOOKS AND MAGAZINES

FREE—Two big New Magazines and information worth hundreds of dollars to you. Essential to stamp, sales manager, Box 744-B, Butler, Ohio, Wisconsin.


Twentieth Century Book of Receipts, Formulas and Processes, an 807 cloth bound volume containing 16,000 proven formulas for the manufacturer, workshop, laboratory, office and home. Send prepaid with receipt $4.00. Send stamp for our 40 more catalog of interest and cost practical, scientific, mechanical and industrial books. Midland Products Co., Dept. R.A., 324 Courtland Ave., Park Ridge, Ill.

BUSINESS OPPORTUNITIES


Draught Art. Order 10 cents.

SEND FREE if interested in business. Bananas bear a full crop every year. $5.00 monthly will plant an acre which should pay 100 per cent annually. Reliable Companies will cultivate and market your bananas for you. Bananas ripe every day and you get your check every 60 days. For particulars address Planting Development Company, Empire Building, Block 150, Pittsburgh, Pennsylvania.

CODE

DO YOU WANT TO MEMOLOGIZE THE WIRELESS TELEGRAPH CODE? THE CORYDON SIRYCODE CODE METHOD IS EASIEST. QUICKER. PATENTED. Send 10c for complete method to Corydon Snyder. 3220 Racevont Avenue, Chicago, Illinois.

COLLECTIONS


DOGS

BEAUTIFUL REGISTERED BULL PUPS $15, Bull Dogs, 331 Packard, Dallas, Texas.

MISCELLANEOUS

FOR SALE: WATCHMAKER'S LATHE at a bargain. R. Jangnoff, 8315 Eustis Ave., St. Louis, Missouri.

Radio Age Classified Ads Bring Results

Please mention Radio Age when writing to advertisers.

Radio Age Classified Ads Bring Results

Please mention Radio Age when writing to advertisers.
CROSLEY
1927 RADIOS

Each set giving the utmost in radio enjoyment at its price. All prices slightly higher West of the Rocky Mountains. All prices without accessories.

The 3.50—$50

Enthusiastic users report amazing performance—uses distinguishable stations loud, clear and steady, even the weakest signal is heard. Price station letter in from every town. Crosley "Crescendor" and "Acuminators" increase reception volume on distant stations and bring in programs entirely missed and passed by on ordinary non-oscillating control radios. Console model shown. 4 tubes. Price: $27.00. Cabinates are skillfully built into the cabinet in a manner which is both an artistic and emotional triumph. Ample space for batteries and accessories.

The 5.75 Console—$75

This set includes ideas for radio reception perfection not found in any other radio. Marvelous exclusive Crosley "Crescendor" and "Acuminators" increase reception volume on distant stations and bring in programs entirely missed and passed by on ordinary non-oscillating control radios. Console model shown. 4 tubes. Included: 4 tubes, four-tube console cabinet, and all accessories: 40 inch mahogany, 30 1/2 inches wide.

"4 Tube RFL-90" Console, $30

Introducing the double drum station selector! Crosley's multi-tube-oscillating perfection in a single, compact radio set. Includes Mou- cine, skillfully built into our exclusive console mahogany cabinet of consistent finish to match finest surroundings. Shown for battery and all accessories: 40 inch mahogany, 30 1/2 inches wide.

The CROSLEY MUSICONE

For 1927.—This is our largest selling look radio, and our market leader. The price, $50.00. The secret lies in the construction, which is all added solid wood, mahogany sides, and back. These are all built with expert craftsmanship by Crosley in the Normal and in the Mahogany. The price is $50.00. The set will give you the results of 100 dollar sets and can be seen in every Crosley outlet.

CROSLEY 1027 FEATURES

Many exclusive others found only in highest priced units.

UNPRECEDED.

When, on ordinary radios, ever weak strain to catch a station miles away, turn the Crescendor on Crosley and instantly swells reception to room filling volume. An exclusive Crosley feature.

All-Metal-Shielded Chassis

This truly great radio features an exclusive Crosley arm, which furnishes a substantial frame for mounting elements, prevents dirty elements, shields the units from each other, prevents interferences, improves the stability of the circuit, increases selectivity and saves costs by standardizing this feature of manufacture. The SINGLE-DRUM TUNING SELECTOR. Nothing in radios equals the ease of tuning and selection of station control. Crosley single drum control enables you to find the station you wish without log book or "tuning.""THE ACUMINATORS" Crossley Acuminators permit tuning so loud and clear—weak stations pass over and entire range passed by ordinary single drum radios. This feature typifies Crosley's provision for best radio reception at moderate cost.

Single Drum Control

$50.00

Write Dept. 63 for Catalog

The Crosley Radio Corporation
Powell Crosley, Jr., Pres.
CINCINNATI, OHIO

Crosley sets are licensed under Armstrong U. S. Patent Nos. 1,113,149. or under patent applications of Radio Frequency Laboratories, Inc., and other patents issued and pending.

"as long as I can pick up 27 programs in 30 minutes beside our 3 locals interference won't bother me

I sat down the other night with this Crosley set. One control. Beginning at one end of the broadcasting wabe band, I tuned in 17 stations, loud and clear, just like the Cincinnati stations, three of which were going full blast. I listened to each program; identified it; didn't hear any others in the background, and passed on to the next,—all with one finger. It was between 7:00 and 7:30 P. M. Central Standard Time.

The air was certainly full. Some of the stations were less than a dial marking apart. It is amazing how the jiggers they call "acuminators" helped on such fine separation.

Even using a hundred foot aerial the local stations were easy to go through. One of them only a few blocks from my home.

Some radio, I call it! $50.00 seems too little. I'd like to see some two hundred dollar sets do as well!"

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"The soul of music slumbers in the shell
Till waked and kindled by the master's spell."
(Samuel Rogers — "Human Life").

WITHIN your set slumbers a world of music which you can charm to a living fullness and richness of tone by installing Thordarson Amplification.

The manufacturers of leading quality receivers have recognized in Thordarson Amplifying Transformers a fidelity of musical reproduction which removes the ordinary artificial tones of radio and replaces them with living harmonies.

Whether you are buying a complete receiver, or whether you are building your own—if you enjoy music—be sure that your transformers are Thordarsons.

THORDARSON
RADIO TRANSFORMERS
Supreme in Musical Performance!

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.
"MEN! Here’s the ‘dope’ you’ve been looking for—
HOW TO GET INTO THE RADIO BUSINESS"

Many Earn
$50 to $250 a Week
in Work That is
Almost Romance

If you’re earning a penny less than $50 a week, clip coupon now for FREE BOOK! New book, profusely illustrated, tells all about the Radio Profession, thousands of opportunities—in work that is almost romance! You can learn quickly and easily at home, through our tested, improved methods, to take advantage of these great opportunities! Why go along at $25 or $35 or $45 a week, when you can pleasantly and in a short time learn to be a Radio Expert, capable of holding the big pay jobs—many men in Radio now earn $50 to $250 a week.

Clip Coupon for Free Book
Don’t envy the other fellow who’s pulling down the big cash. Our proven home-study training methods make it possible for you, too, to get ready for a better job to earn enough money so you can enjoy the good things of life. Most amazing book ever written on Radio tells how—thousands of interesting facts about this great field, and how we can prepare you, quickly and easily in your spare time at home, to step into a big-pay Radio job. You can do what thousands of others have done through our training. GET THIS NEW FREE BOOK. SEND COUPON TODAY.

J. E. SMITH, President
NATIONAL RADIO INSTITUTE
WASHINGTON, D. C.
Dept. C-91

NOW!
Special Short Time Offer
6 BIG OUTLINES

Radio Needs Trained Men

Dear Mr. Smith,
Without obligating me in any way, send me your FREE BOOK, “Rich Rewards in Radio,” and all information about your practical, home-study, Radio Course.

Name_________________________Age_________________________
Address____________________________________________________
Town_________________________State_________________________

SEND THIS COUPON TODAY

Please Mention Radio Age When Writing to Advertisers.
Current Science

Radio Age

Everyday Mechanics

Established March, 1922

Volume 6 March, 1927 Number 3

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PACIFIC COAST REPRESENTATIVE
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CONGER & MOODY, Higgins Bldg., Los Angeles, Calif.

Final Advertising forms close on the 20th of the 2nd month preceding date of issue

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Chats With the Editor

CLIMAXING their work on superheterodynes our staff is presenting in this issue's blueprint section the Ideal Model of the Worlds Record super which has been built for operation in connection with power supply and filament battery elimination. Quality has been stressed, at the same time preserving the distance getting features of this receiver. For those who have followed this series the present article should be of more than ordinary interest.

Scientific articles and notes on everyday mechanics are attracting the attention of our readers and quite a few letters of commendation have been received by the editors. We are always glad to know the desires of our readers and to fill these requirements to the best of our ability.

Armstrong Perry has been taking the novice by the hand, helping him along the rocky road of radio to a point where a four-tube set used with a loop is described. What Mr. Perry has in mind for his next article we cannot imagine, but we know it will be good and our newly-made radio fans will devour it with interest and approbation.

What is known as the pioneer broadcasting station in the world is being described by Dorothy Brister Stafford who has been a regular contributor to this magazine. Her sprightly comments on broadcast stations have been relished as much by our readers as by our editors.

Those who have been engaged in building the well-known Hammarlund-Roberts receiver will find the second installment of the article by Mr. Biles quite complete in details. The various diagrams were printed in the first article which appeared in the February issue.

Quite often we receive a letter from a fan who is not able to purchase a high-priced eliminator and who wishes to make as much of the required material personally instead of buying it readymade. In our next issue William H. Fine tells how to make a simple and inexpensive B eliminator, which will deliver sufficient voltage and current for almost any ordinary receiver, providing it is constructed in accordance with the instructions given.

Frederick Smith
Editor of RADIO AGE.
NEW!

Eveready Layerbilt “B” Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.

DIFFERENT!

For greatest economy all loud speaker sets require the new Eveready Layerbilt “B” Batteries

It will pay you, in convenience and reliability as well as in dollars and cents saved, to use this remarkable battery.

The reason for the Eveready Layerbilt’s surprising performance lies in its exclusive, patented construction. No other battery is like it. It is built in flat layers of current-producing elements, making practically a solid block. The layers make connection with each other automatically, and occupy all available space inside the battery case. Layer-building packs more active materials in a given area, and makes those materials produce more electricity.

Every loud-speaker set should use Heavy-Duty batteries, for they alone offer economy on modern receivers. When you buy new “B” batteries, be sure to get the Heavy-Duty size, and remember that the Eveready Layerbilt has proved to be the longest lasting, most economical of all Heavy-Duty batteries.

Our laboratories are continually testing batteries, and in all our tests we have yet to find a battery that is equal to the new improved and radically different Eveready Layerbilt “B” Battery No. 486. The development and perfecting of this remarkable battery is an outstanding battery-building achievement. It is the result of many years’ experience plus the facilities and resources of the pioneer manufacturers of all dry cell batteries.

NATIONAL CARBON CO., Inc.
New York San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night — 9 P.M., Eastern Standard Time, through the following stations:

wnav-New York wtan-Cleveland
wjas-Prvidence wsw-Detroit
wrei-Boston wns-Chicago
wtn-Worcester woc-Desemport
wrn-Philadelphia wco-Minneapolis
wca-Bluffalo wcc-St. Paul
wca-Pittsburgh woa-St. Louis
wsm-Cincinnati wog-Washington
wsc-Schenectady
Radio Editorials

IT IS with a good deal of pleasure that Radio Age adds several pages of fiction to the radio, current science and everyday mechanics which make this month's portion for our readers. We are sure that those who start reading this first installment of "The Froth Estate" will not miss any of the succeeding chapters. In arranging for the publication of this novel the editors have selected a story that deals with the drama that exists within the inner offices of great newspapers. It is not so much a narrative of the adventures of the star reporter and the sob-sister—those topics have been receiving liberal attention for years—but it is a stirring story about newspaper publishers, department managers and editors.

How is it that we know so little about the daily lives of the men and women behind our great journals? They deliver the gossip of the world at our doors each day but nobody has turned the tables and written humanly, understandingly and sympathetically about the big folks of "The Fourth Estate," which Col. Minimim so quaintly mispronounces.

What happens when a new daily attempts to place its newspapers on the corner stands in a great city? The next installment of "The Froth Estate" will tell about a tremendous circulation war. The army of Bill Rossom, publisher of a "confession and diary daily," is going to shoot it out with the invaders under young Daly Minimil, who believes that freedom of the press should include the privilege of circulating the newspapers which the press runs off.

Mr. Joseph Balsamo, author of the story, is sketching no portraits of publishers or editors in his story. In order to avoid any suspicion of such bad taste he has created his own characters and his own community and started them off on the way of adventure. Mr. Balsamo knows his vegetables and in opening the doors of the editorial sanctum to give his readers a peep at hidden mysteries we feel confident he will reveal incidents and events that will mingle romance and humor with sufficient brush-strokes of melodrama to compel enthusiastic interest to the very end of the tale.

What reason for including a newspaper novel in a radio magazine, it may be asked. Well, the Fortunatus Gazette is building a powerful broadcasting station. That's one reason. Another is that a good story needs no excuse for itself anywhere and gets a welcome everywhere.

IN ANNNOUNCING that it would welcome censorship of newspapers to eliminate the smutt that fills a good many daily newspapers these days the New York Daily News says editorially:

"We hate bureaucracy. We hate the suppression of free speech. But unless the minds of the children of New York are to be drenched in obscenity, it seems to us that a censorship of the press as well as of the theater, must come."

The same peril menaces many other American communities outside of New York. It is a national, not a localized, condition.

The serial story "The Froth Estate" is going to explain why editors print smut. The story is to have a back ground of humor and drama and we are confident it will entertain while it is carrying a big message to readers who perhaps will welcome the facts in this form, written by a man who knows the business of news-gathering and news printing.

ASY THE March issue of this magazine goes to press definite action is reported from Washington as to legislation controlling broadcasting stations. Sometimes we think the radio industry, in giving its attention to this most important matter of regulating the number of stations, their wave-lengths and their intervals of silence, the industry is overlooking a matter that is just as vital as the Washington situation. Those manufacturers and merchandisers of radio equipment who devoutly wish for a further stabilization of the business and a greater prosperity for it, for twelve months in the year instead of six months, may do well to remember that the best way to sell radio merchandise is to create an increasing demand for it. The best way to create that demand and maintain it is to make the broadcast programs so good that no family will want to miss what their neighbors are enthusiastically talking about. The best way to sell a radio set to a person who has been holding off is to convince him that in not owning a receiver he is absolutely robbing himself of delightful entertainment by our Josef Hoffmans, Schumann-Heinecks, John McCormacks and our Kubeliks. He should be convinced because he is depriving himself of just those delights.

It would not be a bad idea to make an improvement in the range and volume of summer entertainment. If there is a continuous line of excellent music on the air throughout the summer the radio business will begin to lose its seasonal aspect. At least it will not suffer from malnutrition for four months out of twelve. In the theater the play's the thing. In radio the program's the thing. And that means the broadcast program, not the Washington legislative program.

NO CIRCUIT ever published in Radio Age has received the enthusiastic approval of its readers that has marked the World's Record Super-Eight. Hundreds of back numbers, principally the November, 1926, and the January, 1927, issues, have been delivered through the mail to those who missed those numbers and the demand still is insistent. It will please the Radio Age followers to learn that development of this circuit will appear in future issues so that several variations of the general scheme of the hook-up may be studied. For those who are willing to invest in the higher-priced equipment the circuit published in this issue will no doubt prove immensely interesting. These various circuits are wired and tested in our own laboratory before publication.
There is a time in life when erecting an aerial is a joyous adventure, but that is before the waist line catches up with the chest measurement. As the years slip away, such stunts as climbing trees and balancing on ridgepoles cause thrills of another frequency. By that time the cost of extra tubes and fixin's is not so large a proportion of the monthly income, so the indoor loop, with amplification enough to make it effective, begins to make a strong appeal to the set builder.

A loop three feet in diameter, more or less, picks up a small amount of energy as compared with a straight aerial fifty to one hundred feet long, even when they are operated at the same height from the ground. The energy picked up decreases as the square of the distance of the aerial above the earth, so the loop loses plenty by the time it is down to the ground floor. According to the formula, it ought to pick up less than nothing in a basement, but Dr. Rogers, a famous inventor, was able to secure good results from underground loops. He found static much less troublesome when his aerial was below the surface of the earth. Some scientists account for this by saying that two groups of waves are radiated from a transmitter, one group through the earth and the other through the ether above the ground. Anyhow, a loop will bring in audible signals anywhere if the receiver has enough stages of amplification.

There is not much use of trying to use a small loop with less than four tubes, three of which are radio-frequency amplifiers, nor is it safe to count on bringing in Honolulu at Metuchen, New Jersey, even with twice that number of tubes. High-power transoceanic code stations can be brought in with a good-sized spool of wire for an aerial, but speech and music do not carry as far as dots and dashes. With a good loop and four tubes, a hundred miles is a good average, though a thousand miles may be covered often enough to make ether-fishing an interesting sport.

Easy to Build

Construction of the loop can be made easy or difficult. There are two main differences between the loop and the straight aerial: the shape, and the fact that both ends of the loop are attached to the receiver instead of one end as in the case of the straight aerial.

A simple loop can be made by running a wire around the room on the picture molding. Such a wire may be used either as a loop, with one end attached to the antenna post of the receiver and the other to the post marked “Ground,” or as a straight aerial with one end attached to the antenna post and the other end free.

Another method is to construct the loop on a closet door. The large outside turn may be fastened first, or the builder may work from the inside out. In either case, the ends should be made fast to binding posts located where they will not be knocked loose by the heads, arms, knees or feet of those who hang wearing apparel in the closet or store in it the makin's of a wet day. The damage to the anatomy will be repaired quickly by Nature, of course, but she will not do a thing for screw holes that have been splintered. They look awful, even when putted up or filled with plastic wood. From
the loop the wires may lead to the set by any convenient route, but the shorter it is the better. Long wires are likely to pick up interference from light wires and other sources.

Portable loops can be made on any available frame, such as an antique reel used by ladies of a past generation for making skeins of the yarn as it came from the spinning wheel. The frame and the loop may be square, octagonal, oval or of any desired shape. The wires should be evenly spaced and firmly held in place. The spacing makes a difference, but it requires higher mathematics to express it adequately. Anyone who, desires to go into the matter exhaustively can secure a pamphlet from the Superintendent of Documents, Government Printing Office, Washington, D. C. The reader will be exhausted before the subject is. A practical loop for this set is one three feet square, with ten turns of insulated wire spaced one-half inch between turns. Insulated wire should be used always in making loop aerials. Taps may be taken off at any point if variability is desired.

The loop has other advantages besides its small size and its convenience. It has directional effects. The electro-magnetic field that forms a part of the advancing radio wave has a greater effect upon an aerial wire that is at right angles to its plane than it has upon one whose plane is parallel to that of the field. There are radio waves coming toward a receiver from all directions, and as the loop is turned on its axis one station fades out and another comes in. If wife is wise, she can tune out the prize fight and bring in the Sunday School lesson merely by adjusting the door on which the loop is constructed when she goes to the closet to get hubby’s slippers.

Taking a diagram from a radio catalogue—and that is a safe place to take it from if the dealer has been in business for five years or more without being murdered—we find that one end of the loop connects directly with the grid of the first radio-frequency amplifier tube. The other end leads to the middle point of a potentiometer, where there is a slider or some other variable connection. Across the two terminals of the loop is shunted a variable condenser of .0005 microfarads capacity.

One end of the potentiometer is connected to all four of the filament rheostats, the secondary coil of the third amplifying transformer, the negative terminal of the “B” battery, and the positive terminal of the “A” battery. This potentiometer is a necessary part of most radio-frequency amplifier circuits. It steadies the action of the tubes and helps to prevent howling. The other end of it connects with the filament terminals that are not connected with the filament rheostats.

The plate of the first tube connects with the primary coil of the first radio-frequency transformer. The other end of the primary connects with the primaries of the two other amplifying transformers and the connecting wire goes on to the positive terminal of the “B” battery.

The secondary of the first transformer, and also the secondary of the second transfor-

mer, are connected to the slider, or other variable contact, in the middle of the potentiometer, and also to that end of the loop which does not lead to the grid of the first tube.

The secondary of the third transformer goes to a combination grid leak and condenser, which is installed between the secondary and the grid of the detector tube. The grid leak should be variable, providing from one-half to six or more megohms of resistance. The condenser is of .00025 microfarads capacity. The other end of the secondary connects with that wire from the potentiometer which, as stated above, connects with all of the filament rheostats. It is possible, of course, to use one rheostat for all the filaments, but it is desirable to have at least two—one for the amplifier tubes and the other for the detector tube.

This completes the hook-up except for the phones, which are connected with the plate of the detector tube and with one of the positive terminals of the “B” battery. This battery should deliver 45 volts, but the phone connection should be shifted from one positive terminal to another until the results of the different available voltages are determined.

**Aerial or Loop**

THIS receiver should work as well with a straight antenna as with a loop, although the directional effect of the loop will be lost by the change. Radio-frequency receivers are likely to be sensitive, and a short antenna may give better results than a long one. Anything from twenty-five feet up, or down, may be tried and experiments will lead to some interesting comparisons. A ground wire is connected to one of the terminals left vacant by the removal of the loop.

It is well to remember, when building a radio-frequency receiver, that it is very sensitive to interference of all kinds. Energy may be transferred from one coil to another although it was farthest from the thoughts of the builder to permit any such interaction. The transformer

(Continued on page 36)
Building the Hammarlund-Roberts

(Part Two)

By LESLIE G. BILES

IT WILL be well for the builder to observe closely the system employed in assembling and wiring. Usually it is the custom to assemble the entire receiver and then do all the wiring. Here the assembly is done jointly with the wiring. This tends toward ease of building because the hand is not hindered by the obstruction of parts not yet in place. The section method of building up the shield makes it possible to wire easily the parts which will later be completely enclosed by the shield.

The first step in the construction of the receiver is to attach the front panel to the baseboard and mount the panel instruments as shown in the picture diagram.

Now mount tuning condenser No. 1 with its small shield. The single hole mounting nuts on this and the other tuning condensers are not used and may be discarded.

After removing the mounting nuts and the short shafts from the remaining two condensers, mount one of them, first placing shield section No. 1A between the condenser and the panel.

Loosen the screws in the friction brakes of all condensers.

Now slide the two aluminum strips of the foundation unit in place, taking care to place them in their correct positions. Then slide shield section 1E on top of these strips and under the lip of the panel shield section so that the holes in the lip of the panel shield, the bottom shield and the strips line up.

Socket No. 2 should then be screwed in place and socket No. 1 is fastened to the baseboard in line with socket No. 2.

Now loosen the two set screws in the rotor of the first tuning condenser, slide the shaft back so that \( \frac{3}{4} \)" projects beyond the rear bearing and then retighten the rotor set screws. Mount one of the Auto-Couple coil cams on the projecting shaft so that the set screw in the cam is exactly on top (looking down on the set) when the plates of the condensers are all the way in.

Before mounting the coils on their condensers remove the long adjusting screws in the square brass posts at the primary end of the coils because they will be extremely difficult to remove when the assembly is completed.

After removing these screws mount the coils on the two condensers as shown, using the brackets and screws packed with the coils.

The cams on tuning condensers No. 2 and No. 3 are not yet to be mounted but the same mounting instructions given above will later apply to these two condensers.

The assembly is now ready for the first part of the wiring.

Use the special wire solder in the foundation unit and a light iron which should first be cleaned and properly tinned.

Be extremely sparing with the amount of flux used and use just enough solder to run in the joint and make a firm connection. Large gobs of solder are entirely unnecessary and only serve to make an otherwise good job look unworkmanlike. If the iron is hot enough to cause the solder to flow freely, no trouble should be experienced in making neat and permanent joints.

In wiring all leads should be run by the most direct route and no attempt should be made to secure square bends or other old fashioned ideas in wiring. Care should be taken to see that none of the wires interfere with the full motion of the condenser rotor plates moving primary coils and their cams and flexible connectors.

Now make the connections between the first coil, antenna switch, condenser and first R-F socket as shown in Fig. 4 and also in the picture diagram.

Now erect shield section No. 1-B screwing the lip of the shield to the shield strip, and fasten the corner of the two shield sections by means of one of the shield corner clamps.

Secure a soldering lug to the hole in the center of the shield, the head of the screw and the lug being on the outside.

Run a wire from this lug to upper end of soldering lug terminal R of condenser No. 1.

Now make the connections to the second R-F stage. As each wire is put in place, check the connection with the picture diagram.

Connect terminal E of coil No. 2 through the remaining hole in the shield to the unattached terminal of Equalizer No. 1.

It might be mentioned here that for convenience in wiring some wires will be cut to designated lengths and only attached at one end. When the other end of the wire is later attached the wire should be cut to the exact length required.

Solder a 6" length of wire to one end of the resistance strip in the foundation unit. Solder the other end of the resistance strip
to a soldering lug secured in place by the binding nut on terminal plus of socket No. 2.

Attach a 7" wire to terminal B of coil No. 2.
Attach an 8" wire to terminal P of socket No. 2.
Attach a 7" piece of wire to the unattached terminal of Equalizer No. 2.

Shield section 1D may now be erected, fastening it in the same manner as section 1B was fastened.

Pass the free end of the resistance strip wire through the shield hole and then attach it to terminal A of the rheostat (the terminal next to the shield).

Thread the free end of the wire attached to terminal B socket No. 2 through the remaining hole in the shield. The free end will be connected later.

Secure a soldering lug in the center hole of shield section 1D.

Attach the grid leak clips to the .00025 mfd. fixed condenser using the screws furnished with the condenser. To one of the terminals on the under part of the condenser, attach the grid condenser connecting strip. The hole in the other end of the strip slips over terminal G of socket No. 3.

Condenser No. 3 should now be mounted. Place shield sections 1C and 2A together so that the condenser mounting holes in the sections coincide. Then mount the condenser against section No. 2A using two 1/4 x 6’/32 round head screws which pass through both shield sections and hold these sections together. Erect this assembly, first placing shield section No. 2E under the lip of shield section No. 2A, taking care that the two socket holes in this section coincide with the socket fastening holes in the shield strip. Fasten the lips of the two shield sections to the shield strip and secure the corners with corner pieces.

Thread the free end of wire from terminal P socket No. 2 through shield section 1C and 2A as shown in the diagram.

Thread the free end of wire from Equalizer No. 2 through the same shield section as shown in the diagram.

Fasten socket No. 3 in place, and run a wire from the lower end of soldering lug R terminal of condenser 3 to terminal minus of socket No. 3.

Mount coil No. 3 to condenser No. 3.

Terminal F of coil No. 3 to terminal minus of socket No. 3.
The free end of wire from Equalizer No. 2 to terminal E of coil No. 3.
The free end of wire from terminal P of socket No. 2 to terminal P of coil No. 3.
The upper end of soldering lug terminal S of condenser No. 3 to terminal G of coil No. 3.
Terminal G of coil No. 3 to the free end of the grid condenser.
Attach a 7" wire to terminal plus of socket No. 3.
Attach a 4" wire to terminal P of socket No. 3.

Part One of this article by Mr. Biles appeared in the February issue of RADIO AGE. In building the set the present article refers back to the diagrams and figures shown in the preceding number.

Those who are accustomed to building receivers will be able to build from the February issue. For those who cannot work from a schematic this article gives the detailed procedure for building the set.

—Editor.

Attach a 6" wire to terminal B of coil No. 3.

Shield section No. 2B can now be erected.

Mount the midget condenser in the large hole in shield section No. 2B in the position shown. The large spacing washer in the foundation unit will be required in mounting the condenser to the shield.

Terminal S of the midget condenser to terminal G of coil No. 3.

Shield section No. 2D should now be erected.

Thread free end of wire from terminal plus of socket No. 3 through shield section 1D.

Thread free end of wire from terminal B of socket No. 3 through shield.

Thread free end of wire from terminal B of coil No. 3 through shield, using hole near the front of the shield.

This completes the wiring of the radio frequency end of the receiver. The extension shaft of the foundation unit and the two coil cams can now be put in place and adjusted as follows:

Push the shaft through condenser No. 2 and then thread on one of the coil cams with the knob of the cam toward the front panel. Continue the shaft through condenser No. 3 until 3/8" of the shaft projects beyond the rear bearing of the condenser. Then turn the movable plates of the two condensers until a position is reached where the set screws in the rotors of the condenser can be reached with a screw driver. Tighten one screw in each rotor slightly and then by means of the shaft turn the plates entirely out of mesh and gently force the rotor sections of the two condensers into line by pressing them up against their respective stops. Then by means of the shaft turn the rotors so that the set screws may again be reached and all screws tightened securely, making sure that the rotors of the condensers have not shifted out of line.

If the condenser shaft turns very stiffly this can be remedied by lining up the condensers properly. One method of doing this is to loosen the screws holding the shields to the shield strips and turn the condenser shaft back and forth several times, at the same time moving back and forth the shield sections supporting condenser No. 3 until a spot is found where the condenser turns most freely. Hold the shield firmly in this position and retighten all screws in the shield mounting strips.

The cams for coils No. 2 and No. 3 should then be adjusted to their proper positions.

Shield section No. 2C may now be erected and work started on the audio amplifier unit.

Mount the ten binding posts on the side of the sub-panel having two countersunk holes. Between the A Batt plus binding post and the top of the panel place a soldering lug.

Next the three amperites are mounted, first removing the screws and nuts from the amperite mounting strips and substituting the six 5/8"x4'36 round head screws provided in the
foundation unit. These screws should be passed through the amperite clip and the amperite base strip and secured under the sub-panel by a nut under which is placed a soldering lug.

Sockets No. 4 and 5 (without bases) are now to be mounted. To mount them it is necessary to take them apart by removing the screw in the bottom part of the socket and pulling the two halves apart. The half with the springs is pushed up through the large hole in the sub-panel and then the top half replaced so that the pin in the top section fits in the slot in the bottom section. The screw holding the halves together should then be replaced.

A soldering lug should be placed under the heads of the P terminal and the minus terminal screws of socket No. 5.

Next secure a soldering lug on the top side of the sub-panel directly in front of amperite No. 3. A soldering lug is also placed on the under side of the panel and held in place by the nut. Then similarly attach soldering lugs to the hole on the edge of the panel near socket No. 4.

Now remove the screws from the .001 mfd., fixed condenser and fasten it to the under side of the sub-panel. Soldering lugs should then be attached to each terminal of the condenser.

The transformers are then mounted with their terminals in the positions shown in the diagram.

All of the wiring now to be done takes place on the under side of the sub-panel. These connections are clearly indicated on the picture diagram by broken lines. The connections represented by solid lines are not to be made until after the audio amplifier unit has been mounted in place.

When these connections have been made the audio unit which is ready to be mounted on the baseboard, and then the radio frequency and audio frequency ends of the receiver are to be hooked up.

End of wire from P of socket No. 3 to P of transformer No. 1.
End of wire from "plus" of socket No. 3 to "B" of amperite No. 1.

Free end of wire from "B" of coil No. 3 to lug "B" on sub-panel.
Free end of wire from terminal B of coil No. 2 to soldering lug B on sub-panel.
The soldering lug on shield section No. 1D to the soldering lug on the minus terminal of socket No. 5.
The soldering lug on the P terminal of socket No. 5 to the P terminal of the jack.
Terminal B of jack to 135 V plus binding post.
Soldering lug on A plus binding post to terminal B of switch (the outer terminal).
Terminal C of switch (near front panel) to soldering lug A on sub-panel.

Checking Your Work

With assembly and wiring completed the builder will do well to follow a systematic course of testing, for even the most careful workman sometimes makes mistakes and a slight error in wiring may cause considerable damage. The following procedure is therefore recommended:

Connect the plus terminal of the A battery to the binding post marked A Bat plus. Then touch the wire from the minus side of the A battery to the metal part of the A Bat-binding post (the tubes are not yet in the set). If a spark occurs it indicates an error in the filament wiring, entire filament circuit should be checked until the mistake is found and corrected.

If no spark occurs make the connection to the A Bat-binding post and turn the combination volume control-filament switch in a counter-clockwise direction as far as it will go. The switch is now off. All five tubes should be placed in their sockets but one should light.

With the volume control full on and with all the tubes in their sockets, remove the wire from the A Bat-binding post and connect it to the plus terminal of a voltmeter. Connect one end of another wire to the minus terminal of the voltmeter and touch the other end of this wire to each of the two C Bat-posts and the 45 V, 67 V, 90 V and 135 V posts. In no case should there be any movement of the voltmeter needle. If any movement should occur the circuit on which it occurs should be traced and the error corrected.

After completing the above tests replace the plus A wire on the A Bat plus binding post and turn the volume control to the "off" position.

You are now ready to connect the "B" and "C" batteries. First connect the "C" batteries and then the "B" batteries.

Final Adjustment

After completing the connections to all batteries the antenna should be attached to the middle post of the antenna switch and the ground wire should be connected directly to the minus terminal of the "A" battery. Now plug in the loud speaker and the receiver is ready to operate.

Turn the volume control in a clockwise direction as far as it will go and slowly turn the two tuning dials simultaneously, keeping both at approximately the same settings. As soon as a station is heard, turn back the volume control until the signal becomes barely audible. Then adjust each tuning dial separately for loudest signal and set the volume control so that the output from the loud speaker is quite soft. Now adjust the Midget condenser (on the left side of the detector stage shield) to the point where the signal is loudest. Then carefully retune the second tuning dial for loudest signal and then make a final adjustment of the midget. Once set, this midget compensating condenser should need no further attention.

We are now ready to adjust the equalizing condensers. First tune in a loud signal at about 30 on the dials. Then disconnect the wire running to the "minus" post of the first socket, leaving the tube in the socket however. Now, with a wooden stick sharpened like a screw driver, turn the screw in the center of the first equalizer until the signal is at a minimum or disappears entirely. Now replace the wire on the post of the first socket. This completes the balancing of the first

(Continued on page 32)
The FROTH

The city of Fortunatus for a decade had been a source of amazement for the rest of the country. Located in Coma, the latest state to add its starry spangle to the permanently waved banner of the republic, the city had grown from nowhere into a big time metropolis before the elder inhabitants realized it. The place awoke suddenly to the diverting discovery that it was a huge patchwork of wickedness and virtue, that it had a traffic problem, a state primary election scandal, a high birth rate, a prosecuting attorney who was a dab at politics and an equally contaminated water supply.

One of the strangest facts about the growth of Fortunatus was that the city stood as a civic contradiction of the tradition that a great town necessarily must rise from the shore of the sea, straddle the current of a mighty river or lave the municipal feet in the limpid shallows of an expansive inland sea. Fortunatus had none of these littoral advantages but it seemed certain nevertheless, that yet a few years more and it would be one of the half dozen greatest communities in the world. Situated between Maine and California and south of the Canadian border the city was the heart of a network of hard roads and took generous toll of the world's gas-driven commerce.

Col. Maximilian Minimil, the biggest man in Fortunatus, occupied the most extensive suite of offices in the tallest building in the city. Like so many other rugged trail-blazers who had started from scratch, the Colonel carried full facial foliage as standard equipment. His dark beard was grizzled and coarse but it was well kept, for he long since had given over the habit of munching fine cut. He had not eschewed tobacco for any ethical reason. He simply found that in building up the Minimil fortunes he had had no time to expectorate and anyhow, in the touch and go of the game, it was seldom safe to turn's one head away from the main source of pasteboard supplies.

Col. Minimil was fifty-five years old, hale, hearty and strong in wind and limb. He was proud of his six feet two of virile manhood and of the fact that he had not been indicted for fifteen years. His clothes, like his home and his fleet of high-powered closed cars and his office, insinuated prosperity just as the steam calliope suggests that a circus is in town. His eyes were dark brown, deep set under shaggy brows and his masterful hands were calloused and gnarled from long years of pushing away propositions that promised less than forty per centum.

His fathers came to the western world with Cortez and he traced his genealogy directly back to a romantic marriage between a Spanish officer and an Aztec princess. In his safety deposit vaults he treasured a document, uttered less than half a century after the conquest of Mexico, in which it was set out that one Montezuma Minimil, grandson of a quartermaster sergeant on the staff of Cortez himself, had bequeathed a pecan grove to the public library of Azlatzcan. This piece later began to exude crude oil and by an odd freak of circumstance agents of the present Minimil bought the land, cut down the pecan trees and turned the library building into a refinery. Not being blessed with a knowledge of his ancestral tongue Col. Minimil always spoke of this good stroke as the Ashcan Development.

"Son" said the Colonel, on the morning of October 16, 1925, "if you will tear yourself away from your other arduous duties long enough to call at my office at 5 o'clock this afternoon, you will learn something to your advantage."

Daly Sayles Minimil knew his onions. He didn't plead another engagement nor was he so foolish as to ask questions. Daly was like that because his father was like that.
At 3 o'clock the young man stepped out of an imported gas-hog at the renaissance entrance of the Minimil building. He wore a raccoon coat and no hat. In his right hand he carried a first edition of "The Constant Nymph." Turning to the military attache who occupied the driver's seat, Daly said simply: "Take Miss Sartorius to the Green Ink Club." He smiled in response to the girl's good-bye salute and hastened away.

The elder Minimil looked up from the coupons that lay in profusion on the glistening top of his mellow mahogany table-desk. It was a chilly day, but bright and clear and the sun was filtering through the mulioned windows, laying a soft tint of old gold upon the figure of the Colonel. One window, slightly open, admitted a gentle zephyr which toyed with the draperies of rose-colored French brocade, tossing them inward and upward and at intervals permitting the insistent sunshine to enter so effulgently that even the form of Miss Sadie Long, the colonel's secretary, lost some of its similarity to a mailing tube. Miss Long had been selected by the Colonel's wife. She stood, then, in a sort of matinee aurora as she said quietly to Colonel Minimil:

"Mr. Daly Minimil is here to see you."
"Why in hell doesn't he come in then?"
"Very good, sir." Miss Long had read so many books of English fiction that she talked like a butler.

"Listen, Dale, you've been talking for several years about wanting to go into the newspaper business. You're not worth a damn in my business, or any other business, so far as I have discovered. You might succeed with a daily paper. Look at that slant-head Rossum. He made good. His paper has just licked my candidate for the governorship."

"Enfield licked" exclaimed Daly. "How'd Rossum do it?"
"By supporting him."
"I don't get it," said Daly.
"Neither does Rossum. He hasn't found out yet that the people knock off any candidate his sheet indorses."
"So," mentioned Daly, "you think if I started a newspaper and supported all political candidates you opposed—"
"Correct" said the Colonel. "The people are tired of having an editor's selected list of candidates shoved under their nose. Newspaper publishers can give us the news but who gave 'em the privilege of doing our thinking for us?"
"The Gods of Olympus, maybe." Daly was thinking fast and enjoying it.
"So's your old man" said the Colonel, who always made a leap for the curb when conversation took a literary turn.
"When do we start?" inquired Daly.
"Right now."
Daly took off his raccoon coat.
"What's the appropriation?" he asked.
"Ten million dollars."
Daly sat down.

II

CONCRETE foundations for the reception of immense printing presses and the sinking of caissons had hardly begun when the people of Fortunatus acquired the habit of calling the enterprise "Minimil's Folly." The Colonel was not a bit disturbed by this pleasant and human attitude of his neighbors, enemies and friends. As marble walls went up and Corinthian colonades arose and joined the
classic facade the Colonel encouraged the builders with feverish enthusiasm.

Fortunatus drove past the imposing pile and raised an eyebrow. The population already enjoyed three morning and six afternoon dailies. Leading citizens who might have possessed some sympathetic interest in the birth pains of the new palladium were deaf to the Minimil ballyhoo. They felt they were under the cold scrutiny of seven established newspaper owners. A bird on the editorial page is worth two in the blue prints.

"We’re about as welcome as the plague in this here Froth Estate" chuckled the Colonel. "But while we are still in our corner we can be making our plans for giving ‘em hell."

"The main thing is to give ‘m a good newspaper when the time comes," laughed Daly. "You see it was Edmund Burke’s idea that the Fourth Estate involved big social responsibilities."

"Social Flapdoodle" scorned the Colonel. "A good newspaper is only another name for a sock full of buckshot."

Daly sighed. He began to realize it was going to be difficult to keep his male parent out of the hand grenade bin. The old man said nothing further but Daly with misgiving, saw the Colonel’s eyes smolder and he knew the embers of past conflicts were only awaiting the opening of the editorial damper to burst into new flame.

Late in June work had progressed to the point where it seemed advisable to call a conference of all the heads of departments. Daly had been acquiring an editorial and business staff and preliminary details were under way. Aside from Daly himself and, of course, the elder Minimil, the most important men in the personnel of the Fortunatus Gazette were Dana Greeley Franklin, editor; Elmer Shortrate, advertising director, Zenus Babbitt, business manager, and A. B. C. Burroughs, circulation director. That first conference was a solemn occasion, the forerunner of many others. The Gazette was about to balance itself uncertainly for a breath-taking instant and then take the first step as a going concern.

They assembled in Colonel Minimil’s office but for once the Colonel was contented to seat himself without the circle. He occupied a chair near a window where he could see and hear, but it was plain that Daly was the executive in charge. Daly wished the chair which he drew up to the table might have been less like a throne in a Gloria Swanson movie. He observed that Burroughs, the new circulation manager, was embarrassed at having dropped a bit of cigarette ash on the $5,000 rug. Burroughs wore a gunman cap but he knew his street corners. Mr. Shortrate was more at ease. He had been connected with a prosperous confession and diary daily and was accustomed to elegance. Mr. Babbitt was tapping a front tooth with a pencil and mentally estimating what the money spent for this regal office would bring if invested at the usual 6 per centum. Dana Greeley Franklin was furtively eyeing the Colonel, scenting an elemental foe. Miss Long sat at her own desk of quarter-sawed solid mahogany and fell to wishing that the jade green shade on the heavily elegant desk lamp were rose-tinted to match the curtains. Green was so trying on a complexion naturally inclined toward sallow.

Daly called upon Franklin for a word as to how editorial plans and policies were shaping up.

"We are almost ready," said Franklin. "We have arranged for wire news and a world-wide cable service has been contracted for. The editorial staff is almost complete. We will be prepared for the first turn on the presses on July 1."

"What are you going to do about those damned crooks who are trying to steal the R. and N. power franchise?"

Colonel Minimil boomed the question at Franklin as if he were to follow it up with a grip on the editor’s throat.

"Why" said Franklin, "I am not familiar with the situation but—"

"Pardon me, dad," interposed Daly as he saw his sire rise and prepare for action. "We will get to that in good time. What we want to do here today is to get a line on general plans and policies, not details."

"All right, Dale" the Colonel replied, subsiding into his chair, "but don’t forget what I told you about that sock."

Daly paid no heed. He turned to Shortrate and asked him if the advertising department had anything to report.

"We have canvassed the field pretty thoroughly" said Shortrate, "and have signed up some pretty fair business. But lots of ‘em are going to wait to see what we do."

"They want further evidence as to our editorial policy I suppose," said Daly. "It might be well to mention the fact here that our editorial policy will not be touched by advertising influence, regardless of how sincerely we may hope that the advertisers will approve of us."

"Quite naturally" said Shortrate.

The Colonel looked over at Burroughs and made a sweep with his hand as if he were swishing a gnat away from the end of his nose.

Shortrate leaned forward and picked up a sheaf of memoranda.

"Income from circulation, from the sale of the paper on the newsstands and to mail and home delivery subscribers, will be of secondary importance to the Gazette" he said. "Circulation, in these days of thick newspapers and the high cost of white paper is per se a liability and not an asset. The more you sell the more money you lose. "But" and here Mr. Shortrate raised a trained conference forefinger, "circulation is necessary in order to obtain any adequate volume of advertising at productive rates."

Shortrate here turned and looked fiddly at Franklin.

"And when I say circulation I mean the proper kind of circulation. I want to stress that fact with the
thought that to succeed we must have co-ordination of editorial, advertising and circulation effort."

"Would you specify?" asked Mr. Franklin. He was wishing the director would not make speeches and stress things with the thought.

"With pleasure," assented Mr. Shortrate. "There are five groups of people in our country:

"Group I—2 per cent. Morons in asylums and public institutions.

"Group II—18 per cent. They have the intelligence of a 9-year-old child. Their incomes are from $500 to $1,000 a year, even though they are adults.

"Group III—60 per cent. They have the intelligence of a child of thirteen with incomes of $1,000 to $3,000 a year."

At this point Miss Long walks unsteadily to the water cooler and takes a drink.

"Group IV—16 per cent. They have 18-year-old intelligence and their incomes range from $5,000 to $25,000."

"Mr. Babbitt wipes his brow between Group IV and Group V, although the room is not warm.

"Group V—4 per cent. Their incomes are from $25,000 up. They form the genius group. Educators, lawyers, preachers and scientists are included in this group."

Col. Minimil looked over at Burroughs and laid the upper lid of his right eye completely over his right eyeball and left it there for some time.

"Cheerful guy," whispered the Colonel.

"Now, mind you," continued Shortrate, "fully 90 per cent of the buying power of this country is represented in Groups III and IV. It is the buying power that produces response to advertising. In order to get advertising, therefore, and in order to retain it you must have a newspaper that appeals particularly to Groups III and IV."

Franklin shrunk in his chair. "Good Lord," he said. "Let's cut out the editorial page."

Daly turned to Burroughs. "What's your reaction?" he asked, and Franklin squirmed again.

"My idea exactly," exclaimed Burroughs. "Jazz it up. Flocks of comics. Two or three sex serials running in every issue. Shortrate's figures look tough for the so-called human race but we got to play the cards as they lay. Snap it up, that's my personal idea."

"If girls wore long skirts Rosson's paper would have been out of business long ago," seconded the Colonel.

"Give 'em some of the highbrow stuff of course," suggested Shortrate, "but for every page of straight news give 'em two pages of jazz."

Franklin looked appealingly at Daly and a message of mutual understanding passed between them. The editor was wondering why a wise providence permitted the invention of advertising departments.

Daly reflected there were kinks in the newspaper profession that he, as a layman, had not suspected. But there was a pretty good brain under the slicked
back hair of the younger Minimil and he was by no means such a coot as his pants made him appear.

"I would dislike very much," he said, "to undertake the operation of a newspaper which was to be edited down to a group rather than up to a group. I realize that there is some technical truth in Mr. Shortrate's analysis. There are hundreds of thousands of persons who are crying for thrills in ink but I am not going to limit any newspaper of mine to a few comic strips, several doses of high pressure fiction and a photographer with a trained menagerie of bathing beauties. We shall be able, I hope, to see the Fortunatus Gazette that it will be entertaining without scouring the hand that buys it. I will not be the publisher of a daily aphrodisiac. I am not an anatomist and I don't want to sell a handbook on the human form divine to my neighbors and my neighbor's children. Mr. Franklin will produce news, pictures, editorials and features that should interest any normal American public. Mr. Burroughs will sell that product. Mr. Shortrate will handle the by-product, which is advertising. I hope I make myself clear. If not are there any questions?"

There was a silence in the dimly lighted room. Babbitt mentally stamped it as a good speech but he said nothing. Shortrate assured himself Daly Minimil was an ass but he didn't mention it aloud. Burroughs made a great to-do about getting out a fresh cigarette. A blush suffused the face of the enraptured handmaiden at the typewriter but the new tint could not prevail against a jade green lamp-shade and the lady merely became saffron.

Franklin smiled at the Colonel.

"A new jewel in the breastplate of Athena," he murmured.

"Thanks for the buggy ride," replied the colonel, giving Franklin a hard look. Then he turned to Miss Long.

"Sadie, the next time you see Bill Rosson just tell him for me that the Gazette will have the Clarion loked on selectivity, distance and volume and that ours is a single control set. Santa Claus is on the way to Bill's place with a sockful of static."

Tom Gubbin, foreman of the press room, and Dan O'Reilley, foreman of the composing room, entered the conference at this moment and sat gingerly on the edges of their Louis XVI chairs as the conference proceeded to new business. Tom told Dan afterward that he felt almost immoral.

"Why does that bird have his office in a parlor?" he wanted to know.

III

Mavis Minimil was modern. She was so advanced that even her dust was invisible to her plodding father. The young woman talked frankly about things that made her mother cough. But she was a good girl and earnestly wanted to be something more than a rich man's daughter. She had tried settlement work, founded a home for waifs, financed a research into the lives of the boll weevil and corn borer, and written for a magazine on the order of Mencken's. When Col. Minimil gave a $10,000,000 impetus to Daly's ambition to be a newspaper publisher she thought it extravagant although even her house dresses were original Poiret models.

"Mavis doesn't think caviar is fit to eat unless the Russian coat of arms is stenciled on each egg," Ethyl Southorius told the bridge club one afternoon.

Mavis only laughed. She simply didn't care. She was thrilled by Dale's good fortune and she refrained from commenting too freely on his obvious delinquencies as a publisher. She was secretly planning to tabasco the humorous column on the Gazette's editorial page. She had contributed to such columns of other newspapers but her offerings mostly came back. One columnist, pressed for time and weighed down by heaps of mail, used a rubber stamp in warding off the fast ones from Mavis and her ilk. Their offerings went back bearing the simple legend "Too hot to handle."

Mavis thought this was vulgar. She was pleased, though, to reflect that she had saved the rejected wheezes. The Gazette should have them all. It can be imagined with what delicious amusement Mavis listened to a conversation that took place at the dinner table one evening in the Minimil's private fortress.

Mrs. Minimil was vastly proud of the family's venture into journalism. She thought it was much better to be referred to as Daly's mother than as the Colonel's wife. Of course Maximilian was all right but he was looking out from behind a set of old whiskers at a new world he did not understand. There were many things Mrs. Minimil did not get in their full significance, but she found time, what with fighting servants and embonpoint, to step into the parade occasionally. She marched in an Independent Woman's Association parade one memorable day and her enthusiasm was only slightly dulled by the fact that she forgot in which ward she lived and discovered she was carrying a banner in a squad of ladies recruited from the gas house district.

It had been an arduous day for Daly and the Colonel. The Gazette was to go on the newsstands the following night, with the early editions that make a morning newspaper so difficult to distinguish from evening for the Gazette's wagon and truck drivers and for the newsboys who were to handle the paper at stands all over Fortunatus and its environs. Bill Rosson of the Clarion had sworn that the Gazette should not be sold from the stands that handled his Clarion. His corner men had vowed they would not stand for competition on their own corners or on any of the other three corners at intersections where they merchandised their papers. The elder Minimil had tried to make amicable arrangements with Rosson but had made no progress. It looked as if the other six newspaper proprietors would stand with Rosson, giving him their moral, financial and whatever other support the common cause required.

Col. Minimil and Daly had been discussing this matter when Mrs. Minimil brought forward her first...
suggestion for putting the Gazette across with a bang.
"Dale, dear," she said, "you remember Lizzie Farley, the nurse who took care of Mavis after she fell off the front terrace wall into a clump of bridal veils?"
Daly remembered vaguely.
"Well, you can't tell how far a cat will jump," said his mother. "She never looked to me as if she had sense enough to pound sand into a rat hole but she's turned out to be a successful authoress. She wrote that fiction story in the Clarion entitled 'Potted and Parted' and it went so strong they had her write a sequel called the 'Heart of a Typist.'"
"Did that turn out to be strong, too?" asked Daly.
"Oh, extremely," exclaimed Mrs. Minimil. "Very strong. And Mr. Rossom is advertising her now as The Tear Gas Bomb of Modern Letters."
"High pressure promotion, I'll say," commented Daly.
"You must have read some of the 'Heart of a Typist,'" insisted his mother, "it has been appearing so long in the Clarion."
"Is it the one where the working girl is engaged to an earnest young man and she meets a wealthy married business man and he takes her to a roadhouse and on the way back that night they spill in the ditch and—"
"Dale, that's it. You have read it."
"Yes, mother dear, I wasn't sure at first but I recall now that I came across it in the original Egyptian, written on papyrus."
"Daly, do be serious for once. You'll love this. I met Miss Fairleigh this afternoon and she says she has a story almost written which she will sell to the Gazette."
"I didn't get the name," said Daly, "did you say it was Fairley or Fairleigh?"
"Ysobel Fairleigh now, Dale. You know most artists change their names a bit when they go before the public."
"And a very tasty appropriation," agreed Daly. "Now what is the name of the serial she wants to sell the Gazette?"
"Who Necks?"
"Pardon me?" said Daly. "Who Necks?"
"Sounds like a grocer's clerk with a hare lip," puzzled Daly, as Mavis laughed. "But I'll bite; who IS next?"
"Necks! Necks! Not next," explained his mother, laughing immoderately, as matrons will, at the quaint mistakes of their children.
"Good Lord!" said Daly, "Sorry mother."
"Yes," exclaimed Mrs. Minimil "and I arranged everything with Miss Fairleigh except the price. I thought you would want to decide about that. What do you think she should get?"
Daly glanced at his father. "Mother," he said, "I am not yet familiar with the practice and technique in such cases as you have outlined but offhand I would suggest that wood alcohol would be just about the correct thing."

What Mrs. Minimil thought of this will never be known for just as she was about to express an opinion of it the butler entered and announced that Mr. Daly was wanted at the telephone. "An urgent matter, he said, sir."
"It's that damned Rossom starting something new," shouted the Colonel as he arose to follow Daly into the library. "There is a popular idea, Mavis, that the next war is going to be in the air but I want to tell you and Ma that the next war is going to be fought on the streets of Fortunatus. Where's my hat?"

BILL ROSSOM, owner and publisher of the Fortunatus Clarion, was a lithe, tallish man of about 45 years who literally had been kicked into fame and wealth. In his younger years he had determined to earn international acclaim as Broncho Bill Rossom and his first step was to undertake to ride a horse. He rejected Wyoming and Montana as suggested scenes for the burgeoning of his ambition and chose the movie lots of Los Angles. He soon learned to snatch a gun from his holster in less than one minute and after a few trials was able to ride bare-back without holding onto the horse's mane. It remained only for him to develop a bit of extra business. This consisted of standing on the ground and, with an agile step and leap, alighting upon the back of the horse, without the aid of stirrup, fence or horse block.
His big blue eyes and shock of straw-colored hair stamped him as one favored of the movie gods. With what an inimitable air he could turn, just before killing the cattle rustler who had kidnapped Isis Osiris, the

(Continued on page 45)
Static and Statistics

By

Dorothy Brister Stafford

IF YOU own a radio receiver you are perfectly familiar with that grand and glorious feeling of impotent rage that comes over you when, with the batteries all up in shape, the tubes burning brightly, and you all set to tune in on some fine program, up bobs old man Static and throws a wooden shoe into the machinery. It was with some such comfortable feeling that we approached the typewriter today with a nice bunch of statistics that had turned up on our desk, all primed to talk about an anniversary that proved beyond the shadow of a doubt that our youthful prodigy of radio broadcasting was old enough to have a history, when something else came to light to divert us to the extent that until we can set down what we think about it we are a total loss so far as being an historian is concerned.

This disturbance was brought about by the reading of a "fable" by a "radio reviewer," which, if it has accomplished no other purpose, has succeeded in taking most of the joy out of life this bright winter morning, and while from its tone, it was obviously composed while the writer was suffering from an acute attack of liver trouble, or in the darkest hour of the morning after the night before, it nevertheless has filled us with a righteous indignation that demands immediate expression.

In the aforesaid arraignment the writer has gone to infinite pains to convince the radio listener that the average large broadcasting station is conducted by a group of half-baked college boys and third-rate entertainers of the small-time class, who regard their audience as a huge joke, and operate on the theory that anything is good enough for the listener out in Hicksville; and the idea is very subtly gotten over that broadcasting is not to be taken as a serious business, as it is more or less of a side-issue for those engaged in it. Personally we are at an utter loss to understand just what a writer expects to gain by such an absurd and unjust attitude, or why an editor should print anything so palpably designed to influence his readers against the first rate stations. Coming as it does shortly after the formation of the greatest combination for organized broadcasting the industry has yet seen, and all the publicity attendant upon the event it seems improbable that any sane person should give it credence, but so prone is the average reader to believe "what he sees in the papers" that we haven't a doubt but that many listeners will take it in entire good faith as a truthful expose of what is back of their entertainment. Heaven knows radio is having a rocky enough road to travel this winter, what with the broadcasting chaos and heterodyning moans developing on all our favorite wave-lengths without any additional stones being fired in its way from the inside. And why a man who presumably makes a portion of his living out of the industry should take a nip out of the hand that is feeding him will take its place alongside other great radio mysteries, such as why the queen failed to materialize when several million people were waiting breathlessly for the royal voice to come over the hook-up. The charitable, friendly feeling of the radio audience toward the

Readers who have tuned in KDKA for the past few years cannot have failed to hear the Little Symphony under the baton of Victor Saudek. The organization is shown in the accompanying picture
purveyors of its programs is the very life and breath of broadcasting, and while all of us know of a score or more stations we'd gladly see annihilated for their interference with the really important broadcasters, such a sweeping indictment as this is bound to do nobody good.

One wonders if such a condition isn't made possible by the fact that the position of "radio reviewer" on the average newspaper is a most nebulous occupation at best. When, in the course of human events, the conventional editor discovered he had to have a radio page, he didn't know exactly who was going to do it. If the paper boasted a musical critic, the buck was usually passed to him, with the result that he condemned everything outside the realm of classical music and usually succeeded in utterly bewildering the bulk of the radio audience. We know of one instance where the radio page is handled by the sporting editor, simply because he happens to be a radio bug—and the result, while doubtless snappy reading to some listeners, must wring the heart of any program director who reads his account of a symphony concert. There is the occasional exception where the editor has regarded the matter seriously and employed a person with some general knowledge of music, a catholicity of ideas, and a genuine interest in what he is doing, with the result that the writer has raised his new profession to the dignity of that of the critic of the drama, literature or music. But too often the condition reminds us of that existing back in our early days when three or four of us were sitting up with the corpse of a morning paper, and the "Bessie Blake" column of advice to girls was done by anyone who had no more pressing duties at the moment. The pathetic spectacle of the hard-boiled telegraph editor, his bald head glistening with perspiration, one suspender held up with a safety-pin and the omnipresent package of Mailpouch protruding from a hip-pocket, wrestling with the problem of "Two Cuties" who want to know if they shall invite the boy-friends in after a dance, often comes back when we read some such authentic "review" as the foregoing—for we can fancy it's being composed under just such circumstances.

We presume the fact that we have just unpacked our hat-box after a trip to the Big City, where we like to go each winter to see some shows and meet people who are doing things, and which this year included visits to some of the more important studios with the result that we are brimming with enthusiasm and admiration for the way they are conducted, has something to do with our disturbance over such a prejudiced distortion of facts. We admit that we don't love and admire the ways and personnel of all radio stations—we haven't had several years contact with the business without discovering some clay feet—but just as all the really great people we have ever met in any profession have been the simplest and the kindest, the individuals and the stations that have disillusioned us are those that don't matter very greatly.

The atmosphere of the great broadcasting station is one of amazing efficiency, extreme courtesy and an overwhelming interest in what the listening public thinks of them. And why should it be otherwise? Isn't the attitude of the public of paramount importance in any undertaking? True, it isn't possible for the great station to extend unlimited invitations to every owner of a radio set to come around and be entertained when he is in the city—we've never seen a busier place outside a metropolitan newspaper office as the dead line approaches than a big broadcasting studio on an important night—but the one waking thought of all concerned seems to be how the program is getting on the air and how it is going to be received. If these earnest toilers have anything in their heads besides radio we were unable to discover it. The old story of the sailors who spent their shore leave boat-riding in Central Park was recalled when we asked an extremely versatile young man, who bewildered us by the multiplicity of his duties, what he did when he went home, and received the prompt answer, "Why, I turn on the set."

**Spirit of Youth**

**True** the spirit of youth is rampant—but where isn't it these days? Aren't some of the most momentous things in literature, art and drama being...
Christine Miller Clemson is another of the sopranos who is frequently heard from the Westinghouse station at Pittsburgh.

done by those under thirty? And you may be sure, in the great broadcasting station where there is a position calling for a man of more years and discretion, that is just the sort of a person you will always find holding down that job. Where there is need for youthful vision and unspoiled enthusiasm there is invariably an energetic younger man bubbling over with the joy of living and the opportunities of this great new field. We should like to take the writer of the derogatory article into the station we have in mind for an hour or so, and if he didn’t eat his ill-assorted collection of words before he got out it would be because he would be so consumed with chagrin that his epiglottis would refuse to function. We want to devote an entire article to this particular station at some future date, and will now get on with the business in hand, which has to do with that grand old patriarch of broadcasting. —KDKA. But we would like to tell you that the first question of all these busy broadcasters we’ve met lately,—leaders of great orchestras, busy young men who are conducting half a dozen different musical units, opera singers, musicians who divide time between concert engagements and commercial features—has been invariably, “How do they like us out in your neighborhood?” “Are we getting over?” Do they care about the radio audience? Well, rather.

And while we have had no such personal contact with the artists and staff at KDKA, we know the same spirit exists at the Westinghouse station, or it wouldn’t now be celebrating its sixth season and receiving honorable mention as the dean of our broadcasters. Think of it! Radio is so new to the most of us that it seems incredible that anything connected with it could be having a sixth anniversary. But an interesting series of dates has been furnished by the Pittsburgh station, which will constitute the Genesis of the history of broadcasting when it is written.

It was Nov. 2, 1920, that KDKA first went on the air to do regular broadcasting, and the subject matter was the result of the Harding-Cox election. Other interesting first time performances include Jan. 2, 1921, when the first service was broadcast direct from a church; Jan. 15, 1921, marked the first pick-up from a banquet hall where Herbert Hoover was the principal speaker. Feb. 18, 1921, was the first pick-up from a hotel, and the same date must have been a great day in Pittsburgh for it was then that the first report was received that KDKA had been heard outside the United States, the confirmation coming from London and several points in Canada. April 11 of the same year marked the introduction of the prize-fight to the air, when Florient Gibson, sports announcer, gave a blow-by-blow account of a lightweight battle direct from the ring-side, paving the way for the Dempsey-Carpentier contest in Jersey City the following July. Beginning also in April the regular broadcasting of baseball scores was inaugurated by KDKA.

**Trail Blazers**

In fact it appears that we are indebted to Pittsburgh for practically all our standard features, and while to those of us who are accustomed to the highly specialized broadcasts of today those initial experiments would undoubtedly seem very crude, it is interesting to note that they paved the way and set a line of conduct that is still adhered to by practically every standard station in the country. Those trail blazers must have had an exciting time with no established precedents to follow, and it is a matter worth noting that a religious service should be practically their first attempt, for one would naturally assume that there would be some timidity in producing anything so radical until the attitude of the listening public had been determined. But apparently timidity and lack of assurance have played no part in the history of broadcasting. The rash pioneers were willing to try anything once, and one supposes that the explorers at the receiving end were so amused by the marvel of being able to hear anything that they bore little relation to the critical, over-pampered listeners of today.

Speaking of this pioneer station, one feels safe in saying that there is no dial-twister throughout the land, no matter

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Jim Hughes, director and announcer of the Teaberry Entertainers. This feature is one of the largest permanent broadcasting features on the air, consisting of a twelve piece symphonic orchestra and quartette, heard weekly through KDKA.
STM Current Science

Science Amateurs Do Good Work

NO LONGER is the typical scientist a stooped gray-beard, who wears a long coat and spouts jawbreaking words in Latin and Greek. As a matter of fact, he never was, but today there is even less justification for the myth than ever before. To people who still cherish the old tradition, however, a visit to a scientific meeting such as that of the American Association for the Advancement of Science, which was held in Philadelphia during the holidays, would be a revelation. Here were gathered nearly 5,000 workers in all fields of science, from Archaeology to Zymology in the alphabet, from Astronomy down to Geophysics in the subjects of which they treat. Among this 5,000 were many of the leaders in their fields, but the long beards were in a very small minority.

Those lucky people who go to Florida for the winter will be able to see another amateur observatory which has been established in Miami by S. Lynn Rhorer, and is now in its fifth season. At this observatory a battery of telescopes is used every clear night to instruct visitors in the mysteries of the heavens.

THERE is a large class of stars known as "variables" which change in brightness more or less periodically. Most of these are bright enough to be seen with a small telescope, but to check up on their variations, a large number of observations, made fairly close together, are required. The A. A. V. S. O., as it is called, with its large number of small telescopes, watches these and its members report regularly to the Harvard Observatory. These amateur as-

Listening in on First New York-London Talk

The first telephonic channel of speech between London and New York was recently opened when Walter S. Gifford, President of the American Telephone and Telegraph Company spoke from his New York office to Sir Evelyn Murray, secretary of the General Post Office of Great Britain in London, officially dedicating this newest achievement in science. Photo shows Mr. Gifford speaking for the first time with London while officials of the A. T. & T. listen in. Left to right—E. S. Bloom, president of the Western Electric Company; F. B. Jewett, vice president of the A. T. & T.; J. J. Carty, vice president; Walter S. Gifford; Bancroft Gherardi, vice president and chief engineer; E. B. Craft, executive vice president Bell Telephone Laboratories; N. T. Gurrensey, vice President; A. W. Page, vice president

Psychologist Demonstrates New Crime Detector

Dr. A. P. Link, Instructor in Psychology at New York University, recently demonstrated how with the use of specially devised apparatus he measures the electrical resistance of the human skin an electrical stethoscope which enables the audience to hear the thumping of the heart of the person under examination, science can aid in detecting and apprehending criminals

Ship on Wheels May Solve Travel Problem

The future "ship of the desert" will not be the traditional camel, in the view of Johann-Cristoph Bishoff, a Kiel inventor, who has evolved a craft which he believes will meet all modern demands for speed, effectiveness and freight and passenger carrying capacity in traversing the earth's arid regions. The "desert ship" is really a gigantic motor vessel, nearly 300-feet long, 38 feet in breadth and standing about 50 feet high, resting on four huge wheels nearly 40-feet in diameter. The strange craft will accommodate 300 persons and have a capacity for fifty tons or more of freight. And it is estimated it will be able to travel about twenty miles an hour. Powerful gasoline engines supply the motive power. Photo shows a sketch of the monster "desert ship" showing the comparison in size with the old mode of travel—the camel.

Makes Experiments With Tesla Coils

Doctor Raymond Morgan, professor of physics in the University of Pennsylvania who gave an illustrated lecture on radio communication with elaborate experimental demonstrations
tronomers are drawn from all walks of life—one very active member, until his recent death, was a Pittsburgh locomotive engineer, who came in from his run about midnight, and then observed until daylight.

Somewhat similar to him is an amateur astronomer in South Africa, R. Watson, who already has the discovery of several comets to his credit, as well as a “nova,” a new star which flashed out from previous obscurity into brightness for a time, then dying out again. Mr. Watson is a telegraph operator, on a night shift, and when he returned to his home early one morning, when other respectable people were sound asleep, he noticed a star in the constellation of Pictor, the “Painter,” which he had never noticed before. This was the new star of nova, and its discovery was immediately spread far and wide to astronomers throughout the world. Another amateur discoverer of comets, as well as of “asteroids” or small planets, was the late Rev. Joel H. Metcalf, a Unitarian minister of Winchester, Mass.

But astronomy is by no means the only science that has its amateur devotees. Take the instance of a prominent New York investment banker, who lives in one of the city’s suburbs, Tuxedo Park. This man, Alfred L. Loomis by name, has established at his home a private laboratory where he is experimenting himself, and aiding other scientists to experiment, on “long shots”—scientific problems that offer too little immediate return for the average university laboratory to investigate, but that may develop into something of importance.

In an entirely different field of science, that of archaeology, a hard-worked factory executive in Illinois has distinguished himself, George Langford, of Joliet, has taken up Indian mound excavating as many men take up golf. At that, he gets more exercise than most golfers, because what he has to do in his hobby is to work all day, when he has one to spare, with a pick and shovel like an ordinary laborer, with only one volunteer assistant to help him. But already his hobby has developed into a real pursuit of science, with important results, which has already won for him a place in the circles of his chosen science.

His digging has been at the “Fisher mounds,” near Joliet, and is important because he has unearthed three, and perhaps, four, layers of remains of Indian civilizations, that existed on the spot at various times in the past. In Old World archaeology several layers of culture above each other are not unusual, but it is rare in America. Another important outcome of Mr. Langford’s work is that for the first time a possible clue has been found to the earlier home of the Iroquoian Indian nation, who played an important part in our colonial history. Previously, no remains of the Iroquois have been found west of Ohio, but in the second layer of the Fisher mounds pottery, ornaments and weapons suggestive of the workmanship of this race have come to light after remaining buried for many centuries. And under them are relics representing a still earlier group of Indians, about which little is yet known. Altogether, Mr. Langford has found hundreds of skeletons, as well as enormous quantities of the other relics.

So science is not the dry study of uninteresting facts nor is it necessarily a solemn pursuit fit only for greybeards. When men, and women, from all walks of life take it up as a hobby, and are able to help advance it, there must be something in it of interest!
March Evening Skies
Anniversary of Discovery of Planet Uranus

By
JAMES STOKLEY
(Science Service)

THOUGH the heavens have little to offer in March in the way of such spectacular occurrences as eclipses, there is one event which is always welcome, and happens on the 21st at 9:59 a.m., Eastern Standard Time. That is the Vernal Equinox, when the sun crosses the equator on its way north, and Spring commences, bringing along its assortment of back-lots baseball, hurdy-gurdies, and poems on spring. But even though the winter has been fairly mild the season is always welcome, despite the poems and hurdy-gurdies.

Since the path of the sun, in which the planets also move, or the zodiac, is divided up into twelve equal "signs," another way of expressing what happens at the vernal equinox is to say that the sun enters the sign of Aries. Aries is a constellation which could be seen in the evening a few months ago. Now it is too near the sun to be easily visible, even though the sun is not in the constellation when it is in the sign. The zodiac is not a recent invention. It was established thousands of years ago, when men thought the part of the sky the sun was in had some mystic influence on people born at that time. Though such ideas have long since been given up by reputable scientists, some of the old terms are still used. In fact, the observations of the old astrologers, misguided though they were in their motive for studying the stars, really formed the foundation for the modern science of astronomy.

A few thousand years ago, the constellation of Aries coincided in the sky with the sign of Aries, but owing to what is called "precession of equinoxes," the skies have changed since then. On the 21st, the sun will not be in the constellation of Aries, but in the neighboring one of Pisces, the Fishes, and it will be some 23,000 years until the signs again fit the constellations.

Bulges at Equator

THIS precession of the equinoxes is a result of the fact that the earth is spinning. We usually think of the earth as being a sphere, but it is really not spherical. It is what mathematicians call an oblate spheroid, which means, in the case of the earth, that it bulges a little at the equator, just like some of the people on it. This is caused by the centrifugal force due to the earth's rotation. When you spin a weight around your head on the end of a string, it tries hard to fly away, but the string keeps it from doing so, unless you let go. In the same way, the part of the earth at the equator tries to fly away from the center, but the force of gravity keeps it from doing so. However, it does succeed in...
getting a little farther from the center than the surface at the north or south pole, with the result that the earth is not perfectly spherical. Another incidental effect of the earth's centrifugal force is that a person weighs less at the equator than he would at the North Pole, because this force tends to throw him away from the surface. Of course, no scales would show the difference, because the weights also would be lighter. But the diminution of gravity at the equatorial regions can be measured experimentally in another way, for the swing of a pendulum varies with the intensity of gravitation.

**Gravitational Effects**

HEAVENLY bodies all exert more or less gravitational effect on each other, depending on their mass and distance. Because of its proximity to us, the moon has considerable effect on the earth, producing the tides, for example, and so does the sun. If the earth were a perfect sphere the gravitational effect of the moon would be the same regardless of its position. As it is, except at the fourteen day intervals when the moon is directly over the earth's equator, the moon's gravity acts more on the parts of the earth's bulge near it than the part on the opposite side. The result is that it tries to pull it into the same plane again, but as the keeps it from responding to the earth is spinning, its momentum pull. However, in combination with a similar effect of the sun, it does cause the earth to turn slowly, so that a line drawn directly up from the north pole will trace out a circle in the sky. In 28,500 years, the circle would be completed. Another result of the "precession" is that what we call the pole star was not always such, nor will it always be so, though for the next few centuries it will be close enough for most of us.

Aries, then, a few thousand years ago, was the constellation in which the sun appeared at the beginning of spring and this was also, in many ancient countries, the beginning of the year. But if we go back about 6,000 years, Aries had not yet reached the position of the vernal equinox, and the constellation Gemini, the twins, visible these evenings in the southern skies, held this important post. It has been said that its stars represent a pair of twins and symbolize the equal length of day and night at this time of year. Some similar symbolic meaning has been claimed for a mythological story about the twins. Castor and Pollux were their names, and they were the sons of Leda. They possessed what might be termed alternate immortality. As soon as one was killed, the other revived, and this, it has been held, symbolizes day and night.

Probably the earliest record of any astronomical event is associated with Castor and Pollux, the two stars of the Twins, or alpha and beta Geminorum, as the astronomer calls them. On ancient Babylonian monuments and boundary stones, archaeologists have frequently found what is called the "Triad of Stars"—a crescent moon, with the horns upward, and two stars beside it.

**Ancient New Year**

ACCORDING to an English astronomer, E. W. Maunder, the two stars represented Castor and Pollux. At the time, 6,000 years ago, the priests were interested in the first new moon of the year, for their calendar depended on the moon as well as the sun, and the year began at the vernal equinox. At this time of year, in Babylonian days, Castor and Pollux could be seen low in the western twilight just after sunset, and when the new crescent moon appeared alongside them, it was the signal to the priests that the new year had started. So important was this phenomenon that they recorded it on their boundary stones and monuments to be preserved to this day.

Coming down to more modern times, the constellation Gemini is associated with another important astronomical event, the anniversary of which comes this month. The ancients knew only the naked eye planets, Mercury, Venus, Mars, Jupiter and Saturn. Sir William Herschel was the first to add to them, and on March 13, 1781, he discovered Uranus. In "The Watchers of the Sky," Alfred Noyes has Herschel say, referring first to the reflecting telescope with which he made the discovery:

"... It was the work of my own hands,
A new one, with an eye six inches wide,
Better than even the best that Newton made.
Then, as I turned it on the Gemini,
And the deep stillness of those constant lights,
Castor and Pollux, lucid pilots,
Began to calm the fever of my blood,
I saw, O, first of all mankind I saw
The disc of my new planet gliding there
Beyond our tumults, in that realm of space."

Uranus is now in the morning sky, but it is so faint that a telescope is always necessary to reveal it. Venus and Mars are both visible in the evening sky this month, however. The former is in the constellation of Taurus, in the southwest, not far from the first magnitude star Aldebaran, which it resembles, both in brightness and color. Mars, however, may be recognized, because it is to the north. Venus can be seen low in the western twilight, especially towards the end of the month, for then it will set about two hours after the sun. It so bright, about six times as bright as Sirius, the brightest star, that it is easy to distinguish.
Use X-Rays To Detect Fake Pearls

With the growing use of imitation pearls almost indistinguishable from the real article, as well as of the so-called "culture" pearls grown by introducing small bits of foreign material inside the shell of a living pearl oyster, it has become increasingly necessary for jewelers to possess some infallible method of distinguishing these manufactured articles from the real pearls produced naturally by the pearl-bearing shellfish. Science has come to the rescue with several devices which measure the properties of a pearl or which permit the jeweler to look through it under an enormously powerful light, thus disclosing, if the pearl be not too large, the telltale central impurity of a culture pearl. A new and more universal method, making use of X-rays instead of light rays, was described recently to the French Academy of Sciences by J. Galibourg and F. Ryziger, of Paris. A narrow beam of the X-rays is thrown against the pearl, beyond which is an ordinary photographic film covered with black paper, as are the films used by dentists to take X-ray photographs of teeth. On this film there appears a pattern of dots made by the X-rays. This pattern indicates the internal nature of the pearl. With proper care, it is said that any culture pearl can be distinguished thus from the genuine article.

Shale Oil Industry May Rival Coal

Distillation of shale, which promises to become very important to the entire nation, is not a new way of getting oil at this time of approaching scarcity, but is merely an old method brushing its cobwebs off after over half a century of disuse in the United States. In France it is older yet, for there the production of oil from shale started in 1838, according to Dr. G. C. Riddell, consulting engineer of New York. In Scotland, oil was obtained from shale before 1850, but the best of the raw material is today exhausted. Shale pits 3000 feet deep show how the industry once flourished.

In 1850 oil was distilled from shale in Utah and Pennsylvania, and the development of a great shale industry would have resulted but for the discovery of well oil. The "liquid gold" fever following the development of oil in drilled wells in Pennsylvania caused the interest in shale oil to dwindle and then die, just as an impending scarcity has brought it to life again.

To date 186 patents have been granted in the United States for the production of oil from shale. Five of these were granted in 1858, fifteen in the next six years, and none at all after that until 1891. From 1891 to 1914 ten patents were granted, from 1915 to 1919, thirty-four and from then to the present time one hundred and seven.

The competitive production of oil by distilling bituminous rocks is no longer in doubt, Dr. Riddell states, for in California it has been produced for three years at less than one dollar a barrel including all overhead charges. This is far below the average cost of American well oil.

The question as to what is to become of the vast amount of spent shale that will result with the development of the industry is puzzling many theorists. The by-product can be used for making pressed, refractory and...
insulating brick and tile, Dr. Riddell says, and at present it has found lesser uses as road material, concrete building blocks and as a filtering substance in the sugar industry.

That the new shale industry is destined to become as great as the coal industry is now, is recognized by engineers and geologists generally. The new business will be developed in the now sparsely populated regions, Dr. Riddell points out, and towns, roads, water systems, movies and other kinds of civilization will appear there.

Light Shining on Mineral Produces Electric Current

A PIECE of the mineral molybdenite, one of the chief sources of the metal molybdenum, used in steel manufacture, may replace the fragile photoelectric cell in some forms of scientific work, says Dr. W. W. Coblentz, of the U. S. Bureau of Standards.

Dr. Coblentz has been studying what he calls the actinoelectric effect of molybdenite, the property that causes it to convert light energy falling on it into electrical energy. Previously he has found that pieces of the mineral have closely adjacent spots which generate either positive or negative electricity. The result is that when the whole crystal is exposed to light the positive and negative currents neutralize each other, and very little effect is noted, but if a single one of the spots is selected and illuminated, a current is produced of sufficient intensity to be indicated with a galvanometer.

Very recently, Dr. Coblentz has found crystals in which all of the sensitive spots give the same kind of electricity, either positive or negative. When one of these crystals is completely illuminated, a considerable current, as compared with the others, is produced. By using vacuum tube amplifiers, such as are used in radio, the current may be magnified greatly and the crystal made available as a delicate detector of light.

Such a crystal is sensitive to the visible light waves and to the infra red, or heat waves, which are similar, but vibrating too slowly to be visible.

**Wind Tunnel Used to Test Aerial Bombs**

An engineer of the Bureau of Standards is shown in the process of testing aerial bombs for resistance to help airmen in getting accurate hits. The air tunnel in which the bombs are tested has an artificial velocity of air current equal to 80 miles. Engineers of the Bureau also use the tunnel for testing of airplane accessories.

**World's First Magazine for the Blind**

Introduced by its blind inventor into Los Angeles several months ago, the first monthly magazine for the blind proves so popular that it is enlarged to 60 pages for national circulation. "The Braille Mirror" became possible as a result of the invention of special presses and stereotypes by J. Robert Atkinson, its publisher. Mr. Atkinson, stricken with blindness at 35 years of age, had no previous experience in the mechanical line before he began his experiments. The magazine covers a wide range of subjects and enables many blind persons to read advertisements for the first time in their lives. Picture shows a blind operator at the typesetting machine invented by Atkinson.

**Eavesdropping Is Hard on Transoceanic Phone**

HARD times are in store for any transatlantic gossips who might wish to indulge in a little eavesdropping on the new overseas radiophone service recently opened. Officials of the American Telephone and Telegraph Company state although absolute secrecy of the transatlantic telephony is not guaranteed, it will be difficult to listen in because a special transmitting system is used. This is the suppressed carrier method, by which the voice is sent through the ether without a carrier wave. In the ordinary receiver, an unintelligible jumble is all that one hears, but when a receiving set is used that restores the missing carrier, it is fully understandable.

Another difficulty of listening in, at least so far as the United States is concerned, is that the signals from London are so faint. It was in order to get them as loud as possible that the telephone company placed the receiving set at Houlton, Maine, 700 miles of long distance lines away from New York, so that at best, an interloper would only be able to hear one side of the conversation.

**Engineers Wear Overcoats in This Engine Room**

For the first time in the history of the American merchant marine an engine room crew were in danger of freezing on an ocean voyage. Ordinarily the warmest part of a vessel is its engine room. But the converted motorship "Tampa" with its Worthington Duplex engines gave off so much heat, owing to their elaborate and highly efficient cooling systems. On a trip to Bremen made recently, the engine room gang of the Tampa wore overcoats on the trip across
Building Ideal Model of the Worlds Record Super 8

Brings Set Up To Its Highest Efficiency

By F. A. HILL
(Associate Editor)

In this photograph is shown the 171 power compact which furnishes A current for the 171 tube filament; B and C voltages for the 171 power tube, and the B voltages for the balance of the receiver shown in Figure 2 on page 27. Do not try to wire the set from this drawing. Use the schematic on page 31 (Figure 4) for the superheterodyne, and the schematic on page 30 (Figure 3) for the power compact. However for the location of the various articles the layout shown in Figure 2 will give a clear idea to the home constructor for whom these articles are written.

Photographically on page 29 is shown a bottom view of the subpanel assembly. Some of our readers have tried with disastrous results to wire up a set from a photograph. We suggest in the interest of accuracy (and economy of your own time) that you use the regular schematic for that purpose—at best a photograph can only show the parts and wires but without regard to their electrical accuracy.

Before commenting on the receiver itself we will refer to the Thordarson R-171 compact shown schematically in Figure 3 on page 30. Inside the dashed lines will be found a 110 volt AC primary; a 5 volt AC, center tapped, secondary for the filaments...
ments of the 171 tube; two 30 henry choke coils; a high voltage secondary, also center tapped, and two one-half microfarad buffer condensers which are to go across the elements of the full wave gas tube rectifier. The high voltage condensers, C3, 4, 5, 6 and 7 are contained inside the Tobe Deutschmann block for the 171 compact. Proper connecting lugs are provided on this block so that connections from it to the Thordarson compact may be made as short as possible.

Fixed resistances may be used if desired (and we personally prefer them) but in this model two variable ones, made by Allen-Bradley and running from zero to fifty thousand ohms, are used. Their position is also shown in the schematic. The fixed 10,000 ohm resistor in series with the variable resistance controlling the 45 volt output is an Aerovox while the 2,000 ohm resistor in series with the center tap of the filament transformer and the negative B is an Allen-Bradley, cartridge type. Rectifier tubes used with the compact were the new 85 milliamper tube made by the Q. R. S. interests in Chicago. These tubes have been run up to their manufacturers' rating and have given excellent results. They fit in the standard UX sockets and thus require no special method of assembly.

In the upper section of Figure 3, are shown the first and second audio stages of the receiver. The filament of the 171 tube being AC is not supplied from the set itself but from the 5 volt winding of the 171 compact. Grid bias for this tube is secured through the 2,000 ohm resistance between the center tapped filament transformer and the negative B line. This bias will be automatic and depend upon the amount of current consumed in the plate circuit of the 171 tube. Please notice that while the grid return of the first audio transformer goes to the negative of the set's C battery, the grid return of the second audio goes to the negative A and B whence it secures its bias on account of the 171 filament not being a part of the set filament supply. The output transformer is used to isolate the direct current from the loud speaker windings.

If desired the entire power compact may be encased in an iron (or other metal) container as shown in the photograph on page 25. This permits not only portability and neatness of appearance, but also allows the set owner to use the compact as a source of power for any other receiver he may happen to have on hand, providing the last tube in such receiver is changed over to use AC on the filament of the 171 tube. Those who have been accustomed to the small rating B eliminators of any kind, will be somewhat startled at the increase in quality on all tones due to a power tube and a greater reserve of power in the compact arrangement than in any of the previous forms of B eliminators. Filament battery elimination is secured from a 5 ampere Balkite charger through an Abox filter which works perfectly.

Going now to the super itself the wiring diagram is shown in blueprint Figure 4. A center tapped loop is used in order to gain regenerative qualities in the first detector which instead of using a grid condenser and leak, makes use of the rectifying properties of a grid negatively biased. This bias is obtained from a common C battery which also carries the pickup coil of the oscillator and the grid return of the second detector. Thus rectification in both the first and second detectors is by the bias method, while the pickup coil is located in this line because of its being more or less at a low potential position in the circuit, obviating the necessity of long wires in the actual grid line itself.

Filament control has again been simplified. This time the first and second detectors, the oscillator and the final audio tube filaments are placed on a one ampere Amperite (4-A) which is shown as R2, while the three intermediate filaments are placed on a 6 ohm rheostat, R1, and may be varied as desired. A further control is a 100,000 ohm variable resistor placed across the primary coil of the last iron core intermediate, as shown in the schematic.

Tuning control is accomplished by a .0005 mfd. Remler on the left side of the set which spans the loop circuit, while another Remler .0005 mfd. at the right goes across from grid to plate of the oscillator tube. A Sangamo .006 mfd. condenser is put in series with the variable condenser to act as a protective measure against accidental shorting of the variable condenser plates and this adding another victim to the tube morgue which most experimenters maintain. This fixed condenser will not have any perceptible effect upon the tuning of the oscillator circuit, although its inclusion will prevent accidents.

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**LIST OF PARTS**

(Articles shown below were used in the model constructed by members of the staff. Other parts of equal merit may be used if desired.)

**Receiver**

- 2 Remler .0005 mfd variable condensers
- 2 Selectone type 400 long wave transformers
- 2 Selectone type 410 long wave filters
- 1 Thor radio frequency coupler (plug-in type)
- 2 Silver-Marshall audio transformers
- 1 Silver-Marshall output transformer
- 1 Qualitone center tapped loop
- 3 Sangamo 1 mfd bypass condensers
- 1 Sangamo .006 mfd fixed condenser
- 1 Sangamo .002 mfd fixed condenser
- 1 Frost 6 ohm filament rheostat
- 1 Frost 100,000 ohm variable resistor
- 1 Amperite 4-A for 1 amper
- 1 X-L variodenser type N
- 1 Jones base mounting plug
- 1 Carter tip cord tip jacks
- 1 Silver-Marshall RF choke coil
- 1 7½ volt Eveready C battery
- 1 Formica 7x26x3/16 panels
- 2 Benjamin standard panel brackets
- 8 Benjamin cushion sockets for subpanel mounting
- 1 Abox filter
- 1 Balkit 5 Ampere charger

**Power Compact**

- 1 Thordarson R-171 power compact
- 1 Tobe Deutschmann condenser block for same
- 2 Allen-Bradley 0-50,000 ohm heavy duty variable resistors
- 1 Allen-Bradley 2,000 ohm cartridge resistance
- 1 Aerovox 10,000 ohm fixed resistor
- 1 Q. R. S. 85 milliamper full wave rectifier tube
FOR the loop input terminals three Carter imp cord tip jacks were used. Another two jacks of the same type were used for the filament terminals from the compact, while two more jacks were put on the subpanel for the output transformer leads to the loud speaker.

Drilling templates for the Benjamin sockets to be mounted directly on the subpanel are furnished with the unassembled sockets. The inch holes may be made either with a 1-inch fly-cutter, or a circle of small holes may be drilled and the center knocked out. For speed in construction a panel cutter that will make an inch hole will be much more satisfactory.

Bias on the intermediate grids is secured from the common C battery and will be somewhat critical for best results. The audio bias will generally run from 1 1/2 to 3 volts negative.

Regeneration in the loop is controlled by the X-L variodenser which should be set for a value which will give regeneration (but not oscillation) at a point about midway between the upper and lower ranges of the broadcast channels, say about 300 or 333 meters. Then the condenser may be left alone and the set logged easily for the entire 94 broadcast channels.

In this article we are not much concerned with the logging of the receiver, since it will run quite true to form with the others which appeared in the November, 1926, and the January, 1927, issues. In its operation by the staff the contested points were rechecked to see that nothing had gone amiss in its construction or in the peaking of the intermediate. Hotbeds of radio disension on most receivers center around 970 kilocycles, 670 kilocycles and 640 kilocycles, and it was our desire to see that ten kilocycle separation was possible with this receiver as with the previous ones. Between WGN on 990 kilocycles and WGES on 950 kilocycles there should be KOIL 980, KDKA 970, and CNRR 960 kilocycles. These three should be neatly separated if utmost advantage is taken of the directional effects of the loop.

Ten kilocycles below WQJ on 670 kc you should pick up WOS on 680 kc, while ten kilocycles above WQJ you should have no trouble in tuning in WIZ on 660 kc. The same should hold true around KFI on 640 kc, with KMA on 650 kc and WFAA on 630 kc. With this set KFI became a laboratory criterion for reception on his signal strength several adjustments being made to see if the volume could be brought up higher. Loud speaker volume on KFI with perfect tone quality was secured without trouble and maintained night after night. The occasional exceptions were when WAPI down in Alabama persisted in polluting the air with third rate music, which we feel did not suit the taste of our distance hunting readers. At times WRC in Washington can muddle up KFI's wave into a distorted tone. One of the evenings on which the receiver was in operation Los Angeles was brought in at 8 p.m. Central standard time, which was considered fairly neat work. No tests were made on the set Monday nights for obvious reasons.

When KRLD at 840 kilocycles is not on the air, CZE Mexico City may be tuned in on the loud speaker. During intervals when WCFL is not on the air (and WEAIF is not too strong) KGW may be brought in although this will depend much more on luck than on design since this West Coaster is not particularly permanent as to volume.

A few last words before finishing the series on the World's Record sets. If blasting occurs on locals shift to a 112 in the first detector stage and go back to a 200-A or 201-A for longer distance work. Do not keep the loop too highly regenerative since too much regeneration will introduce distortion into the signal. Use voltages (plate) as shown in the schematic because these values have been worked out for best quality. Do not expect louder signals on the 171 than on the ordinary tube, but do look for better quality. Do not place bypass condensers too near to air core filters since their proximity to the metal might alter the characteristics. Do not build the set in a hurry—take your time and make it a worthwhile job for you will probably keep it for some time to come.
Building the Hammarlund-Roberts Set

(Continued from page 3)

R. F. stage and the same procedure should now be following with the second R. F. stage.

The antenna “short” “long” switch enables the receiver to be adapted to different types of antennae and should be experimented with until the operator becomes familiar with the best position of the switch for the different wavelengths.

In general, the two tuning dials will read more nearly alike with this switch in the “long” position and this position will also afford the greatest selectivity. When throwing this switch from one position to another it will be necessary to slightly readjust the first tuning dial.

Batteries and Tubes

For the operation of the receiver the batteries and amperites required depend on the type of tube used. It may be noted that the new detector tube UX-200-A or CX-300-A may be used in any of the combinations of storage battery tubes which are listed herein. It is recommended that this type of tube be used if great sensitivity is desirable or if reception over extreme distances is an object of special importance. No change in either battery voltages or amperites is required.

Although either dry cell or storage battery tubes will prove entirely satisfactory, it should be noted that in general, storage battery tubes are more satisfactory than the dry cell type and should therefore be used where possible.

The new power tubes which have recently become so popular well deserve their popularity. For maximum operating efficiency they call for somewhat higher plate voltages and consume a little more A and B current than the 201-A type of tube, but this is more than repaid in the form of greater volume and greater freedom from distortion caused by overloading. Therefore, it is recommended that type 112 or 171 tubes be used in the last audio stage of storage battery tube combinations, and the 120 type in dry cell tube combinations.

A tube combination which is highly recommended for the average installation, is shown below. It may be used without making any changes in the receiver and can be depended on for stability, volume and tone quality.

UX201-A or CX301-A in sockets Nos. 1, 2, 3 and 4, UX112 or CX312 in socket No. 5. 6 volt storage “A” battery. 3.45 volt “B” batteries. 2.45 volt “C” batteries.

To secure in full the advantages of the 171 type of tube, 4.5 volt “B” batteries should be used, and a 40 volt “C” battery should be connected to the “C” or front stage binding post. With these voltages the plate current drawn will be normal conditions is 18 or 20 milliamperes, which is too much to safely pass through the windings of the average loudspeaker.

This difficulty can be easily overcome by connecting a choke coil (such as used in B eliminator filters) directly across the terminals of the loud speaker jack. As the resistance of the average loud speaker windings is considerably higher than the direct current resistance of such a choke, most of the 18 or 20 milliamperes of plate current will pass through the choke coil and so prevent the burning out of the speaker windings. At the same time the alternating current impedance of the choke is so high that practically all of the voice currents will go through the loud speaker and no loss of volume will be noticed.

If the method suggested herewith is used the choke coil may be placed in the rear portion of the left side of the cabinet, two wires run from the terminals of the choke through the space between the front and rear shields, and then soldered to the terminals of the jack.
NOT long ago one of our readers, Gilbert D. Dust, R. R. 6, Dallas, Texas, sent us a circuit arrangement which he has found very satisfactory and which in the original form of submission appeared to be a very complicated circuit. However, a little analysis finally evolved the diagram which follows:

As will be seen this is one stage of radio followed by a regenerative detector and one stage of audio (though in Mr. Dust's sketch two stages of audio were shown). The link circuit shown in this diagram is interesting and might be duplicated by experimenters for their own information and satisfaction. The constants for the set are simple: L1 is the primary coil, consisting of about 10 turns of wire; L2 is about 35 to 40 turns, depending on the variable used; L3 is the primary of the RF coupler and has 10 turns while the secondary, L4, has about 35 to 40 turns; L5 is the regenerative coil of about 25 turns. All coils except the regenerative coil are wound on a 3½ inch tubing with No. 20 DCC wire; the regenerative coil is wound on a 2½ inch tube with No. 24 DCC wire. If you already have an antenna coil and a three circuit tuner you can hook them into this scheme. The link circuit is but a piece of No. 18 DCC wire looped around the secondary coil four turns from the grid end and carried over and looped over the top of the regenerative coil, L5. Probably the link circuit permits a semi-regenerative condition in the first RF tube. At any rate it is interesting and what's more the log which Mr. Dust furnished us is both lengthy and indicative of considerable skill in DX hunting.

RELATIVE selectivity of the different types of sets in use is very aptly illustrated in the accompanying diagram which is excerpted from a recent article on the progress during 1926 of radio receiving sets written by Dr. Alfred N. Goldsmith.

In the diagram it is assumed the receiver in each case is tuned to a frequency of 660 kilocycles (455 meters). The signal field strength required to produce a standard signal of comfortable intensity in the loudspeaker has been plotted as the ordinate of the curves at this point. As the signal frequency is altered (leaving the receiving set unchanged) the corresponding field strength to produce the same standard signal in the loudspeaker are plotted.

As will be seen, the single-circuit receiver requires but little increase in the field strength of an undesired signal, as much as 50 kc. removed from the original frequency, to cause the loudspeaker to reproduce it with standard signal strength. The two-circuit receiver, on the other hand, requires a considerably greater field strength of an interfering signal 50 kc. off the desired frequency to produce an equal disturbance.

When the selectivity curve for the three-circuit receiver is examined, it will be seen that signals as much as 50 kilocycles removed from the desired frequency will be practically excluded unless their intensity is extremely high. This is true in even greater measure for a super-heterodyne receiver with one stage of tuned radio frequency and two stages of intermediate frequency tuning. Under present broadcasting condi-

Cruel Treatment

"And what's more, if I catch you fighting again I'll make you listen to the bedtime stories every night on the radio!"
tions, the ideal curve would be a flat-bottom curve with vertical sides, the width of the bottom being 10 kilocycles (and extending from 655 to 665 kilocycles in the case under consideration). In all the preceding curves, receivers having high efficiency radio frequency tuning stages, electrically separated from each other by one-way amplifiers, have been assumed.

It is clear from the preceding that the trend of receiver design, based on present-day selectivity requirements, has set strongly toward multi-tuning-stage amplification (at radio frequencies and intermediate frequencies).

JOSEPH WEIGHTMAN of Middletown, Ind., makes a simple cone speaker by means of soldering a lug to the center of a common headphone unit, and attaching it to a cone of parchment paper. The housing may be any form, the sketch below showing the kind preferred by Mr. Weightman.

HAROLD E. TAYLOR, 1365 Cass Ave., Detroit, Mich., writes to inform us of his results with the Clough 7 tube super published in the January issue of this magazine. He tuned in successively KPO and KFI and also WHB, while within three miles of WWJ. He arranged the audio end so that the output of the first stage of audio led to the input stage of a Western Electric 6025-B power amplifier. He also found that from an analysis of the oscillator readings his long wave transformers were peaked at approximately 44 kilocycles. (The manufacturer pe a k e d these transformers at 55 kilocycles.) Perhaps a difference of tube capacities would affect the frequency shift; also the proximity of the intermediates to other metallic objects. Other readers have been playing with the Clough 7 tube super and report extremely good results.

FREQUENTLY we have been asked by readers to give them data on the construction of intermediate transformers. This is a subject that is rather touchy with us since we have found as a general rule that satisfaction is not obtained by the reader when making his own intermediates and the failure on his part is reflected back upon the staff of the magazine. So as a consequence we do not recommend that readers make their own intermediate coils. So many factors can enter into the makeup of these units that if a well equipped laboratory has a hard time in keeping accurate matching of inductance values, what chance has the poor home constructor with limited apparatus or unique what must of necessity be a precision piece of apparatus. If members of the staff would only care to tackle the construction of intermediates then we feel we would be derelict in our duty if we intimated that readers might be successful in making their own. It might be perfectly well for a man to make his own mission rocker, or even a davenport, but few individuals would be successful in making their own alarm clock or watch.

BEN SINEFSKY, Box 73, Rothschild, Wis., is one of the first of our readers to report by letter excellent results with the World's Record super 8 which was published in abbreviated form in the November, 1926, issue, and elaborated upon in the January, 1927, issue of this magazine.

Likes Science

MELLON ENGINEERING CO.
Pottstown, Pa.
Radio Age, Inc.,
500 N. Dearborn St.,
Chicago, Illinois

Gentlemen:
I wish to tell you that I like the new sections of your magazine. "Keen- ing Step with Science" and "Every- day" Mechanics", very much. As a whole I think your magazine is one of the best on the subject of radio. However, I'd like to see more articles like "How a Variable Condenser Af- fects your Set Tuning" by Kirk B. Morcross.

Your faithful Booster,
(Signed) Ralph Mellon

Static and Statistics (Continued from page 18)
what his geographical location, who hasn't at some time in his career heard KDKA. In our own early days it seemed that the first week the triumphant cry was, "I've got Pittsburgh," and the second week, "I can't get anything but Pittsburgh." True, at that time, due to its reputation as our most exasperating fader, no one in our vicinity ever thought of receiving all off a program from KDKA, but in this era of tremendous power, and receivers which amaze us by their performance, the fading is reduced to a minimum, and it is now possible to spend an evening with the Pittsburgh station with as good reception as any other equally distant broadcaster. At times, in fact, they register with such volume that it is either a case of turning them out or getting out of the house, and if there is anyone in South Africa who hasn't heard the Westinghouse Band, when the engineers are trying to get it there, he would do well to check up on his set.

One is constantly running across some interesting experiment when tuning in on this station which would relieve the monotony, if such a thing could exist where such a versatility of broadcasts is going on from the various studios from morning till night. And the many educational and informative programs that are continually going on the air are as familiar to the average listener as the murky condition of the atmosphere surrounding KDKA's antennae. One notes a painstaking thoroughness in everything they do.

For instance when Pittsburgh gives football scores it isn't the results of a meagre dozen or more major games you hear—it's a sporting lexicon of every contest taking place on American soil that day. And so dependable are the news broadcasts from the Pittsburgh Post studio that when something of importance breaks, it is a common thing to hear, "Well, we'll wait and get it from Pitts- burgh."
Our oldest friends among KDKA's standard features are the aforesaid Westinghouse Band and Victor Saudeck's Little Symphony Orchestra, the latter one of those sterling radio organizations that is always to be depended upon for sound presentations of standard works. In the days before the large symphony orchestras were put on the air we were indebted to this group for some of our most precious half-hours of musical enjoyment, and they still preserve their high standard.

In addition to its sustaining programs, KDKA presents a number of commercial features, one which has interested us being the Teaberry Hour, and in addition has its own combination of hook-ups, though whether this claim is to be continued under its apparent arrangement with the National Broadcasting Company is not entirely clear at the present time.

But whatever develops in this rapidly moving industry, one is confident that the pioneer station will go steadily on furnishing us with dependable entertainment as it did back in those primitive days when its audience was listening painfully through uncomfortable headsets instead of taking its ease before elaborate mahogany cabinets from which rolls music in tremendous volume. And one notes with much satisfaction that no matter how many pirates perch on the 809 meter wave, the Westinghouse station apparently just increases its power and comes roaring through as though it were alone on the air.

Openshaw Now With Pilot

MARTIN OPENSHPAW, of Amperite fame, has resigned from the Radiant Company to accept the post as General Sales Manager of Pilot Electric Manufacturing Company, Inc., Brooklyn, New York.

---

Improve Your B-Eliminator with Allen-Bradley Resistors

When you build a B-Eliminator, be sure that your kit contains Bradleyohm-E for plate voltage control and Bradleyunit-A for the fixed resistors. Then you will be assured of perfect plate voltage control.

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**PERFECT FIXED RESISTOR**

This solid, molded fixed resistor has no glass or hermetic sealing in its construction. It is a solid unit, molded and heat-treated under high pressure, that is not affected by temperature, moisture and age. The end caps are silver-plated, and can be soldered without affecting the accuracy of the Bradleyunit. By all means, use Bradleyunit-A when you need a fixed resistor in your radio hookup.

Always insist that Bradleyohm-E and Bradleyunit-A are included with your B-Eliminator kit. You then will be assured of perfect voltage control.

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Hookups.

---

Use Allen-Bradley Perfect Radio Devices
A Loop and Four Tubes
(Continued from page 8)

dragging in things. The builder must be as careful about his angles as a Chinese architect. The Chinaman builds his house without any regard to the line of the street because a certain position of the house will make it hard for the evil spirits to come in. Take a tip from the Chinaman or the goblins will get you. Parallel wires have an inductive effect upon each other when the current is flowing. To reduce induction to the minimum, wires should be at right angles.

Shielding often is used by amateur and professional set builders. The shields are metal plates or boxes and they are grounded so that any roving field of energy that is seeking a playmate may be intercepted and precipitated to earth.

The diagram shows no tuning coils, which proves that not all manufacturers and dealers put into a diagram everything that they have for sale. The variable condenser shunted across the loop takes care of the tuning. It is placed in the antenna or ground lead when the loop is discarded. A 50-turn coil or a variable might be employed. It would be connected to the antenna and the ground wire, and the end next to the antenna would be connected with the grid of the first amplifier tube.

In order to secure satisfactory results with a loud speaker, it probably would be necessary to add two stages of audio-frequency, with one of the new power tubes in the last stage. Radio-frequency amplification builds up the weak signals to the point where they can pass the detector, but it does not increase the volume of sound as audio-frequency amplification does.

This is the set to build when the family declares itself to be sick of radio loud speakers, or when the family monopolizes the household receiver and prevent dad or the oldest son from hearing what they crave for. With the phones on and his favorite station tuned in, the constructor can let the rest of the world go by.

The diagram lends itself readily to the construction of a portable set. In the early days of broadcasting a Washington inventor built a set in a suitcase and it made a hit. With a collapsible loop, or one built in the cover of the case, such a receiver can be carried easily in an automobile, train or steamship. It might be very valuable as a means of keeping in touch with the stock market or produce exchange. Trucking and taxi concerns have used such outfits for the purpose of communicating orders to drivers, saving the time and mileage required for visiting or calling up a central office. They were successful, so far as one-way communication could be satisfactory, but it is impractical in these days of crowded airplanes to equip trucks and cabs with transmitters to use in acknowledging receipt of orders, and drivers are as expert in using alibis as in using radio.

It is hardly necessary to tell the amateur who has worked his way up to a four-tube set that the selection of parts is highly important. The best are the cheapest in the long run or in the short run either. Good workmanship is essential to success. A one-tube set may work after a fashion even if it is thrown together, but when three stages of radio-frequency are employed, every connection must be made with care so that it will be non-microphonic. The tubes must be cushioned so that slight jars will not set the bells a-ring. Wires must be as short as possible and must be placed at angles that will minimize inductive effects and effects of capacity. Panels must be of excellent insulating quality. Necessary marks on panel and baseboard must be scratched, not made with a pencil. A pencil mark makes a good grid leak but it can do a lot of damage when it connects parts that should not have a conductive pathway between them.

An extra ground wire may reduce interference. Four miles from America's strongest transmitting station an experimenter ran out a wire from his six-stage radio-frequency amplifier and laid it on the lawn. After that he was able to hear stations that formerly were drowned out by interfering waves from the powerful station. These were so strong that at times they made the loud speaker diaphragm throw a stream of air that would blow out a match, while the speaker bellowed like a factory whistle.

Four tubes provide an opportunity for endless experiments and valuable discoveries may be made. Resistance or capacitative coupling may be used in place of transformer coupling. Different types of tubes may be tested in all sorts of combinations. A four-tube set should be able to bring in the European broadcast stations when the radio weather is good.

Constructors who enjoy the building process more than quick results can design a four-tube set from the bottom up. Others will prefer to purchase a kit with diagrams and templates. Complete kits can be purchased from many manufacturers and dealers, with panels all drilled and everything included except what the packer forgot to put in.
Above is shown the new Timmons Concert grand cone speaker, which instead of being an exact oval, is an elliptical cone, having its driving mechanism located at the lower focal point of the ellipse. Offsetting the driving unit, it has been determined by the Timmons Radio Products Co., results in securing a much greater surface for actuation with a limited physical dimension of the cone itself. Recent tests by the staff of RADIO AGE have shown it to be equal to, if not better than, our laboratory criterion.

Protect Oil Fields From Lightning

Protection of oil fields from lightning is believed by western oil men to be assured through the scientific researches of John Milton Gage and his associate, Dr. Alfred Walter Simon, of Los Angeles. By means of wire devices encircling the oil tanks, the inventors hope to ward off the shafts of lightning and save millions of dollars for the oil companies of this country. Gage is the inventor of the apparatus. Nearing above the pool of oil built into the experimenters’ laboratory at Los Angeles represents thunder clouds. John Milton Gage (right), points at “protection wires” which in the laboratory experiments fend off the shafts of lightning from above.
An Index to the Best in Radio Hookups!

How long have you postponed making that favorite hookup of yours because you couldn't find reliable and clear diagrams? We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

January, 1925
- A Six-Tube Super-Het.
- An Efficient Portable Set.
- A Tuned Plate Regenerator.
- Making a Station-Finder.
February, 1925
- A Three Circuit Regenerator.
- A Resil Low Loss Set.
- Blueprints of a 2-tube Reflex.
March, 1925
- A 4-Tube R. F. Receiver.
- How to Wind Low Loss Coils.
- A Short Wave Receiver.
- Blueprints of a Two-Tube Ultra Audion and a Regenerative Reflex.
April, 1925
- A 3-Tube Portable Set.
- "B" Voltage from the A. C. Socket.
- An Amplifier for the 3-Circuit Tuner.
- Blueprints of a Five-Tube Radio Frequency Receiver.
May, 1925
- A "Quiet" Regenerator.
- How to Make a Tube-Tester.
- A Unique Super-Het and an Improved Rein-arts.
- A Six-Tube Portable Receiver Illustrated with Blueprints.
June, 1925
- Reducing Static Disturbances.
- A Seven-Tube Super-Heterodyne.
- Browning-Drake Receiver.
- Overcoming Oscillations in the Roberts Receiver.
July, 1925
- Learning Tube Characteristics.
- How Much Coupling?
- Blueprints of Conventional Radio.
- Symbols and Crystal Detector Circuit.
August, 1925
- How to Attain Smooth Tuning.
- Alternating Current Tubes.
- Deciding on a Portable Super.
- And a big 60-page blueprint section.
September, 1925
- Thirty-one ways to prevent self-oscillation.
- Tuning efficiency with two controls.
- Ideal Audio Amplifier Circuits.
- Blueprint section.
October, 1925
- Auto-Transformer Coupling.
- Some Facts about Quality.
- An Improved Slide-Wire Bridge.
- Blueprints of Circuits Using Single and Dual Controls.
November, 1925
- A Good Audio Oscillator.
- An Efficient Short-Wave Transmitter.
- Blueprints—Adding R. F. Stages.
December, 1925
- Tuned R. F. and Regeneration.
- Radio Age Model Receiver.
- Inductive Gang-Control Receiver.
- Tuning with Chart Curves.
January, 1926
- Radio Age January Model Set.
- A Four-Tube Toroid Set.
- Power Supply Device—Blueprint Feature.
- Finishing Your Radio Cabinet.
February, 1926
- February Radio Age Model Set.
- Plug-in Coil Receiver.
- Universal Testboard—Blueprint.
- Eliminating Audio Distortion.
March, 1926
- Improving the Browning-Drake.
- Phaseless Tubes in a Set.
- Which Type Intermediate?
- How to Make a Wavemeter—Blueprint.
April, 1926
- Shielding Your Receiver.
- Home Testing Your Tubes.
- Balanced Capacity Receiver.
- Several Sets on One Antenna.
May, 1926
- Short Wave Transmitter—Blueprint.
- Simplifying Battery Changing.
- List of European Broadcasters.
- Protecting your Inventions.
June, 1926
- Antenna Design.
- Simple Crystal Set.
- Improving the Neutrodyne.
- Golden Rule Receiver—Blueprints.
July, 1926
- Compact Portable Super.
- Short Wave Receiver.
- Shielded Golden Rule Set.
August, 1926
- Receiver, Transmitter and Wavemeter.
- Beginners 200 mile Crystal Set.
- History of Amateurs.
- Changing to Single Control.
September, 1926
- How to Make a Grid Meter Driver.
- Short Wave Wavemeter.
- Power Amplifier for Quality (Blueprint)
October, 1926
- Crystal Control Low Power Transmitter (Blueprint)
- Raytheon Design for A B C Elimination.
- What Type Loud Speaker to Use.
- Nine Tube Super Brings Back Faith.
November, 1926
- Blueprints of the Henry-Lyford.
- World's Record Super With Large Tubes.
- How to Use a Power Tube in Your Set.
- Illuminated Controls on 4 Tube Receiver.
December, 1926
- Starting Radio with Crystal Set.
- Six Tube Shielded Receiver.
- Types of Rectifiers Discussed.
January, 1927
- Full Data on World's Record Set.
- Dual TC Receiver.
- Doug Super Design.
February, 1927
- Building the Hammarlund-Roberts.
- Making a 30 Inch Cone Speaker.
- Data on the B-T Power Six.
- Browning Drake Power Operated.
He Talks to the Air

Arthur ("Bugs") Baer, newspaper and vaudeville humorist, who recently appeared in Every Day Hour program.

"Bugs" had his own private idea of how a radio announcer should direct himself between musical numbers of a program, so he was asked by Every Day Hour program directors to prepare his announcements as well as deliver them.

Good News for Radio Listeners

Radio legislation of an adequate nature now seems assured with the agreement by congressional conference committees embodying the following provisions:

A commission of five members appointed by the President for a term of six years each.

The commission will have original jurisdiction in granting, renewing and revoking all station licenses for a period of one year. Thereafter the Secretary of Commerce shall be the originating source, and only matters of a controversial nature appeared either by the Secretary or any party aggrieved will be handled by the commission. The Secretary of Commerce is given all administrative functions and full control over operators and their licenses. The act is to take effect upon passage and signature by the President. All commissioners must devise themselves of any radio interests or radio holdings. Broadcasters must sign a waiver of their right against the government to use any wavelength.

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Please Mention Radio Age When Writing to Advertisers.
Radio Is Used to Find Auto Noises

What does the voice look like? Of course you have never seen it. But visitors to the General Motors building in Detroit recently were able to see projected upon a screen the sound waves their voices made. They saw, also, how General Motors has harnessed radio and put it to work to make better automobiles. It was a demonstration in popular form of the more delicate and elaborate apparatus used in the G. M. Research Laboratories for finding automobile noises.

What the microphone tells about a motor. Upper pattern shows a tuning fork vibrating at a pitch of 12 cycles. The lower pattern is that produced by striking on the pan of the car with a hammer. Note the change in the pattern at the moment of impact.

Noises are sounds having irregular and complex waves. To study them, it is necessary to reproduce them faithfully on a photographic film, where they may be measured. The resulting data are used to trace the offending noise to its source. The apparatus used in the General Motors Laboratories consists of three distinct units:

1. The microphone.
2. The vacuum amplifier.
3. In the oscillograph a tiny spot of light reflected from the moving element vibrates back and forth across the photographic film revolving on a drum. After development the film shows a trace representing the waveform, intensity and pitch of the sound picked up by the microphone.

Ordinary radio equipment is not accurate enough for this work, and each of these devices must be specially built.

Noise hunting in cars is difficult because vibrations may be

“telegraphed” from one member to another. There is always the danger that the wrong member will be accused of making the noise. It often happens, too, that when the real source is found, the changes necessary to remove it cannot be made. In such cases one or more of the members, through which the noise is being “telegraphed” to the air and the passenger’s ears, must be changed so that they will no longer respond to the vibrations of the offending part.

MAKE YOUR OWN CONE OR ROLL SPEAKER GENUINE ENSCO KIT

Only $10

The Sensation of 1926-27

MAKE YOUR OWN THREE FOOT CONE SPEAKER IN LESS THAN AN HOUR. Complete parts furnished to kit form. We guarantee this speaker the equal of any manufactured cone speaker at any price.

With this THREE FOOT CONE SPEAKER you may use all the tones. It brings out the true depth and richness of instrumental music. Can be operated softly for living-room music or full volume for dancing and stage use. Complete kit includes famous “ENSCO” cone unit, the only direct-drive, diaphragm units for large horns. All horns Forest for big cone, with brass apexes, blueprints showing five different types of cone and rollpeaker construction. All necessary instructions. Buy this wonderful speaker under our absolute guarantee. Your money back if you are not convinced that it is the finest reproducing medium obtainable at any price. It works on any set, with ordinary tubes or with Power Output.

Send No Money!
Write your name plainly as indicated below, then mail and envelope kit will be forwarded to you. Just pay postman $1.00 upon delivery.

Screws and nuts are furnished.

ENGINERS’ SERVICE CO., 26 Church St. (Desk A), New York City
WESTERN DISTRICT OFFICE AND
911 Steger Building Chicago, Ill.

Please Mention Radio Age When Writing to Advertisers.
Studies Three Inch Pieces of Light

A METHOD for cutting off three-inch pieces from a beam of light, like a meat cutter slicing a bologna sausage, though the light moves at 186,000 miles a second, was described to the members of the American Physical Society, at Philadelphia, by Dr. Ernest O. Lawrence and Dr. J. W. Beams, of Yale University.

Though light travels so fast it can encircle the earth seven times in a second, Dr. Lawrence and Dr. Beams made use of a shutter that turned the light on and off with such rapidity that each “piece” of light was only about three inches in length.

The investigation was undertaken in an endeavor to measure the length of what are called “quanta” of light, for according to modern ideas, light is transmitted as separate pulses, each of which is called a quantum. Physicists have been uncertain as to how long these quanta are, but by some it was believed that they were as much as a yard in length.

These extremely short flashes of light were measured by a very delicate photoelectric cell, which gives off an electric current when illuminated, and they found that so long as the total amount of light reaching the cell was the same, the resulting current was not affected by the length of the individual flashes. One three inches long produced as much effect as a piece of light many miles or more in length, and this shows, say the investigators, that the individual quanta are less than three inches in length.

Gurney with Enesco

Milo Gurney, formerly technical editor of Radio Digest, has opened a Western district office and studio of the Engineers Service Co., at room 911 Steger Bldg., Chicago, Ill.

This gives the Chicago area representation in a product—cone speakers—which are now attracting a good deal of attention from the radio fans.
SOMETHING NEW IN RADIO

You need no longer delay your purchase of a high quality receiving set. With this new model you may now buy as you go and decorate the cabinet to express your individuality. The complete Art Cabinet model may be purchased much as you would a sectional bookcase.

You can start with the Rimba CN-6 tube tuned radio frequency receiver, purchased on a ten-dollar trial loan. This may be used as an air band set.

Price $73.00
You may then add a portable case, which may be used for making your own name, for only $12.50.

The New Idea Radio Co.
3658 W. Grand Ave.
CHICAGO

Fish Paralyzed

ONE of the latest freaks displayed by lightning is the paralysis of fifteen fish reported to the U. S. Bureau of Fisheries from one of its stations in Maine. After a severe thunderstorm the fish were found lying in the bottom of the pond apparently lifeless. After raising them to the surface it was found they could move their heads but the bodies were paralyzed. After several days their condition was unchanged. The other fish in the ponds were affected only by a loss of appetite for a couple of days.

Thousands of friends of Jack Nelson will be interested in learning that the famous studio star is taking a rest from active duty and that he has severed his connection with the Mooseheart-Palmer House-Edgewater Beach Hotel-Herald and Examiner station, known rather cumbersomely over the air as WEBH and WJJJD. The four-ply radio station was not the best background for a man of Jack's ability in any event. Where so many interests are combining, perhaps for reasons of economy, to present programs, there is likely to be a tendency toward a lack of individuality. Jack is nothing if not individual. He was the pioneer who made WDAP famous five years ago. Radio listeners will be glad to have him back on the air where he can have more latitude and do his stuff in his own way.

Prof Gets Mike Fright

A college professor, trained in speaking, recently took fright at the microphone of WGY and found himself speechless. He was scheduled to deliver a ten minute talk between selections by a high school chorus of fifty voices. The young people left the studio as the speaker was being introduced by the announcer. The professor went to microphone but no sound came and he began to wave his arms in signal of distress so the announcer cut the microphone off.

"Bring the chorus back in the studio," begged the professor.

So the young people were herded back and the professor began his talk, confidence returned with the atmosphere of the school room.
belle of Belvidere, and smile inscrutably into the camera, almost unbelievably scornful of the two gun with which Looney Luke had him covered! Isis was over there now, waiting to share in the triumph of the final rehearsal. Officers of Apollo Pictures, Inc., were in the eager gallery of spectators. Apollo Pictures had hastened Bill through its novitiate, spurred on by the fact that the only other available actor-rider recently had lost his health by habitually leaving ginger ale out of his rickeys and the starving nation was crying for more blood and sand and sage brush.

When all was ready Bill's tall figure straightened as if galvanized. His eye flashed as he took an extra hitch in his belt and slapped the dust out of his chaps. Stepping forward in his first major movement of his symphony he placed his right foot upon a grapefruit which had been lost by a screen-mad little girl from Indianola, Ia. The grapefruit emitted a damp hiss but it was too late. This trivial mishap so modified Bill's leap that instead of jumping upward at an angle of 82 degrees he jumped horizontally.

Percival, the grand old roan of the silver sheet, caught Bill on his starboard midriff. The horse grunted horridly and then, turning about and seeing Bill lying cold upon the synthetic desert sands the faithful old walker walked over leisurely and stepped, once, on Bill's face.

Upon departing from Los Angeles Bill Rossum went directly from the hospital to the railroad station. He was accompanied by Isis Osiris, who had nursed him through his convalescence, with the aid of the hospital doctors and nurses, and who was now to follow him to the world's end, if need be, for she had surrendered her heart and her hope of a career at the same time.

Nobody in Fortunatus knew the true story of this chapter in Bill's life, with the exception of Bill and Isis. Bill never thought it necessary or in good taste to speak of it and Isis had no opportunity to do so, for as soon as Bill began to make really important money Isis spent her winters in Florida and her summers in Switzerland.

As Bill stopped at the cashier's desk of the hospital to pay his chits he was mildly surprised at the obsequious way in which the cashier handed him the bad news. Secretly he had been worrying lest his adventure should have made him the butt of ribald or college humor. But there was no lurking smile behind the courtesy and deference of the cashier. As Bill and Isis strode along the train platform at the station, porter after porter bowed as porters bow only to the truly great. Once started on their journey the Pullman conductor asked Bill if he would not prefer to change his drawing room to one with a southern exposure.

"There is something wrong somewhere," mused Bill. "Whom do these people think me to be?"

Isis looked across the tiny compartment at him, the dawning of a great idea playing upon her countenance.

"I've got it, Bill," cried Isis. "It's your face."

She handed him her mirror and for the first time since Percival stepped on him Bill looked upon the image of his countenance. It was the face of a master of men. The horse's foot had raised his brow and widened it. His eye, formerly pleasant, now, under over-slung brows, had a malevolent expression which made him catch his breath. His mouth, once ordinarily good, had been kneaded into an expression of grim determination and abysmal cunning. It was such a mouth that must have been the first to say: "They shall not pass." His nose, once Greek, was Roman.

"I see," exulted Bill Rossum, hurling aside the mirror, "I see, I see."

Hours later, as the train went around a bend, Bill and Isis caught a glimpse of distant skyscrapers, hundreds of them, etching a jagged skyline.

"Fortunatus!" whispered Bill. "I will play on that town like a fiddle."

---

A KICK IN THE FACE

transformed Bill Rossum from a third rate movie actor into a master of men—

This startling metamorphosis is but one of the thrilling events in the absorbing serial, "The Froth Estate," by Joseph Balsamo, now running in RADIO AGE.

A big circulation war between powerful newspaper interests; a gigantic tussle in which no weapon is barred nor money spared to insure the defeat of the newcomer in the field.

Read the April issue of this magazine for details of a plot undreamed of in the annals of newspaperdom.

Place your order now with your newsdealer for the April edition; or better still turn to page 51 where you will find a handy subscription blank. Fill it in now to make sure of your getting each installment of this galvanic narrative, the first of its kind ever published in the world.

500 N. Dearborn St. RADIO AGE, Inc. Chicago, Ill.
Absorption Circuit Used to Rid Super of Repeats

Experimenters May Find Solution of Their Problem in Recent Patent

One of the most interesting circuit arrangements, from an experimental standpoint, is disclosed in the recent application granted by the patent office to William F. Diehl, of Jamaica, N. Y., on a method of coupling an absorption circuit to the oscillator of a superheterodyne to eliminate repeat points in its operation.

Application was filed on December 19, 1924, and granted on November 30, 1926. The description given herein is taken from the claims in the Diehl papers.

In the conventional superheterodyne the oscillator creates a locally generated current, which when combined with the signal current (incoming from the loop or antenna) gives in the plate circuit of the first tube, a current of intermediate frequency. This plate circuit is tuned to the intermediate frequency by the capacity C3 across the primary of the intermediate transformer, and passes through amplification into the intermediate stages where it is finally detected and amplified by audio transformers. The frequency of the current supplied to the intermediate amplifier is equal to the difference in frequency of the signal current coming into the loop and that current generated by the oscillator. From this it will be seen that the same value of intermediate frequency will be obtained for two values of frequency in the oscillator circuit. This circuit can be set to generate either a higher or lower frequency than that of the incoming signal, resulting in the appearance of a given station’s signals in two positions on the oscillator dial. This has been considered an objectionable feature of the super, and the method outlined by Mr. Diehl is advanced to eliminate one of the repeat points, by the following improvement:

A third circuit is added to the conventional super, consisting of L1 and L2 in the schematic on this page. L1 is the usual pickup winding, while L2 is a tuned absorption circuit. This absorption circuit is coupled electrically to the oscillator circuit, and mechanically coupled to the loop circuit through a common insulating shaft for the rotors of the capacities C and C2.

Assuming a received signal of 1000 kilocycles, an intermediate frequency of 50 kilocycles; the conventional super would receive with an oscillator setting of either 950 or 1050 kilocycles.

With the addition of the absorption circuit which is tuned to 1050 kilocycles, resistance will be introduced into the oscillator circuit at 1050 kilocycles and prevent oscillation at that frequency, leaving, however, the 950 kilocycle oscillation required to mix with the incoming signal. Or the absorption circuit may be set for 950 kilocycles so that with this setting resistance is increased at 950 kilocycles in the oscillator, stopping its oscillation at that value, and letting the 1050 kilocycle oscillation go through unimpaired. The values of intermediate frequency are merely illustrative. The system should work with any of the commercially made long wave transformers. The degree of efficiency with which the system

Interesting scheme disclosed by William F. Diehl for coupling an absorption circuit to the oscillator in order to swallow one of the undesired repeat points in a super.
works will depend a great deal on the care with which the absorption circuit L2 is made. The portion of the absorption circuit which is spanned by C2 should be approximately equal in inductance to the value of the grid tuned inductance in the oscillator. Its coupling primary may be of approximately five to ten turns, the exact value being found by the individual experimenter. The coupling coil L1 may be any type of winding, about five to ten turns per coil. Capacity C2 should be equivalent to that of C1 in the oscillator circuit.

As yet this system has not had any commercial application of which we know, but from the tinkerer's viewpoint it will serve to while away the hours at the workbench, making up the coupling units to work best for absorption purposes.

Navy Has Private Hospital for Sick Carriers
Chester Brackhausen, trainer at the Anacostia pigeon loft, is shown giving first aid to "Endurance," one of the birds carried on the Alaskan Mapping Expedition and also a veteran of the A. E. F., having served as a carrier during the World War. "Endurance" is one of the prize birds of the thousands of carriers trained at the naval air station for use in the service. Anacostia has the largest training loft for carrier pigeons in the United States.

Young Sea Worms Fathered by Live Wire
FIRST stages of growth of the eggs of a common sea worm, Nereis, have been produced in the laboratory, with no other father than an electric wire, by Dr. Ware Cattell of Memorial Hospital. The work was done at the marine biological laboratory at Woods Hole, Mass.

Dr. Cattell placed egg-bearing female worms in dishes of sea water, and turned an electric current on them with specially designed apparatus. The shock caused them to discharge their eggs, which were subsequently found to be acting as though they had been fertilized in the normal manner with the male elements. A part of these electrically activated eggs carried on growth as far as the earlier stages of larval life.

During the past few years, unfertilized eggs of many species of animals have been caused to develop, sometimes to advanced stages, by chemical treatment, heating, pricking with needles, and a number of other stimuli; but the present experiment is the first in which an electric shock has performed the function of parenthood.

Here is "Doctor" Glenn and his patient Mr. Ford. When the Famous Lullaby Boys arrived in Cincinnati to broadcast over WLW, the Crosley station, big Ford was ill and some of the first of their programs were broadcast direct from their hotel, where Ford remained in bed.

Ancient Living Cells Found in Cactus Plant
WHAT are perhaps the oldest living cells in the world have been discovered by Dr. D. T. MacDougal, of the Carnegie Institution of Washington, in the stems of some of the giant cactus plants on the Arizona desert. These remarkable Methuselahs among living cells are certainly more than a hundred years old; some may be two hundred years old. All living creatures, including man, are composed of tiny living units which can be seen under powerful microscopes. These are the cells. Although men may live a hundred years or even a little longer, the living cells of the muscles and the blood and other tissues usually die from time to time and are replaced by new cells. Only in the nervous organs, including the brain, is it probable that individual living cells last during the entire life of the body. In the body of a very old man a few brain cells may be as old as he is and almost as old as the cells which Dr. MacDougal has found.

SM
Freaks
Or Fundamentals?

S-M audio and output transformers have enjoyed the same phenomenal popularity as have other S-M products—simply because every feature of their design is based upon fundamental engineering practices.

As an example, the primary impedance of an S-M 220 audio transformer (the factor which governs the "flatness" of the frequency versus amplification performance curve) is the highest of any known transformers. It is 15,000 ohms at 20 cycles—625,000 ohms at 1,000 cycles. The factor that results in high primary impedance—and uniform amplification—is the high primary inductance. High primary inductance is the direct result of a large number of primary turns and a large core of high grade steel. The primary inductance of an S-M 220 is 100 henries, under operating conditions. It is the highest of any known transformer.

Therefore, remember when you buy an audio transformer that uniform amplification from 30 cycles up to 5,000 depends upon primary inductance, this upon primary inductance, this in turn upon a large core and many turn windings, and those upon the physical size of the transformer.

There is no short cut of good engineering to real quality. That is why the S-M 220 audio, the design of which is not a feat in mathematical juggling, but an application of sound engineering, is guaranteed to give you better quality than you've ever heard before. That's why the return average under this unheard of guarantee is but one in every four thousand.

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Geranium-Scented Boiler Rooms For Power Plants

DIPHENYL oxide, a white chemical with a powerful reek like geranium scent raised to the nth degree, is the newest stunt in the efforts of engineers to get double work out of every shoveful of coal that goes into the firebox. The trick consists simply of using the chemical in one boiler to run one engine, and then using the exhaust vapor from that engine, still very hot, to raise steam from ordinary water in a second boiler, according to Dr. H. H. Dow, manufacturing chemist of Midland, Mich. Dr. Dow has been experimenting with one of these bi-fluid boiler systems for some months, and states that it has proven itself quite successful and very economical of fuel.

The idea of getting double use from the original firing of fuel was tried first with mercury as the liquid in the first, or high-temperature boiler. From certain points of view this metallic liquid is almost ideal, but its great weight and considerable initial expense, together with constant losses, interposed engineering and economic difficulties. Furthermore, any leakage of mercury vapor is almost certain to be injurious to the workmen in the plant, because mercury is exceedingly poisonous. For these reasons therefore Dr. Dow sought for another liquid that would be light, cheap, and non-poisonous, and still have high capacity for carrying heat over into the second boiler to generate steam for the second engine.

A number of organic chemical compounds were found to possess these qualities, but at the temperatures used in boilers they tended to break apart into other compounds useless for power purposes and to clog the boilers with carbonaceous materials of no use for carrying heat. Diphenyl oxide, however, has been used and recondensed and used over again many times at a pressure of 200 pounds per square inch and a temperature of 800 degrees Fahrenheit, with but little deterioration. It weighs but little more than water, as contrasted with mercury, which is heavier than lead. Its price is only 30 cents a pound in quantity lots, which according to Dr. Dow makes its cost, volume for volume, less than two per cent that of mercury. The compound has been produced hitherto in comparatively limited quantities because its only use has been in the perfume industry, but Dr. Dow states that there is no limit on the bulk that can be made.
Further Notes on the Worlds Record Super 8

QUITE a number of super fans have written in regarding the superheterodyne featured by RADIO AGE on page 18 of the January, 1927, issue. Out of the host of letters received only two readers have failed to get the results they expected. Their questions have since been answered and it is hoped by this time these two gentlemen will have fixed up their set.

Two or three points may be of interest to those who have either built the set, or contemplate doing so. The schematic circuit shown on page 18 is electrically correct and should be followed for the wiring. The choke coil shown in the drawing as RFC may be eliminated from this set if desired since using a series feed on the oscillator plate the coil is not essential.

For use with batteries (dry or wet) the 22, 67, 90 and 135 volt connections are correct. However for use with eliminators having only four taps, the 67 and 90 volt wires may be joined together and run to the 90 volt tap on the eliminator. The 22 and 135 volt wires are all right for either eliminator or batteries, but since most eliminators have only the 45, 90 and 135 volt taps some provision had to be made for the 67 volt terminal being supplied.

Another point of interest is the fact the bias on the intermediate stages (to which is joined the audio bias) is more or less critical for best results. Tune in a distant station (or a local with volume cut down) and then adjust the bias on the intermediates for best quality and volume. The C battery in the center tap of the loop may also be shifted until a value is found that delivers best quality and volume.

If the loop circuit is too highly regenerative (that is, oscillates too freely) the 0.005 mfd. fixed condenser shown between the plate of the first detector and the filament of the same tube, should be used. If the loop circuit does not oscillate at all, the 0.005 mfd. condenser referred to should be removed.

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RADIO AGE SUBSCRIPTION BLANK

Radio Age, Inc. 500 North Dearborn Street, Chicago $2.50 A YEAR

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(3-27)

Please Mention Radio Age When Writing to Advertisers.
Standardization Is Responsible For Radio Industry Stabilization

By A. J. Carter*

THERE has been recently a great deal of comment through the medium of the press regarding the need for standardization in the radio industry. It is apparent that the radio public does not realize what great strides already have been made. Neither do they appreciate what a vast amount of research is required.

Great care must be taken to prevent standards from being adopted that will limit or retard the development of new products and ideas. Consequently this is a task that can be done only by engineers who have had experience in every phase of the industry.

The Radio Manufacturers' Association is ideally equipped to carry out this work since it is composed of the principal and representative manufacturers of the radio industry, consequently having the support and co-operation of their engineering departments.

The work is being carried out systematically by means of sub-committees composed of engineers and representatives of interested manufacturers. Public opinion and that of manufacturers is solicited by means of questionnaires. This information, supplemented by the experience of engineers, forms the basis of a recommended standard specification which is submitted at a regular meeting for final acceptance.

Sub-committees have been formed to investigate the following subjects. Many of their recommendations have already been adopted; others will make their reports at subsequent meetings:

1. Wiring Devices (Cords, colors, cord tips, etc.)
2. Variable Condensers and Dials
3. Rheostats
4. Transformers
5. Plugs, Jacks and Switches
6. Sockets
7. Receiving Sets
8. Vacuum Tubes
9. Test Instruments
10. Arrestors and Aerials
11. Panels
12. Resistance Units
13. Condensers (Fixed)
14. Radio Wiring for Buildings

New committees are being formed from time to time and this work will be carried on indefinitely. It is the aim of the R. M. A. eventually to standardize the entire industry.

The co-operation of the Institute of Radio Engineers and the excellent support of the industry as a whole have resulted in bringing about, in two years, a degree of standardization that required from six to ten years in the automobile and other industries.

It would be too lengthy to give details regarding the benefits already derived from this work. One of the most important effects, however, has been the tendency toward stabilization, which is brought about in the following manner.

The raw material supplier is benefited because there is a greater demand for standard material. Consequently he can anticipate demands, carry a larger stock, and give better deliveries at a reduced cost.

The manufacturer having a ready source of raw material can keep his plant running constantly, make prompt deliveries, thus preventing cancellation of delayed orders.

Radio misfits have practically ceased to exist. Parts are interchangeable, therefore the dealer and jobber are not required to carry duplicate stocks of parts. The manufacturer has, in this way, earned the confidence of the trade. In view of this the jobber and dealer are likely to order in advance of the consumer demand.

Standardization has already enabled manufacturers to furnish the consumer with a better product at a lower cost.

The radio industry has made rapid progress and it is largely due to the foresight of the R. M. A.
| WRAM | Lombard College | Galesburg, Ill.  244 |
| WRAV | Antioch College | Yellow Springs, Ohio  263 |
| WRAW | W. A. Radio & Electric Corp. | Reading, Pa.  238 |
| WRAX | Berachah Church Inc. | Philadelphia, Pa.  268 |
| WRCB | Emmanuel Lutheran Church | Valparaiso, Ind.  278 |
| WRC | Radio Corp. of America | Washington, D. C.  468 |
| WRCO | Wayne Radio Co. | Raleigh, N. C.  252 |
| WREC | Wooten's Radio Shop | Whitehaven, Tenn.  254 |
| WREO | Motor Car Co. | Lansing, Mich.  285 |
| WRES | H. L. Sawyer | Woburn, Mass.  300 |
| WRHR | Wash. Radio Hospital Fund | Washington, D. C.  256 |
| WRMH | Rosedale Hospital, Inc. | Minneapolis, Minn.  219 |
| WRK | Aeromotor Corp. | Hamilton, Ohio  270 |
| WRM | University of Illinois | Urbana, Ill.  273 |
| WRMU | A. H. Grebe & Co., Inc. | Motor Yacht "MIU"  236 |
| WRRY | Experimental Publishing Co. | Covington, Ky.  374 |
| WRR | City of Dallas | Dallas, Tex.  246 |
| WRRS | Racine Radio Corp. | Racine, Wis.  360 |
| WRS | The Radio Shop | Chicago, Ill.  257 |
| WRS | Radiol Mfg., Inc. | Bay Shore, N. Y.  216 |
| WRA | Larus & Brother Co., Inc. | Richmond, Va.  256 |
| WSAI | United States Playing Card Co. | Cincinnati, Ohio  326 |
| WSAJ | Grove City College | Grove City, Pa.  229 |
| WSAN | Allentown Call Publishing Co., Inc. | Allentown, Pa.  229 |
| WSAR | Daughy & Welch Electrical Co. | Fall River, Mass.  322 |
| WSAC | Clifford W. Vick | Houston, Tex.  248 |
| WSAX | Zenith Radio Corp. | Chicago, Ill.  268 |
| WSAY | Chase Electric Co. | Pomeroy, Ohio  244 |
| WSBB | Atlantic Journal | Atlanta, Ga.  428 |
| WSBB | Tribune & Daily News | Philadelphia, Pa.  393 |
| WSBT | Stix Baer & Fuller | St. Louis, Mo.  273 |
| WSBD | South Bend Tribune | South Bend, Ind.  316 |
| WSDA | Seventh Day Adventist Church | New York, N. Y.  261 |
| WSRA | Virginia Beach Broadcasting Co. | Virginia Beach, Va.  517 |

**Dominion of Canada**

| CFGC | Calgary Herald | Calgary, Alta.  434 |
| CFCE | Marconi Wireless Tel. Co., Ltd. | Montreal, Que.  411 |
| CFCH | Abitibi Power & Paper Co., Ltd. | Iqoquois Falls, Ont.  500 |
| CFPK | Radio Supply Co. | Edmonton, Alta.  517 |
| CFON | W. W. Grant (Ltd.) | Calgary, Alta.  434 |
| CFOR | Laurentian U. | Sudbury, Ont.  410 |
| CFPG | Victoria City Temple | Victoria, B. C.  329 |
| CFQZ | The Jack Elliott (Ltd.) | Hamilton, Ont.  341 |
| CFHC | Henry Birks & Sons | Calgary, Alta.  434 |
| CFKC | Thorold Radio Supply | Thorold, Ont.  248 |
| CFQC | The Electric Shop (Ltd.) | Saskatoon, Sask.  329 |
| CFRQ | Queens University | Kingston, Ont.  450 |
| CFRC | Westminster Trust Co. | Toronto, Ont.  387 |
| FYC | Commercial Radio Ltd. | Vancouver, B. C.  411 |
| CHBC | The Calgary Albertan | Calgary, Alta.  344 |
| CHHC | Ralley & McCormick (Ltd.) | Calgary, Alta.  434 |
| CHCS | The Hamilton Spectator | Hamilton, Ont.  351 |
| CHNC | Northern Electric Co. | Toronto, Ont.  357 |
| CHUC | International Bible Ass'n | Saskatoon, Sask.  329 |
| CHS | R. Booth, Jr. | Ottawa, Ont.  434 |
| CHY | Eastern Electric Co. | Montreal, Que.  411 |
| CJGA | Edmonton Journal | Edmonton, Alta.  511 |

**Republic of Mexico**

| CYB | Mexico City | 380 |
| GYL | Mexico City | 400 |

**Republic of Cuba**

| PWX | Cuban Telephone Co. | Havana  400 |
| 2BY | M. W. Burton | Havana  260 |
| 2OK | M. G. Velesio | Havana  360 |
| 2OL | Oscar Collado | Havana  257 |

**Great Britain**

| 2LO | London | 365 |
| 5IT | Birmingham | 479 |
| 5WA | Cardiff | 353 |
| 2BE | Belfast | 440 |

**France**

| Lyons | 550 |
| Paris | (Eiffel Tower) | 2,650 |
| Paris | 1,780 |
Short Waves Improve With Sunspots

Reception of radio broadcast programs on fairly long waves generally gets worse as spots on the sun increase, but with short waves, of about 34 meters length, it gets better, Greenleaf W. Pickard told the Institute of Radio Engineers at their annual session. Advantage has been taken of this phenomenon in the new transatlantic radio phone service, because the voice is sent from New York to London simultaneously on long and short waves, so that as transmission with the long waves gets worse, the short wave transmission improves.

Mr. Pickard has been studying the relations between activity of the sun, as indicated by the presence of sunspots, magnetic storms on the earth, and radio reception. He began the study in March, 1926, and has continued it to the present, measuring chiefly the reception from station WBAB of Chicago, which operates on a wave length of 226 meters. There is a very close correlation shown between the magnetic character of the days, as determined at the Cheltenham, Md., magnetic observatory of the U. S. Coast and Geodetic Survey, and the radio reception at the time. When the monthly averages are taken, there is no obvious relation between the sunspots and magnetism of radio reception, said Mr. Pickard, but when weekly averages are used "an increase of solar activity is paralleled by an increase in magnetic disturbance and a decrease in reception."

Device Eliminates Gears in Engines

At a recent meeting of the Royal Society of Arts, in London, George Constantinotescu, delivered, by invitation of the Society, a lecture describing recent developments of his remarkable device called the "torque converter," replacing the usual gear-shift systems of automobiles and similar machines. This device is described by some engineers as being the most remarkable innovation in the science of mechanics since the invention of the steam engine. One of the problems encountered in many applications of power is the problem of varying the speed of a moving machine without changing the speed of the engine which drives it. In gasoline automobiles, for example, it is necessary to provide some gear-shift arrangement, by which the driver can operate his car rapidly or slowly, the speed of the engine changing much less than does the speed of the rear wheels. The new device does away with this necessity.
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CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook RADIO AGE's classified advertisements.

The classified advertising rates are five cents per word for a single insertion. Liberal discounts are allowed on three, six, and twelve-time insertions, making rate of 4 1/2-4, 3 and 3 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the April issue must be sent in by February 25.

AGENTS WANTED
I AUTO GAS SAVER FREE
To introduce. Amazing car performance. Doubles mil-

AUGE. CRITICL LOW, inverter. 0-90, Wheaton, Illinois.

AGENTS: Make $5 to $15. Daily. White Rose Polish. Send 50c for full size sample and particulars. WHITE ROSE DISTRIBUTORS, Box 201, Memphis, Tenn.

WANTED. AN ACTIVE MAN TO TAKE ORDERS for Hardy fruit trees, berry bushes, evergreens, flowering shrubs and roses. Liberal commission. First purchase. Sales instruction and outfit free. Sherman Nursery Company, attention Mr. Smith, Charley City, Iowa.

AUTOMOBILE ACCESSORIES
FREE—CIRCULAR—IN Cold WEATHER starting for Ford, Chevrolet and Star owners—P. O. Box 1523-E, Denver, Colorado.

BOOKS AND MAGAZINES

FREE—Two big new Magazines and information worth hundreds of dollars to you. Envelope 2c stamp. Sales-

Twentieth Century Book of Receipts, Formulas and processes, an 807 cloth bound book containing 16,000 proven formulas for the manufacturer, workshop, labor-

BUSINESS OPPORTUNITIES
PECAN-Orange-Fig Growers "On the Gulf," Monthly circulars. Guaranteed quick return. Sub-

CODE
DO YOU WANT TO MEMORIZE THE WIRELESS TELEGRAPH CODES? THE CROWDY SCIENCE COPY

COLLECTIONS
Three Collection Lists Thot Actually Catalog: Pre-

BEAUTIFUL REGISTERED BULL PUPS 15$. Build-

MISCELLANEOUS
FOR SALE: WATCHMAKER’S LATHE at a bargain. R. Jergemenk, 5103 East Ave., St. Louis, Missouri.

HELP WANTED
SET BUILDERS! We furnish jobs for you. (No fee) compete our wanted today. In every community to

Radio Age Classified Ads Bring Results

Please Mention Radio Age When Writing to Advertisers.
CROSLEY 1927 RADIOS

Each set gives the utmost in radio enjoyment at its price. All prices slightly higher West of the Rocky Mountains. All prices are without accessories.

The 5-50—$50

Extensive owners report amazing performance and Prices

are giving

the utmost

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price.

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Rocky

Mountains. All

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accessories.

"6 Tube RFL-90" Console, $95

Introduces the double drum station selector! Crosley's winning non-resonating perfectly balanced tuned radio set. Includes Muncion skillfully built into exclusive mode-by-sound cabinet of two-tone finish to match floor surroundings. Room for batteries and all accessories, 60 inches high, 29-1/2 inches wide.

THE CROSLEY MUSCIONE

The secret of the popularity of the latest selling loud speaker on the market is this: NOT the horn shape, NOT the cone shape, but THE form shape. For do not the production of all audible sound, BE-WAB, all instruments, there is only one genuine Muncion. It is built solely by Crosley under mass production methods which makes its unsurpassed value possible.

Crosley sets are licensed under Armstrong U. S. Patent No. 1,413,478 or under patent or applications of Radio Frequency Laboratories, Inc., and other patents issued and pending.

CROSLEY 1927 FEATURES

Many exclusive—other found only in highest priced radios.

When, on ordinary radios, ears must strain to catch a station, away, a turn of the Crestation on Crosley radios instantly creates reception in room filling volume. An exclusive Crosley feature.

THE CROSLEY MUSCIONE

Marvelous exclusive Crosley "Crescendo" and "Acuminators" increase volume on distant stations and bring in programs entirely missed and passed by ordinary one-dial control radios.

In this 6-75 Console, Crosley again brings to the radio public all the advanced ideas in radio at a price within the reach of all. Console model stands 40 inches high. The Crosley Muncion is skillfully built into the cabinet. Ample space for batteries and all accessories. A Mahogany cabinet with rose gold trimmings makes it possible to match the surroundings in any home.

6 tube model—The 6-85

$85

Write Dept. 63

THE SINGLE-DRUM STATION SELECTOR

Nothing in radio equals the joy or the convenience of single drum control. Crosley single drum control enables you to find the station soundly without breaking your ears. To control Crosley Acuminators permit tuning in local and coast-stations reception at moderate cost.

Power tube adaptability marks the Crosley "Muncione and "Acuminator" features. No other Crosley provision for best radio reception at moderate cost.

CROSLEY RADIOS
Thordarson Amplification Reproduces Every Note

NO NOTE of any instrument—not even the faintest harmonic—can escape Thordarson Amplification.

Leading Radio set manufacturers know this secret of musical reproduction. That is why you find more Thordarson transformers in quality receivers than all competitive transformers combined.

Whether you are buying a complete receiver, or whether you are building your own—if you enjoy music—be sure your transformers are Thordarson's.

Thordarson Amplification Reproduces Every Note

THORDARSON RADIO TRANSFORMERS Supreme in Musical Performance!
An Unqualified Recommendation

for

VICTOREEN

Radio Products

VICTOREEN
R.F. TRANSFORMERS
Because Victoreen Transformers are actually tuned to a precision within one-third of 1 per cent, they are especially recommended to all builders of Super Sets. Victoreen Transformers are available in two types—No. 170 for use with regular tubes and No. 171 for dry cell tubes. Price $7.00 each.

VICTOREEN
MASTER CONTROL UNITS
This one dial unit has been so constructed that by means of compensator controlling the antenna condenser, adjustment is permitted up to a 30 degree variance in capacity, with a 360 degree vernier motion. Used in circuits employing two or more condensers of the same capacity. Easy to mount—no change of wiring necessary.
Two condenser type Price $19.50
Each additional condenser. Price $4.50
A Victoreen Super is the last word in radio. It is without a peer. It has range, clarity, volume and selectivity.

VICTOREEN
AUDIO CONTROL UNITS
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Chats With the Editor

WITH this issue our magazine enters its sixth year of service to radio fans of the world. Great progress has been made in the industry in that period but none of it has been of a revolutionary nature. For example we still have the regenerative set, the crystal detector, the reflex, the tuned radio frequency and the superheterodyne. We had all of these five years ago but their ability to perform is nothing compared to these same sets in 1927 when better production methods, keener research, more radio enlightenment and better broadcasting conditions are in effect. Of all these sets the last named, the superheterodyne, now seems to have the floor, principally on account of its distance getting qualities and the wavelength chaos which listeners have encountered in the air. This statement was made out by the tremendous interest manifest by our readers in the recent series on the Worlds Record models. Incidentally we shall have more data supers in a forthcoming issue—a treatise on trouble shooting which should be appreciated by everybody who has ever tinkered with a superheterodyne.

Attainment of quality reproduction is another objective reached successfully this year, although still further improvements can be expected although these will be of a gradual rather than a startling nature. Any progress which we may expect will come step by step instead of through a breath-taking revolution in radio. So do not worry about having to junk your present receiver for some time to come.

Radio legislation has now been paused. The President, as we go to press, is about to name members of the radio commission and the disorganized aerial conditions give promise of being shortly straightened out to the satisfaction of millions of listeners who take their radio seriously. And while on this subject we do not know of a better broadcast list than the one in the back of this magazine. It is corrected every thirty days from figures furnished by the Department of Commerce.

Intermediate stage transformers peaked at a frequency value which prevent the appearance of the lower beat on the dial of an oscillator, have been developed. Their operation, together with the data on a dandy power amplifier, is described in the blueprint section of this issue. Elsewhere in this magazine will be found a method of single-controlling a superheterodyne, which is also an interesting improvement in design.

Frederick Smith

Editor of RADIO AGE.
Fun, Fascination and Profit in a Five-Tube Set

ARMSTRONG PERRY

The man who starts to build a five-tube radio receiver will open up enough possibilities to keep him busy the rest of his life.

A five-tube set will take a current of 10 microamperes from the radio waves, which means 10 millionths of an ampere, and deliver to a loud speaker a current millions of times stronger. The output current, however, will retain all the characteristic oscillations of the feeble antenna current, and such a set, with a good loud speaker, is capable of reproducing the broadcast music from local stations with such fidelity that many listeners would be unable to distinguish the reproduction from the original music.

If a man could deliver as large an output in proportion to his input of corned beef and cabbage, those hog calling contests they are having would have to be prohibited by international law to prevent all the hogs in the world from swarming toward our own middle west.

There are several questions to be decided before the construction of the set begins. A kit or separate parts will cost from forty to fifty dollars and the tubes, batteries and loud speaker will increase the expense to $100 or more. Mistakes and losses should be reduced to the minimum by careful planning.

A five-tube set usually has two stages of radio-frequency amplification, a detector and two stages of audio-frequency amplification. If great distance rather than volume are desired, three stages of radio-frequency amplification may be used and only one stage of audio-frequency. Even four tubes may be used for radio-frequency amplification, but the interaction between circuits handling the high frequencies is so difficult to control that it is better to limit the radio-frequency side to two stages.

One stage of radio-frequency with two of audio-frequency should bring in all the stations that the average fan wants, with good volume. There is not much use of trying to cut through the interference of the hundreds of eastern stations and bring in the western stations before midnight, regardless of the power of the receiver, and even less than five tubes should enable the night owls to get the coast before they say their prayers and go to bed in the morning.

Before going very far with the plans for the set, it is well to decide...
whether it is to be attached to an outside aerial or operated with a loop aerial. It can be designed to use either or both. A five-tube outfit is powerful enough to give good results on local stations with a small loop, and it may even bring in stations several hundreds of miles away.

The loop is convenient and it eliminates much interference, but its small size limits the amount of energy it can gather from the radio waves. I have heard European code stations with loop sets in this country, but they were long-wave stations and the loops had many turns. A loop designed for broadcast reception has few turns and cannot be expected to do the work of an outside antenna.

**Tuned or Untuned R. F.?**

A NOOTHER question to decide is what type of radio-frequency amplification to use. The amplifier may be of the tuned or untuned variety. If it can be tuned, it will bring in more stations because it will cover more wavelengths. Then there is the question of coupling. Coupling the stages through amplifying transformers gives a higher ratio of amplification, but resistance coupling reduces the tendency to distortion and broadens the range of wavelengths covered. Resistance coupling gives its maximum results on wavelengths of 1,000 meters or more, which are far above the broadcasting waveband, but it is used successfully in broadcast receivers.

The set builder should aim at perfect reproduction rather than to follow the example of those dealers who turn their big loud speaker horns upon the street crowds and demonstrate how much noise and distortion can be produced by brute force and ignorance. Distortion in a slight degree is almost inevitable in using amplifying transformers. The higher the ratio of amplification, the more troublesome it is likely to be.

The audio-frequency transformer is less of a problem than the radio-frequency end of the set. The frequencies are much lower after the current passes the detector and there is not the same tendency for stray lines of force to fly all over the place and set up inductive effects that make the loud speaker howl. The audio-frequency amplifier is less critical in its adjustment. Changes in filament current have less effect. The builder who can work out the problems on the radio-frequency end should have little trouble when he reaches the audio end of the set.

The main decision to be made concerning the detector is whether it shall be regenerative or not. By feeding back part of the plate output to the grid circuit, the detector can be made to amplify the incoming signals considerably. This is accomplished by inserting a tickler coil in the plate circuit and placing this coil in inductive relation to the grid coil, or by simply connecting a wire from the plate to the grid circuit. The grid leak and condenser should be between the grid and the point where the wire connects, so that the "B" battery voltage will not be placed on the grid.

Whatever method is used, regeneration always increases the tendency to distortion. Many believe that the neutrodyne method is better. This consists of neutralizing the capacity that exists between the internal parts of the tube by placing small condensers in external circuits.

The types of tubes to be used should be selected at the start so that the proper sockets can be installed. If a change seems desirable after the set is in operation, adapters can be purchased that will make it possible to use one type of tube in another type of socket, but it is better to have the correct socket for each tube.

Many prefer the low-voltage tubes lighted by dry cells. Others like the more powerful 6-volt tubes lighted by storage batteries. Dry cells are easier to handle and safer than storage batteries, but a good storage battery with a battery charger will give very little trouble after installation.

Dry-cell tubes can be used in some positions in a set and the larger tubes in other positions. Trying different tubes in different positions is one of the favorite indoor sports of the experimenter. The new power tubes have opened new possibilities in both volume and clarity of reception.

**Types of Coils**

THERE are several types of coils, each with its own special advantages and disadvantages. The selection may depend on whether the builder wants a small and compact receiver or is willing that it should occupy more space. A variometer or variocoupler composed of a cylindrical stator and a spherical rotor will occupy much more space and weigh much more than one composed of flat spiderweb coils hinged so that their relative positions may be changed by turning a knob.

There are any number of condensers. Present opinion seems to favor those in which the possible losses are reduced by eliminating unnecessary metal, and those designed so station settings are well distributed over the dial or drum that guides the hand of the operator.

The old practice of mounting most of the parts on the upright panel is disappearing. Now, as many parts as possible are placed on the base or sub-panel. The advantage is obvious. Parts that might be affected by the body capacity of the operator are farther from him. Heavy parts that once placed considerable strain upon the thin upright panel, because of the leverage that an unbalanced weight has on its point of support, now sit securely on a firm foundation.

If a modern set should slip from the hands of the man who was placing it on a table, and fall a few inches, it probably would sustain little if any damage. A heavily loaded panel might be split by the same kind of mishap.

Shielding should be considered by the builder of a five-tube set.
of the stray lines of force that are developed when a set is in operation, as well as the capacity of the body of the operator and nearby objects, may be turned aside or neutralized by proper shielding.

Shields are made of metal and are grounded. Sometimes they are merely partitions that separate transformers and other units. In some sets they are metal boxes that completely enclose the parts to be isolated. Proper shielding can do no harm and it may improve the set greatly.

The tendency today is toward simplified control of tuning units and filaments, for most sets must be sold to persons who want to avoid all inconvenience in operation. One-hand tuning seems to be in demand, though what the operators want to do with the other arm is not quite clear in these days when the closed car has taken the place of the parlor sofa. It certainly does not increase the efficiency of tubes to control five or more filaments with one rheostat, nor does it improve the tuning of a set to turn all the condensers with one knob.

A reasonable amount of simplification is good, as anyone will testify who has ever operated an old-time amateur set in which there were so many knobs to twist that the program was over before the operator could discover what they all were for. However, there is much to be gained by having the detector filament under separate control, and the radio-frequency and audio-frequency amplifiers on separate rheostats. Automatic control of filament current is provided by some modern devices.

Tuning condensers are more efficient when separately controlled, provided the operator knows how to use them. Some of the better sets have the condensers mounted so that a single knob turns them all, but with individual controls for fine adjustment.

Having decided all the above questions, and having chosen dials or drums, panel and cabinet, the builder is ready to select the kit that he wants or to design a set to be made from parts selected separately. It never pays to try to save money by purchasing cheap parts for a set on which valuable time is to be spent. The best parts and materials cost so little more than poor ones, and poor parts do so much to waste the time and energy of the builder, that there should be no hesitation about paying the right price for really good articles.

Any man who is investing in a five-tube set can afford to have a good set of tools also. A set of drills, plenty of pliers and side-cutters for different purposes, an electric soldering iron and a good assortment of wire, bus bar, lugs, clips, connectors and so on will save their cost by saving time and improving workmanship.

The final problem, perhaps, will be the choice between batteries and battery eliminators. Battery eliminators may not be desirable on sets with fewer tubes, but a good eliminator settles the problem of current supply unless the electric service in the town is too erratic. In my town it is, for the wires are on poles and every heavy storm fells trees, breaks wires and interrupts the service.

Perhaps the safest, quietest and most satisfactory source of power is a good storage "A" battery, a storage "B" battery with enough cells to deliver ninety volts or more, and an efficient battery charger. A trickle charger will take care of a battery operating two or three tubes, but for a five-tube set a charger with a rate of six amperes should be installed if the battery is designed to be charged at that rate. Some chargers will deliver either a trickle charge or a higher charge as may be desired.

A FIVE-TUBE kit can be purchased for less than fifty dollars. It does not include tubes, batteries, phones or loud speaker as a rule. The blue prints and instructions are so complete and explicit that even a beginner can put the outfit together and make it work even though he may have no technical knowledge.

A week's spare time should be sufficient for finishing the assembly and placing the set in operation. The expense involved will be no more than many a man loses on a prize fight, and it will enable the builder to follow the fights without being so deeply affected by the atmosphere created by the promoters for the purpose of lining up the public on the losing end of the gamble.

Sensibly used, a five-tube set will save its cost many times over by entertaining the family inexpensively and giving the youngsters better mental food than they are fed ordinarily in places of amusement. Games can be organized, based on distance covered and numbers of stations brought in by the different members. Evenings at home can be made as thrilling by such means as many of the outside attractions. A whole neighborhood group may be held together and safely led through the perilous years of adolescence.

A man who makes a five-tube set and presents it to a school or other institution where it is needed, or who even sets it up for an evening now and then and brings in some of the important broadcasts, is a real philanthropist. The tremendous opportunities offered by radio are being lost in thousands of schools for the lack of someone to demonstrate how easily radio service can be established and maintained.

The workman is worthy of his hire, and if a man can build or assemble these popular five-tube sets and install and service them, he may be able to work up a profitable spare-time business. He may even develop it to a point where he can escape from toil, endured merely for the sake of making a living, and find the joy of becoming his own boss.
An Inexpensive Eliminator for the Home Constructor

By WILLIAM H. FINE*

NINETEEN TWENTY-SEVEN BRINGS with it a marked increase in the demand of radio fans for efficient devices with which to eliminate our old friend the "B" battery;—simple and inexpensive devices that can be readily attached to the house lighting system the same as a vacuum cleaner, flat-iron, washing machine or other household appliances.

Such a device, which must necessarily be designed to rectify or change the usual alternating current, in general use throughout the country for home consumption, to direct current suitable to be used for radio purposes, is made up of three major elements, viz.:—a reliable method of converting the alternating current; an efficient and dependable filter system for smoothing out the ripples or pulsations after conversion, and a simple but reliable means of controlling and adjusting the final output of the eliminator to take care of the various voltages required for successful operation of the receiving set.

The majority of "B" eliminators now on the market employ a special type of tube for rectifying the alternating current and the publicity given this method through the press, has more or less side-tracked another and less expensive method.

Reference is made to the full-wave chemical rectifier and the following text describes such a power unit any novice can build at a relatively small cost yet with positive assurance that the finished product will meet every expectation for dependable performance and furnish a constant source of plate current sufficient to meet every requirement of the average radio receiver.

All parts designated can be easily secured from practically all reliable dealers. After the parts are mounted on a suitable baseboard, the entire assembly can be housed in a metal container to suit the builder's fancy. Special stress is laid upon the importance of using only good parts, not necessarily the most expensive but those manufactured by companies who have established a reputation for building quality products. Care in their selection, plus neat workmanship, gives assurance of entire satisfaction in the finished job.

The necessary parts for the construction of the herein described eliminator are:

1 baseboard, 4 1-pint jars, 4 covers for jars (cut from bakelite or other dielectric material with one small vent hole in center and two larger holes to accommodate the electrodes), 2 30-henry choke coils, 1 terminal strip, 4 aluminum electrodes, 4 lead electrodes, filler for rectifier cells, 2 2. mfd. blocking condensers, 4 4. mfd. blocking condensers, 2 1. mfd. blocking condensers, 6 binding posts, 1 2,500 ohm fixed resistance with mountings, 1 10,000 ohm fixed resistance with mountings, 10 ft. lamp cord, 1 attachment plug, 1 S. P. S. T. knife switch, 2 1 ampere cartridge fuses with mountings, 2 No. 10 M heavy duty Radiohms, 1 No. 50 M heavy duty Radiohm, wire, screws, etc.

The lead and aluminum electrodes, as well as the filler material for use in the rectifier cells can be obtained from any dealer or service station handling Willard storage batteries. While common borax can be used as a filler it is not recommended because it crystalizes and creeps over the exposed part of the electrodes. This creepage will eventually short the cell rendering it inoperative.

To prepare the solution, dissolve each package of filler in a pint of water, preferably distilled. Stir until all the filler is dissolved and then let stand for a few minutes until all foreign matter settles to bottom of jar. When liquid is clear, fill each cell about three-quarters full. After the electrodes have been attached to the covers insert them to about three-fourths of their length into the solution and the eliminator is now ready to attach to the receiving set. While the cells will not need any further attention for several months, in order

(Continued on page 47)

In the schematic above is shown the method of rigging up a homemade B eliminator. If proper care is taken in its construction, the plate supply problem will have been solved, except of course for the operation of an extremely large set

Central Radio Laboratories
Portable Direction Finder Has Many Government Uses

By S. R. WINTERS

U NIQUE in that it is probably the only portable radio direction-finding device in the world that operates over such a wide band of wave lengths—from 39 to 3,300 meters—a new apparatus developed by Francis W. Dunmore of the Radio Laboratory of the Bureau of Standards may be transported and installed with quite the facility a large camera is put to service. Equally as simple in manipulation, this novel radio direction-finder is governed with but two controls.

When the entire United States is to be eventually crisscrossed with radio beacons for guiding aircraft along predetermined courses and with every ship depending upon radio for finding its port of safety, this new equipment for locating the source and direction of a radio signal makes its appearance at an opportune moment. Other radio direction-finders may be equally as efficient but the Dunmore device is said to excel in the particular of operating at relatively short wave lengths and in the simplicity of control, two knobs, one for tuning the radio receiving set and the other for obtaining a balancing effect. These features, too, are not insured at the sacrifice of portability, because the apparatus is relatively compact.

Experimenters and members of the "Homemade Radio Set Builders' Club" will be interested in knowing the popular sad of shielding radio receiving sets is adopted in the construction of this direction-finder. An aluminum box affords a cozy home for all of the radio receiving units, including batteries. The single exception to this sweeping statement is that the coil antenna is mounted on a bakelite shaft extending through the aluminum box. This pick-up coil is revolved in different directions of the compass by turning a handwheel under the shielding aluminum box. The shielding of circuits in radio receiving sets may be carried to extremes in some instances in response to a popular fad, but in designing this radio direction-finder the Bureau of Standards ventures the contention, "This shielding is important, especially when receiving the higher frequencies, since the directive effects are blurred if any circuits except the direction-finder coil pick up power from the wave."

CAM-ACTUATED tuning condensers, an idea of Mr. Dunmore’s for which he was granted a patent during 1926, has made possible a reduction of the tuning controls of the super-heterodyne receiving set used with this direction-finder to a single one. This is accomplished by mounting the main tuning condenser and the heterodyne generator tuning condenser on the same shaft. The latter condenser has connected in parallel with it an auxiliary condenser of slightly smaller capacity operated by means of a cam which may be slipped on the shaft carrying the two tuning condensers. The movable plates of the balancing condenser are connected to an antenna, which is an integral part of each direction-finder coil. This antenna consists of a brass rod the height of the coil which passes through the center of the coil. Another rod is telescoped into this one, which, when extended, doubles the height of the antenna. Such an antenna, according to the Bureau of Standards, gives sufficient antenna effect for good balancing. It was found this small antenna connected to the movable plates of the balancing condenser was much more effective than grounding them. Seven cans of different shapes are necessary to the proper functioning of this direction-finding device.

The operation of this new apparatus over such a wide band of wave lengths—from 39 to 3,300 meters—is made possible by a set of seven interchangeable plug-in coils. These vary in size from 12¾ inches square to 24½ inches square, the former having only two turns of wire, and the later sixty turns of wire, space wound in four layers. Each of these seven direction-finder coils has imprinted on it the wave-length range over which it operates, thus facilitating the plugging-in of different coils when wave length variations are desired. Each coil has a socket containing four terminal plugs, two connected to the end of the coil, one to the center of the coil, and the fourth to the brass rod antenna. The coils are enclosed, being wound on box frames made of wood.

(Continued on page 31)
ON THE face of it, it all appeared very innocent. Just the studio director coming to you and saying, "How 'bout a little talk over the air next Saturday afternoon? Something 'bout the activities of women. What they've accomplished. What they're going to do. 'Bout fifteen minutes."

You had been rambling around radio studios off and on for two or three years. You had never made a talk over the air but there was no reason why you couldn't. It certainly looked simple enough. Just sit down at a table in front of a microphone and talk. In an ordinary, conversational tone of voice. No fuss, no bother at all.

It never occurs to you, therefore, that you can't make the talk. Still, you feel that you must show a little modest reluctance so you remark, "Oh, I don't think I could talk over the air. I never did. I . . ."

"What of it?" demands the director. "You've been around here a long time. You know what it's all about. Just get some material together and come up here and broadcast it. That's all there is to it. Easiest thing you know!"

Oh yes, it's the easiest thing you know all right! Just about as easy as trying to convince a woman that she's not the type to wear bobbed hair; as easy as attempting to show a man where he's all wrong about his baseball dope; as easy as . . .

But, of course, before you broadcast, you don't know these things. All you know is that you have been asked to talk over the air. Talk over the air! Talk to millions of people! You! Well, now . . . not so bad.

At a later day you know it was some instinct of self-preservation that made you ask the studio director, as a kind of after thought, "I suppose I can give my talk from notes, can't I?"

You can't fathom the rather odd look he gives you, so you dismiss it when he says, a trifle hastily, "Certainly. That's the way you'll want to."

Nice, friendly places, studios. Filled with people you've known for two or three years. Studio directors, announcers, pianists. This particular studio in which you have been selected to make your maiden voyage out into the ether, was one you liked particularly. Nice atmosphere. Everything jolly. Everybody friendly.

You go up rather early on the day you're to make your talk. Just so they'll know that you'll be there and ready to go on the air at the proper time. You've been up hundreds of times before but today you feel—er—well, not exactly superior, of course, but just a little . . .

You are having a delightful time, walking confidently around, chatting with this person and that, casually observing, now and then with a light laugh, "Oh what time is it getting to be? I'm going to give a little talk over the air this afternoon you know."

And receiving replies of, "Oh, you ARE?"

The first inkling you have that things may not be all that they seem, comes to you when the young announcer approaches you and inquires solicitously, "Not getting nervous, are you?"

You look at him wide-eyed. "Why of course not!" you reply. "Whatever made you think that?"

"Oh, nothing!" retorts the young announcer hastily. "Only some of them do, you know."

"Well," you assert sweetly, "I won't!"

"That's fine!" says the announcer, giving your shoulder a pat which, you know later, was a reassuring one. "We'll be ready for you pretty soon."

For the first time you begin to feel a little uneasy. So some of them got nervous. How silly, how perfectly ridiculous. Nervous! Why in a few minutes you are going to walk up to that thing they call a microphone and give a talk. In just a few minutes you are going to talk over the air.

But there's something that sticks in your mind rather unpleasantly. Some remark. Oh, yes, the one the announcer had made. The one when he patted you on the shoulder and that had something 'to do with, "We'll be ready for you pretty soon."

Where had you heard that phrase before? You search your memory and then a chill settles along your spine. Oh yes, now you know where you had heard it. In the hospital, just before they took you into the operating room. The doctor had come in and patted your shoulder jovially and had remarked cheerfully, "Not nervous, are you? That's fine! We'll be ready for you pretty soon!"

Just then the announcer hails you cheerily, "Just two more minutes and then it will be your turn."

Two more min . . .

And then something happens inside of you. Something awful. In your breast a terrible commotion sets up. Some dreadful pounding. You clear your throat hurriedly and swallow. Or try to. Your mouth is dry! Your tongue is thick! And the announcer is saying, "Now come over here and sit down. I'll announce you in a couple of seconds. Got your notes ready?"

In a daze, you open your purse to look for your notes. Oh, merciful heavens, where are they? Here! No, that's a letter. Where . . . dear heaven . . . Ah! In your hands, your poor shaking trembling hands.

"Right here," says the announcer, placing a chair for you. "Quiet now! We're on the air!"

And then your name. "We announce with great pleasure . . . Your name. It must be, that it sounds so strange. But for that matter, everything is strange. The studio, the announcer, those people who, a moment ago, you were talking to so gaily, now sitting motionless in their chairs, grinning like apes!"

The announcer gives you a tap on the shoulder and a quick nod. You open your mouth. You reach frantically for a full breath. You speak! You are on the air!

(Continued on page 83)
Single-Controlling the Victoreen

ANY readers of this magazine have requested data on arranging the operation of the loop and oscillator condensers on a single dial in their superheterodynes. The article following deals with such a method of operation which has proved highly satisfactory with either the antenna pickup coil or the loop. The latter has been found more satisfactory of use in the larger cities where congestion exists, whereas if the super is to be used a hundred or more miles away from the big broadcasting centers the antenna coupling is permissible and quite satisfactory.

Going to single control on a super is not quite as hard a job as might be expected, especially if it is possible to trim one of the condensers against the other. In the Victoreen master control unit which was used in the laboratory model this trimming accomplishment is performed with the knob on the extreme left of the panel which compensates for capacity differences between the oscillator setting and that of the loop or antenna coupler condenser. Absence of a regenerative loop circuit also makes it a great deal easier to single control these two condensers than if a midget were provided for creating a regenerative loop circuit.

Two means of intermediate control have been used. The first is by means of a filament rheostat controlling the filaments of the intermediate stages. The other is by alteration of the grid bias applied to the intermediate grids through a 400 ohm potentiometer. Further flexibility in operation is afforded by the special rheostat gang mounting which controls the filament temperature of the second detector and the first and second audio stages. These values are determined by test and the settings left alone until other tubes are used.

Instead of grid detection by C battery both the first and second detectors are operated with a grid leak and condenser. Biasing for the audio grids is allowed through the C battery placed next to the audio transformers and shown in the photograph of the baseboard arrangement of this super. Audio bias will depend upon the plate voltages applied. In this particular model all 201-A tubes were used with the exception of the last audio which is a UX-112.

Long wave transformers made by the Victoreen interests and peaked at 88 kilocycles were used throughout. Their position in the set may be seen by consulting the photograph of the finished model. Repetition of stations on half their frequency difference was greatly minimized through the peaking of these transformers at the value stated above. In addition through the single controlling of both the loop and oscillator dials, a great deal of interference that might have crept in through not having both dials in resonance all the time, was eliminated. This condition is particularly true of any large broadcasting center and where arrangements can be made to prevent the two dials from straying from resonance the results are always gratifying.

On account of the design of this
model it is possible to use busbar in the assembly without having to use more than one or two pieces of spaghetti, this insulation only being used wherever there is a cross-over of wires or two wires running parallel which by sagging might short circuit themselves. The panel size used was seven by twenty-six inches while the baseboard was made nine and a half inches by twenty-five inches. If desired the same receiver may be adapted to the subpanel assembly and a great deal of the wiring run underneath the subpanel.

As is customary in wiring up any receiver it is a good idea to test all inductances and transformers before putting them into the set and wiring. For testing opens a voltmeter and a C battery will suffice, or even a head set and a C battery. However, visual indication is always much better so the battery and voltmeter method is more desirable. If the coil is open no reading will be secured when the voltmeter and battery is placed across the two ends of the coil. In testing the secondaries of transformers the voltage reading will generally be a little lower than when testing primaries due to the greater resistance of the secondary coils of the audio transformers. In intermediate stages very little difference will be found between readings on the primaries and secondaries. For condensers the test is the same only when a condenser is shorted readings will be secured whereas when the condenser is o. k. no reading will be obtained on the voltmeter.

The pictorial diagram shown with this article should suffice for even a novice since it shows exactly where all wires should be located. Be sure to make good solder joints in every case. Many a poor chap has blamed a set’s operation for his indifference in making good joints. You cannot be too careful in soldering. Another thing to remember is that you do not have to finish the set between supper and bed time. Make a good job of your work and you will always find it profitable.

In actual operation the single control Victoreen proved itself a distance getter despite the absence of the regenerative feature in the loop circuit. Its selectivity was likewise good and the tone quality was very enjoyable.

**LIST OF PARTS**

(Parts specified here were used in the actual model described. Other parts of equal merit may be used if desired.)

1. Victoreen master control condenser unit
2. Victoreen audio control unit
3. Victoreen 2 ohm master rheostat
4. Victoreen 6 ohm rheostat
5. Victoreen 400 ohm potentiometer
6. Victoreen RF transformers
7. Victoreen oscillation coupler
8. Samson audio transformers
9. Frost sockets
10. Dubilier 1 mfd bypass condenser
11. Sangamo .00025 mfd grid condensers with clips
12. Durham 2 megohm grid leaks
13. X-L. pushposts
14. Jones base mounting plug
15. Formica 7 by 26 by 3/16 panel
16. Wooden baseboard 9 1/2 by 25 inches

Pictorial diagram of the single control super. Although Radio Age’s model was made without antenna coupler, the pictorial diagram above shows either method of energy pickup. Binding posts shown in the diagram may be eliminated and a standard base mounting plug used instead for greater simplicity.
R OSSOM'S rise in Fortunatus has been the subject of so much comment it need be sketched here only briefly. It is interesting to point out a few rungs in the ladder of Bill's ascent which have been overlooked by the biographical enthusiasts. In the first place this man, who fell from the Parnassian heights of moviedom and had the good fortune to light upon a mattress, broke all the rules which are supposed to govern success. Bill would have been a wallflower at the dance of the magazine advertising pages. That is to say he bought his toothbrush and his tooth lotion with reckless disregard of the almost universal warning that the gums soften and recede and that four out of every five are headed for dental desolation. Bill at times had hiccies on his chin; yet the department manager did not turn him from the door when the day for promotions rolled around. He never read a halitosis classic, yet he was not thrown out of directors' meetings. He did not change his brand of bath soap because a fair dance partner declined the second dance. He simply changed partners. He was the life of the party although he never took a correspondence school course in conversation. He drank coffee for the caffeine there was in it and his brain functioned normally although he did not take his cereals seriously. He didn't register for primaries and he didn't vote at elections. He never had a savings account.

Mrs. Rossom's luxuriant hair was amber and her eyes were deep violet. Bill had picked a vivid beauty as a background for his ascent to the heights. Isis was tall and she wore her dresses and gowns with an air that made other women envious and made men turn to look a second, or even a third, time. Hence it was the big well tailored Rossom and his surpassingly fair lady made their entry into Fortunatus under almost favorable conditions. It was true they had spent their last penny for tips and food on the train from Los Angeles. Isis was a little disturbed about it.

"Leave everything to me," Bill reassured her, "I can get farther on my face than some birds can with a roll that would ditch a war tank." She glanced at his face and was comforted.

Bidding the taxi driver wait Bill surrendered his bags to bellhops and doorman while he assisted Mrs. Rossom from the cab. The clerk saw them coming even afar off and the unctuous flourish with which he made ready the register of the Hotel El Dorado shrieked of the prospective broaching of wine casks and the slaying of fatted calves.

"Mr. and Mrs. Rossom, from the coast," said Mr. Rossom expansively, as he strode to the desk and looked about the ornate foyer as if to give it the expert judgment of the man who may be satisfied with a place and again, may not.

"Something up and away from the noise and heat," said Bill. "Parlor, bedroom and bath will do, but the best you have; the best, you know."

The clerk raised a pink hand just a trifle. He conveyed this that he was prepared with something simply made to order for the Rossom taste; high, cool, comfortable, roomy, quiet, rich in appointments, perfectly serviced.

The little parade of bellhops and the two welcome guests was starting for the elevators when Bill turned, laughing softly.

"I had forgotten the driver," he chuckled. "No chance to get to a bank—twenty will be okay for the moment—ah, thank you."

The yellow-back passed quickly to a bellboy who made haste to pay the taxi man and bring the change to the Rossom suite.

VI

B ILL'S first day in Fortunatus was devoted to conferences with dealers in newsprint paper, printing house executives and the officers of a nation-
ally prominent advertising agency. He permitted it to be known, under strict admonition of secrecy, that he and his associates had been making a survey of the newspaper situation in Fortunatus and that they had decided to publish a tabloid daily. A tabloid newspaper is one whose pages are one half the size of the average newspaper page, and therefore in some quarters regarded as twice as good as the average page.

So insistent was Bill's warning that not a word should be breathed about his plans that it was fully four hours before the publishers of the six Fortunatus newspapers heard of it and called a meeting to discuss ways and means of nipping this dangerous competitor in the bud.

Inquiries discreetly made at the Hotel El Dorado brought little information to the agents of the publishers. Bill has registered as "William Nathan Rossum and wife, San Francisco" and the wires soon were carrying questions to representatives of the Fortunatus publishers in that far western city. The San Francisco replies were prompt:

"Only Rossum known in California is Bill Rossum, punk movie actor who left state after being incapacitated by accident. Rossum a tall, pleasant-faced sheik. No personality, busted flat. Can't be your Rossum."

Agents of the Fortunatus publishers had another look at Bill as that self-possessed gentleman draped his tall figure over the telegraph counter and dictated several telegrams to Eastern points. "Pleasant-faced sheik." This impressive personage with the figure of a Viking and the face of an eagle? "Busted flat?" This urbane occupant of the best suite in the best hotel in Fortunatus? Wives of busted actors do not ask the manager to tuck away a hat full of gems in the hotel safe. Mrs. Rossum had done that. Of course the manager should not be censured for being ignorant of the fact that the diamonds were only movie brilliants. And the manager could not be expected to know that the only genuine stones in the Rossum collection had been taken to a neighboring city on the day following the arrival in Fortunatus and had there been left in pledge for the repayment of a fund with which Isis came back to Bill and gave him as a working balance while the big tabloid deal should be simmering.

Not being able to identify and classify Rossum and assuming that he was associated with local interests who preferred remaining in the background until the tabloid newspaper was launched the six publishers got together and put up $50,000. They sent for Bill.

"We can run you ragged if you start a newspaper in Fortunatus," they told Bill. "But we realize that you must have put some time into the preliminary work and probably it has involved some expense."

"You'd be surprised," said Bill, quite truthfully.

"In view of these facts," the committee spokesman summed up, "we are authorized to offer you $50,000 as a reimbursement for your expenses and trouble. Accept it and abandon your idea. Reject it and get ready for the rough house."

Bill told Isis about it that evening as they sat under the softly shaded lamps in the main dining room of the Hotel El Dorado. They were in a nook delightfully adapted for prudential confidences and Bill enjoyed the wonder and admiration that shone in the exquisite violet depths of Mrs. Rossum's eyes as he recounted the experiences of the day.

"Dearest!" she exclaimed, "do you mean they just took things for granted and passed over a check for $50,000?"

"Not exactly for granted," explained Bill. "Even after they decided the safest course would be to make me an offer they continued their investigation as to who I was or might be. Just to keep them interested I sent off two telegrams this afternoon, one to a mythical broker in New York, ordering him to sell a thousand shares of R. S. V. railroad stock at the market and I wired a senator in Washington asking for the latest information on the prospective passage of a bill affecting the newsprint supply."

"But you don't know any senators and you have no R. S. V. stock," protested Isis.

"True enough, kid, but the newspaper boys don't know that yet. They only know that I sent the messages, a fact obtained by certain devious methods known to the initiate."

"What are you going to do now?"

"Just stay in Fortunatus and grow," said Bill, lighting a cigarette. "These newspaper gentlemen will want revenge and I don't want to rob 'em of a chance at it."

Bill looked into a convenient pier glass. He smiled at the reflection of his own evil countenance. His face, he mused, would be his fortune. He prayed for strength to remember in all times of stress that the world would accept those fiercely arrogant eyes at their own apparent value, the cruel lips would be a command even if they should remain closed. He would try to forget always that he was not the man he seemed to be.

Mrs. Rossum lifted her glass to him and he raised his rickety.

"Here's to the horse, Perceval," she said.

"May my mask never slip," said Mr. Rossum.

VII

On the evening of June 29, 1926, Col. Minimil and his son were motoring toward the business center of Fortunatus. They agreed in attributing the main resistance to the launching of the Gazette to Mr. Rossum, of the Clarion.

"How did that bird happen to get into the newspaper business?" asked Daly as he and the Colonel settled back in the comfortable upholstery.

"Put in his stack with nothing but Jack high in his hand and got away with the bluff," said the Colonel.

"Meaning?" prompted Daly.

"He made a face like a man starting a new newspaper nineteen years ago," said the Colonel. "They bought him off with a $50,000 check and tried to stop the check after they discovered Rossum had nothing, knew nothing, planned nothing. Old Man Halsey, owner of the Clarion went around to see Bill next day and made such a roar that Bill took pity on him and
offered to shoot most of the $50,000 into Clarion stock. Old Halsey grabbed at it and Bill went into the Clarion organization. Less than a year after Rossom showed his ugly poker face in the Clarion office he owned the paper. He cleared it of debt and began to print this here now fodder for the feeble minded and it wasn't another year before every nitwit in Fortunatus was a Clarion reader.

"A proud record," commented Daly.

"Sometimes I got a hunch he has nothing to go on but a hard mug," said the Colonel. "Believe me if he's planning a bluff this time we will call him right off his chair."

"Right-ho," assented Daly.

The Colonel looked him doubtfully as if pondering the use of the American language.

"About this fellow Rossom," went on Col. Minimil.

"He has pulled every boner a publisher can commit and yet he gets along as if he had a brain. He was against the war and he was sore about the peace. He has been on two sides of every public question in the last ten years and sometimes he has been on three sides. He raises the devil with women and girls for wearing short skirts and then he goes ahead and prints legs all over the Clarion pages. He roasts the city council for grafting and then turns around and steals an alley for a railroad spur track to his composing room door."

"He's a bad actor," said Daly. "Burroughs called me up to tell me that Rossom is getting the Flats gang in line to help his circulation crowd put it over on us tomorrow night when we try to distribute the Gazette to the newsstands."

"What about police protection?" asked the Colonel.

Daly laughed. "I would as soon try the League of Nations," he said.

"Then it's up to us."

"Yeah," said Daly. "Up to us to fight 'em and lick 'em."

Burroughs and his henchmen were waiting for the Minimals in the anteroom of Daly's private office. They knew zero hour was approaching and there wasn't a scrapper in the crowd who was unhappy. They quickly gave Col. Minimil and Daly a summary of the situation. Rossom's gang, it had been learned by spies in the camp of the enemy, were to go forth in motor cars on the night of the 30th and seize all the Gazette delivered to corners in the downtown district. They were to dump these into the railroad canal. At other corners, early on the morning of the first, they were to plant husky men with newspapers and these Janizaries were to make life completely uncomfortable for any Gazette men who tried to turn an honest penny at any of the four corners at the aforesaid intersections. The enemy was to be possessed of weapons that would be most serviceable in street combats.

"Do they figure they can carry on such a fight indefinitely?" inquired Daly.

"Not at all," explained Burroughs. "They do figure, though, that if they keep the high pressure up for a day or so it will be a hard job for the Gazette to hire men to take the chance of trying to sell our paper."

"Then our job is to whip 'em right at the start," mused Daly.

"Right-whoa," agreed Col. Minimil. The Colonel visibly was picking up in spirits.

VIII

Daly and the Colonel became acquainted that night. Each found in the other hitherto unsuspected qualities of shrewdness, generalship, resourcefulness and courage. Daly's mind was working smoothly and efficiently.

Before dawn a small fleet of trucks had appeared at the warehouses of the Northern Paper Corporation and had removed therefrom great quantities of paper. An expert eye might have observed that the paper was not in rolls, but appeared to be wrapped in huge bundles. These trucks were unloaded, also before dawn, at the entrance of the Gazette's mailing rooms and thence were whisked inside and the place was locked and bolted against all possibility of intrusion by curious outsiders.

Burroughs laughed when Daly told him the plan of campaign for the opening skirmish. Both Daly and his father were in Daly's office all day. Throughout the great building were the stirring sounds of preparation for the first issue of the Gazette. Pressrooms, engraving rooms, composing rooms, editorial rooms, business offices went joyfully about their difficult but enjoyable tasks.

Burroughs was as busy as a popcorn salesman at a Sunday double-header. He gave final instructions to his wagon men and to the leather-lungs who were to man the stands. The first issue of the Fortunatus Gazette was to go on sale at 9 o'clock that evening, with a summary of baseball, racing and other sport results and a condensation of the important news of the day, local, national and foreign. It had been decided for reasons that will appear later that only one hundred of the most important downtown corners of the city were to be covered with that early edition. Later issues would go forth to the stands in the residence districts, the suburbs, the country towns, by wagon, motor truck, street cars, railroad trains and by express and mail to the more remote points.

Fortunatus citizens began to take an interest. It is the good fortune of the newspaper publisher to be able to establish an impression in the minds of the customers that the newspaper is a civic institution whose proud duty it is to lead the people aright on all questions of politics and finance, public economy, morals of the stage and of the magazines, progress of the gentler arts, to condemn the public bitterly when it votes for the wrong candidate and to praise without stint those civic leaders and their satellites who do just what the newspaper wants them to do. For this service the newspaper charges so much per paper at the newsstand and so much per page from the advertiser. It is rarely admitted by publishers that they are operating their journals as business institutions, actually
striving for a profit on their enterprise in dollars and cents in addition to the huge revenues they receive in the form of soul satisfaction as a reward for service well performed for a helpless and puzzled populace. So the good citizens of Fortunatus were eager to welcome another newspaper. They coveted it but they could not have told why.

One item of dramatic interest was the rumor that had been travelling the streets all day to the effect that Bill Rossom and Hard Max Minimil were staging a battle. At 9 o’clock restless thousands, who never seem to be quite awake until the bright lights were switched on, were milling about at the intersection of McKinley Boulevard and Cleveland Avenue. That corner was the peak of activity in Fortunatus, both by day and by night. Street cars, motor cars and the lowly citizens who try to get about on foot converged here in rushing torrents or in whirling eddies. It was a reserved seat in the civic theater, from which to watch the advent of the Minimil newspaper.

The first Gazette delivery truck came into view promptly at 9 o’clock. Its approach was heralded by strident blasts from a horn, calling general attention to the handsome machine, dressed up like a Baltimore oriole in glistening black and orange. A huge bundle of newspapers was dragged from the gleaming chariot and deposited by the side of a black and orange stand of steel, which was the first market place of the Fortunatus Gazette. “Bull” Edmunds, the best all around, catch-as-catch-can, mauler, gouger, biter and gunman in the Gazette’s selected army of circulation promoters, was in charge of that stand. “Bull” made a move to loosen the rope that bound the bundle of papers. As he did so a large automobile which had been parked a few yards distant, moved up to the corner stand and stopped. Three men leaped out. They were the sort of men one yearns not to meet in a dark alley. One of them had a gun in his hand. He advanced toward “Bull” and shoved him back a few paces into the crowd. To the astonishment of observers who knew “Bull” and his notched record that individual made no resistance. In an open window, a few feet above the crowd a photographer set off a flash light just as the two other banditti lifted the bundle of newspapers into the tonneau of their car. The three agents of a free press then leaped into the car and as the lights were shifting from red to green they dashed across the street intersection and were lost in the maze of speeding traffic.

“Newspaper hi-jackers” yelled somebody in the crowd. “Old Max Minimil has been tricked by Bill Rossom.”

It seemed true. Yet it was strange that “Bull” Edmunds should be leaning against his devastated stand, smiling and calm.

A few minutes later another car drove up to the corner. Again a load of newspapers was delivered to Edmunds, this time a much larger load. As “Bull” arranged the papers on his stand and on the curb beside it he raised his power-speaker in a perfect roar of verbal advertising.

“Get a Gazette, the new newspaper!”

Several other cars edged up to the curb. They were occupied by men who were obviously contented to remain there, effectually blocking the parking of other cars in that part of the street, and watching with intense interest the operations of “Bull” Edmunds and of the members of the crowd that engulfed him.

At ninety-nine other corners the same sequence of events had taken place. The first deposits of newspapers had been carried off by rough gentlemen and the supply had been refilled.

It was 9:30 o’clock when Col. Minimil called Bill Rossom on the telephone.

“Bill, somebody has been stealing your Clarions and I thought as we were old pals I would tell you about it.”

“What’s the joke?” asked Rossom.

“Can’t make it out,” said the Colonel. “In order to make sure our first issue would get off smoothly we went over to the Northern Paper Corporation’s warehouses last night and bought up a lot of old Clarions that you folks had turned in for old paper. The unsold copies, you know. Well we sent these in bundles to our downtown stands tonight just as a sort of a rehearsal, you understand. If you will believe me, somebody sent gangsters around to all the corners and robbed us of your Clarions.”

There was an eloquent interval of silence after the Colonel finished speaking. Then Rossom snapped an answer.

“How do you figure all this interests me?”

“Any guy with a plush-lined sense of humor like yours would be interested, Bill.”

“Where is the laugh?”

“The big laugh is coming now, Bill. As soon as the mysterious gangsters disappeared with those decoy bundles we delivered the real bundles of Gazettes to the corners and they are selling fine, thank you. I might mention that there are at least three automobiles standing by at each corner, loaded with boys who are quick on the trigger and if any of the birds who stole your Clarions should come back and try to carry off our Gazettes, McKinley Boulevard will begin to look like a Hindenburg line. And that goes tomorrow morning and the next morning and from then on regardless.”

Bill Rossom said something over the wire that sounded so much like blasphemy that the Colonel fairly beamed.

“I forgot to tell you, Bill, that at twenty corners we took flashlight photographs of the gunmen stealing newspapers. The pictures came out fine. If there is any more of this gang stuff we are going to print the pictures.”

Rossum hung up the receiver. Outside of a few skirmishes on the following morning the Gazette distributors met with no trouble in placing the paper on sale. (To be continued)
Making a Ground-Glass Drawing

Do you ever hear of ground-glass drawings? They are easy to make and transfer, but it will be necessary to make a drawing box in order to make the copies. You draw pictures just as you see them with this drawing box, and portraits can be handled in the same way.

Construct a light pine box from dry-goods boxes, making it twelve inches long, ten inches deep, and ten inches high. The box is enclosed except at one end, and one side is hinged in order to make the ground-glass focus easily. In the front end of the box cut out an opening into which a small reading glass lens will fit tightly. Any clear, highly magnifying glass of this nature will do. Make slots one-eighth inch deep in the top and floor boards of the box so they are paired, and a ground glass may be slipped into the grooves in a perpendicular position. Make six of these slots, each one being one inch from the other. Make a swinging door for one side of the box by hinging the board to the front edge, and the box is completed and ready for the ground-glass. This must be cut out to fit the box so it will slip readily into the slots. Ground glass can be made by filing and sandpapering common clear glass on one side until it has the surface of a piece of commercial ground-glass.

Throw a cloth over the box, keeping the lens uncovered, and adjust the box in front of the scene you wish to take. If it is a person, he should be sitting near a window. Place the box a few feet away so you can see the image on the ground glass. Now swing back the side door, and make your focal adjustment. Try out all six slots until you find the one which gives the sharpest image on the ground glass. Use an indelible pencil to make the drawing, and again throw the cloth covering over the box and your head, excluding most of the light except that which comes through the lens upon the ground-glass plate. Copy the image directly upon the ground-glass with the pencil, shading lightly here and there, and making a clear-cut outline.

Now slip the ground-glass from the box and lay it upon a table. Slightly moisten a sheet of drawing paper with a sponge, and lay it flat upon the ground-glass, pressing it down evenly. Now peel off the paper, and the drawing will appear upon the paper in purple lines. Rinse off the ground-glass, slip it back again in the box, and it is ready for another drawing.
Table Lamp Made from Old Table Leg

Grandfather's table legs are coming to the front. They are lighting the way to progress—or at least helping to illuminate some of the parlors and reception rooms in Chicago.

Merle Meyers, a young teacher in the manual training department of the Chicago public schools, seems to be responsible for the emancipation of grandfather's table legs. And here is a hint for any bright boy or his father who knows how to use a few simple tools.

"I am a fiend for looking around in garrets and store rooms for old furniture," said Mr. Meyers. "And I often tell the boys in my classes that many fine treasures may be found that are simply going to waste there. Not long ago while prowling through the basement storeroom of one of my neighbors I came on an old dining table. It was made of solid black walnut. I found the owner was saving the table simply because he could not bring himself to throw it away. It had been made by his grandfather who had cut down the trees, milled the lumber and built the sturdy old piece with his own hands.

"The legs were neatly fluted and turned. There had been five such legs originally but one had been broken off and lost. I offered to make my neighbor a table lamp from one of the legs and part of a leaf if he would give me the balance of the material. He gladly accepted the offer.

"The rest of the task was easy. With a hammer and screw driver I took the whole table apart. I found some pencil marks had been made in 1849 by the old Michigan pioneer who had put the parts together originally. In making the lamp I simply bored a hole through the center of the leg and extended a three-quarter inch brass tube from the end where the caster formerly had been to a height of seven inches.

"From the top of this tube I suspended a bracket for the lamp shade and also the attachments for a pair of electric light bulbs. The large end of the table leg was attached to a round base turned from one of the leaves. I drilled a hole laterally through the base and through this strung the wire up through the center of the leg and to the bulbs."

The owner of the old table was very much pleased to get this artistic memento of his grandfather's work of almost a century ago and Mr. Meyers found material for many other valuable articles of woodwork. And the poor old table legs—what a dramatic rise after being kicked around by so many shoes from one generation to the next. This item of information about the old table legs is written by the light of that very lamp.

Submarine Hauled from Bottom of the Sea by Locomotives

The U.S. Submarine S-48 which was wrecked off Portsmouth, N.H., two years ago, was hauled out of the sea by locomotives on two timbers, making an improvised drydock. Never before has a feat of this kind been attempted with a vessel of this size. A cradle was first built around the sub and then the ways greased. Three locomotives were coupled to the end of a five-mile long steel cable which turned over many blocks and thru pulleys and at a given signal the locomotives started pulling, the submarine being slowly brought up on dry land.

Noted Pianist Spends Spare Hours in Machine Shop

An interesting sidelight on the life of Josef Hoffman, world famous pianist, is his hobby of mechanics. He spends much of his spare time in the machine shop of Edward W. Bok, noted publisher, at Merion, Pa., where he makes useful and ornamental things with the tools the shop is provided.

Restoring Old Ship Models Is Lawyer's Hobby

Henry B. Culver, New York lawyer, has adopted as his hobby the restoring and repairing of ancient ship models. He has just completed the work of rigging and repairing "The Dartmouth," a contemporary seventeenth century named for Lord Dartmouth, whose mother was a Washington of Sulgrave, kin of George Washington.
April Evening Skies
Leo, and the “Sickle” Succeed Orion as Prominent Southern Constellation—Mizar, in Great Bear, Really Three Stars
By JAMES STOKLEY

Leo, the Lion, with its familiar “Sickle” in the southern sky, Orion about to disappear until next fall below the western horizon, and Virgo, the Virgin, with its brilliant star Spica, and Bootes with the shining Arcturus in the southeast—to the student of the heavens, these mean that spring has arrived. The maps show how these stars, and the others, are placed in the April evening sky.

The lion, Leo, or at least the stars of the constellation, seems to bear little resemblance to the figure of the king of beasts, but in ancient times, in India and Egypt, it was represented in the same way as today. The blade of the sickle represents the lion’s head, as he is facing west, and the rest of the constellation the body. Even the medieval Christians who endeavored to remove the pagan star groups from the sky and replace them with biblical characters, left the lion as one of those with which Daniel was associated.

One explanation of the origin of the sign is that in midsummer, when the sun is among the stars of the constellation, the lions in Egypt came down to the banks of the Nile to escape from the heat, for at that time the river overflows. As Egypt has from the earliest days been dependent on the annual inundation of the Nile, the sign of Leo was also an object of worship among the Egyptians, according to Pliny.

According to the Greek mythology, the lion represents the one slain by Hercules in the first labor, and was placed in the heavens by Jupiter to commemorate the historic conflict. The second of his labors is associated with the neighboring constellation of Hydra, the water serpent. This group represented to the Greeks the water snake slain by Hercules after he had finished with the lion. According to this legend, the snake had many heads, varying in number from nine to a hundred, depending upon which version of the story we accept. The center head was immortal. As fast as Hercules destroyed one head two new ones appeared, and so the encounter would have doubtless ended in disaster for Hercules, but for the fortunate suggestion of his nephew, Iolaus, that he burn them off. This they did, burying the immortal head under a rock, where the monster was unable to find it. Thus, having completely lost his head, the serpent annoyed Hercules no more!

In the northern sky, the large dipper, or the Great Bear, is very conspicuous, as it is nearly overhead in the early evening. In this position, it affords a good opportunity to see the interesting pair of stars, Mizar and Alcor, which are shown on the map. Mizar is the second star from the end of the handle of the dipper—the one at the turn of the handle. Keen eyesight will reveal near it a much fainter star, which is Alcor, so that the pair is sometimes called “the Horse and Rider.” Many early peoples, as well as the American Indians, are said to have used this as a test
of keen eyesight. But in large cities the smoke and haze in the atmosphere, as well as the glare of the lights, make it difficult to see, even with keen sight. But such slight optical aid as a pair of opera glasses reveals it easily.

**Double Stars**

From early times it was thus known as visual double star—a star that could be seen as two with the unaided eye. But in the year 1550 the Italian astronomer Riccioli, who is famous for having named the craters of the moon, turned his telescope on it from his observatory in Bologna. Not only did he see the bright Mizar, and the fainter Alcor, but he saw that Mizar itself was double, as it consisted of two stars of nearly equal brilliance, but too close together to be seen separately by even the keenest eyesight. This was the first "double" star to be discovered, but since then many more have been found. In fact we now know that on the average one star out of every 18 in the sky is double. Many of these were discovered and observed by the late Prof. S. W. Burnham, at the Yerkes Observatory of the University of Chicago. After his death, his mantle fell on Prof. Eric Doolittle of the University of Pennsylvania, and when he died it went to Prof. Robert G. Aitken, the associate director of the Lick Observatory of the University of California. Dr. Aitken now spends most of his time observing these double stars with the great 36 inch telescope of the Lick Observatory, and plotting their motion. The members of such pairs do not remain in the same place all the time, but revolve around each other. Their motion is much the same as would result with two heavy balls, tied at the end of a short string, and thrown into the air, spinning around together. They would revolve around the center of gravity of the two, and so do the double stars, showing that they, like the balls on the earth, are under the influence of gravitation.

But Mizar is more than an ordinary double star. It is what is called a spectroscopic double, and, in fact, was the first star of this kind to be discovered, as well as the first double. The brighter of the two stars that Mizar is shown to be by means of the telescope looks single with even the most powerful optical aid, but by analyzing its light with the spectroscope, which turns white light into a rainbow-like band of color, it is shown to be two stars. This band of color, the spectrum, of star light, is crossed with numerous dark lines. The position of the line in the spectrum depends on the speed with which the light which produces it is vibrating, the lines in the red part of the spectrum, for example, being produced by light vibrating more slowly than the lines in the blue part.

**Sound Wave Analogy**

A NYONE who has heard a fire engine, or a locomotive, go past, ringing its bell, knows that the sound of the bell is shriller as it approaches, and deeper as it goes away. This is because the sound is caused by waves in the air, and the pitch of a bell depends on the speed with which these waves vibrate. As the bell approaches, the waves strike the ear closer together than if the bell were standing still. As a bell of higher pitch would also cause the waves to come closer together, the person who hears it thinks that the bell is of higher pitch than it really is. And then as it goes away, the waves are spread out more than ordinarily, and the sound is interpreted as of lower pitch.

The same thing happens with light. When a star is approaching, the light waves are closer together, and the lines in the spectrum appear nearer the blue end than if it were still, and when it is receding they appear nearer the red end. The result is that by measuring the position of the spectrum lines very accurately, it is possible to tell whether the star is moving towards, or away from us, and how fast.

But the curious thing about Mizar is that the brighter member of the pair, when its light was analyzed through the spectroscope, showed that the lines were sometimes double and at other times single. This meant that when the lines were double the star was both approaching and receding, at the same time, a contradiction which could be explained if the star itself were double. This is the case, and the two revolve around each other once in about 20 days and 14 hours.

No planets are well placed for observation all evening during April, but Venus and Mars can be seen in the western sky in the early evening, and late in the evening Saturn appears above the eastern horizon, and is directly south at 2:53 a.m. None of these are shown on the maps, but Venus, which sets about 2 hours and 45 minutes after the sun, may be recognized because of its great brilliancy as it shines in the west.

**New Speed Camera Shows Lightning Travels in Spirals, Not Jagged Lines**

J. W. Legg, an engineer of the Westinghouse Company, has just invented a new high-speed camera capable of making 2,600 pictures a second and by which he has demonstrated in experiments that lightning and electrical flashes do not travel in jagged lines but in complicated spirals. The jagged line is but an optical illusion resulting in the inability of eye and cameras hitherto in use to record the true nature of the flashes. Mr. Legg says the flashes traverse many times the distance of a straight line between the points of termination and origin. The Legg camera is fitted with 22 lenses and a shutter operated by a small motor and can be adjusted to any speed, up to 2,600 exposures per second. Photo shows Mr. Legg photographing an electrical flash with his new camera.

**Heart Beats Heard Like Roar of Train Thru Loud Speakers**

Students sat in the Amphitheatre of the clinic of the Medical School, Univ. of Penn., and heard heart beats of patients which were as clear as the rumbling of a train. Dr. C. J. Gamble is shown with stethoscope placed on the chest of a patient, during a diagnosis in which heartbeats and murmurs were amplified millions of times.
Radio Will Play Big Part in Future Wars

Wars of the past have unquestionably been bad but a more terrible aspect is given to the picture of future wars by the greater extent to which radio is to be used in controlling the annihilation of the enemy’s troops or cities. If radio played an important part in the World War how much more important it will be in the next war can readily be seen from the great amount of research, both military and civil, that is being carried on to further harness electric energy that travels through space at 186,000 miles per second.

Perhaps chief attention now centers on the use of an aerial torpedo, either launched from a mother ship at a distance and guided to its destination by radio, or radio controlled planes which will drop high explosives over a crowded city and return to their base without guidance other than the radio control signals. The same radio control principle may be applied to a torpedo discharged from a submarine. Its activity after leaving the submarine may be controlled by wireless waves. Under such conditions the accuracy of such torpedoes will be far greater than the old type where once discharged the torpedo must follow a prescribed course. While the detection of submarines by radio is better developed so far nothing has been designed to detect an oncoming torpedo, if submerged.

Where in previous wars the battles have been fought largely on land in the next conflicts the action will probably take place principally on the water and in the air. Here two factors will take a part; men and machinery. To be successful these battles must be waged at a saving of man power, so we may expect to see radio, electricity and mechanics combined intensively in the destruction of an enemy’s forces or territory with the least expenditure of human energy. With this in view the war of the future becomes a fight between nations having the greatest financial resources to be able to carry on a war of machinery. In it the scientist will be called upon to develop more terrifying destructive machines with which to punish an enemy, and at the same time the same scientist will be called upon to discover protective measures against the enemy using the same tactics.

In the case of the aerial torpedo scheme as soon as a method of properly directing the course of the torpedo is discovered, other scientists set about to find a means of preventing the same torpedo from reaching its destination. Thus a radio barrage may not be hard to conceive of in the next war; the barrage to consist of a number of signals sent out in the hope of at least some of these signals interfering with the operation of a radio controlled plane or torpedo.

Detection of vessels at sea by means of the underwater oscillator was a stunt used during the past war. In the next one even better means of locating such craft will probably be used in which radio waves are directed ahead of the ship. If these waves rebound back to the ship the direction of the craft ahead is shown, although its distance is not known very accurately unless it is possible to measure the time involved in the going and coming of the radio waves. This method is being used with some success at present in a radio altitude meter for use on planes where the time involved in the sending of the wave and its return to the plane is calculated so as to determine the height of the plane above the earth or water. This same means is employed in showing (during night flying or in foggy weather) whether the plane is dropping too low for safety. Another possibility of the same device is the direction of icebergs at sea, giving a warning to a vessel so her course may be altered.

If these measures are applicable in time of peace it seems certain many more applications will be found for use in the wars of the future.

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Does the Moon Affect the Weather?

By Dr. W. J. Humphreys*


If you ever had the good fortune to live in the country, or even to spend a few summers in the mountains, you surely are familiar with the confident assertion that as soon as the moon changes the weather will get better. If the fields are parched, there will be rain when the moon changes; if they are too wet the change of the moon will bring fair weather and clear skies. Whatever you want in the way of weather, that, they tell us, you will get, when the moon changes—a cheery, hopeful expectation inherited from grand-dad's grand-dad, an ancient legacy of faith, misplaced to be sure, but so comforting that it were a pity to destroy it, if we had nothing so good or better to offer in its stead. But let us destroy it, for really the moon does not control the weather, and there are indeed much better guides to follow than the olden tradition that it does.

But how do you know, the faithful ask and have a right to ask, that the moon does not influence the weather? It is certain that the great tides of the ocean are caused mainly by the moon; and even the continents, mountains and all, are raised and lowered, twice a day, nearly a foot by the tug of the moon. Surely, then, so the moon advocates insist, the tides of the light, mobile atmosphere must be many times larger—so large indeed as to
Dr. W. J. Humphreys, meteorological physicist of the U. S. Weather Bureau, who explains the fallacy of supposing that the moon regulates the weather, produce great changes in the weather. All this appears very reasonable, we must admit, but it happens that the atmosphere does not behave that way, and so far from it, indeed, that its tides are so minute that they can be detected only by the most searching and delicate means. We must give up the idea, then, that the moon pulls the atmosphere about in great ebb and flows, and thereby affects the weather—must give it up, because, on careful examination, we find that nothing of the kind happens.

But how about the heat from the moon, our friends, the faithful, inquire with good reason; isn't that greater at full moon than at new moon and enough greater to change the weather? Yes, we must answer, it is greatest at full moon, but even then, as shown by direct measurement of the moon's radiation, so small that it can alter the temperature of the earth by only one or two thousands of a degree, a change so trivial that no one could be certain of it, nor would take any account of it if he were. In quite a different, and hidden, indirect manner, however, the moon changes the temperature of the earth manifold as much as by its own conspicuous radiation. It does so in this way: Since both it and the earth swing around the sun together, and at the same time rotate about each other like a big weight and a little weight at the two ends of a stick hurrying end over end through the air, it follows that at full moon, the time when the moon is on the opposite side of the earth from the sun, the earth itself is closest to the sun, and at new moon farthest away. This action of the moon changes, between full moon and new moon, the distance of the earth from the sun by about 6,000 miles. That is, at full moon the earth on the average is about 6,000 miles nearer the sun than it is at the time of new moon. Well then, says our moon friend, if you change your distance from the fire that heats you by 6,000 miles surely you will make a big change in your temperature. Truly, 6,000 miles seems a long way when thought of in terms of travelling over the face of the earth, but it is a mighty little part of our 90-odd million miles from the sun, and the temperature effect of this relatively small change in the total distance from our great source of heat is correspondingly minute, in fact only about one five-hundredth of a degree, far less than one measures on any ordinary thermometer, and much too small to be noticed in connection with the weather.

Perhaps, now, our moon champion will offer another and very pretty bit of evidence in favor of the idea that the moon greatly affects the weather. Why, he says, many a time I have seen the moon just eating up the clouds. The sky was nearly covered with clouds at sundown, and then in less than an hour the moon was shining bright and there scarcely was a cloud to be seen. The moon had devoured them all, and surely we must agree that the weather is different under a clear sky from what it is under a cloudy one. Of course, we agree to that, for the difference is very real, and we agree, too, to the statement that often a sky that is considerably clouded at and before sunset is seen, during the light of the moon, to clear off rapidly as the twilight deepens. But we do not admit that the moon had anything to do with causing the clouds to disappear. It just enabled us better to see them getting smaller and fewer and farther between. This is how it all comes about: When the sun goes down, clouds cool faster than the dry air. They lose heat and also chill the air they are in. This chilled air contracts, as cooled things do, becomes correspondingly denser, and sinks to lower levels, pulling the cloud particles along with it. As it sinks it gets warmer and warmer, and stops sinking and warming only when it comes to the same temperature as the air that then surrounds it. Now, as the sinking air gets warmer, of course the cloud droplets in it evaporate and the cloud disappears. The whole process is very simple and evidently happens just as well when the moon is below the horizon as when it is above. The difference is with ourselves. We don't see so clearly the vanishing of clouds on a dark night as on a bright one. In fact, we scarcely see it at all except when there is a moon to make the clouds distinctly visible. And so it happens that we mistakenly attribute the disappearance of the clouds to some action peculiar to the moon, when as just explained, the moon has nothing to do with it.

The moon then does not make big tides in the air; it does not in any way appreciably affect the temperature of the atmosphere; and although it seems to dissipate clouds—to eat them up, as we say—it does nothing of the kind. We are sure, therefore, after all this, that the moon does not noticeably control the weather. But our moon friend is not so sure of it.

(Continued on page 37)
Superheterodyne Minus Repeat Points on Oscillator

One Spot Super and Power Compact Best Ever Made

By F. A. HILL

(Associate Editor)

FORTUNE has at last smiled on radio fans interested in securing a super without the repeat positions so generally considered objectionable. Our own jubilation over running across such a desirable set has risen to such a point it will be rather difficult to restrain our enthusiasm as this is written.

Two factors have contributed to bring about a state of receiver perfection that is so high we frankly have not previously found such a condition possible. In the super end credit is due to the Madison-Moore interests in Denver who have produced an intermediate stage transformer peaked at a frequency value that prohibits the appearance on the oscillator dial of the repeat point, or beat, so common to the ordinary superheterodyne. In the audio end we have to thank Thordarson for the design and manufacture of a 210 power compact whereby even the novice may now have reception such as he has never encountered heretofore. The careful combination of these two features in the RADIO AGE model of the One Spot super has resulted in a receiver and power amplifier that surpasses anything with which we have experimented.

Having opened up a field for the use of intermediates peaked at such a high frequency that the second beat does not appear in the set’s operation, it is not very difficult to see a large portion of the transformer industry swinging into line before many more moons have waxed and waned. Anticipating the keen interest of the thousands of super fans who have followed our models and answering the questions of hundreds who have complained of the two beats on an oscillator, we have prepared the superheterodyne to be described in these columns. We hope it will be the means of satisfying our readers’ expressed wishes for a distance getter without repeats and with a quality of output equal to if not better than anything that has been placed on the market. Naturally this design will be the forerunner of many similar models involving the use of other quality parts whereby the same results may be achieved. Having produced this particular model we are content to rest until another set of parts is produced which can be made into such an excellent combination. So much for the enthusiasm. Now let us get down to the history of the component parts which have played a most important part in the excellent results secured.

Shortly after having made up the One Spot model and found that it was an ideal set for our readers, we interrogated the makers of the transformers as to the steps leading up to their production of an intermediate with such a high frequency. From Madison-Moore we learned their cue had been given by the enormous number of super fans who were quite satisfied with their old type intermediates but who wondered if it would be possible to make an intermediate that would eliminate the high beat that so often interfered with the reception of desirable stations. The Denver manufacturers decided the time was ripe for such a departure in transformer design and set about to build one. They decided upon a frequency of 480 kilocycles (624.6 meters) Transformers were then worked up for the intermediates so as to obtain maximum amplification without oscillation. This, however, was the eas-
iest job of all. When these transformers were incorporated in a set there was absolutely no pick up of strength on distant signals even when using the 200-A detector tube. It was then necessary to do considerable experimental work in order to give the set sensitivity, and the new head end hookup as used in this receiver (see schematic) is the outcome of this experimental work. In the receiver to be described only 45 volts are used on the intermediate stages and with grid returns to the negative A, instead of a bias on these grids since it was felt that some tendency towards rectification might be present with such a bias. Also no potentiometer is used. If one were used greater amplification might be secured but with the following objectionable results: A sacrifice of selectivity and tone quality (the former has been noted by all super enthusiasts) due to the fact the potentiometer would handle the grid returns of number three, four and five tubes, or it would be connected to the grid return posts of transformers number two, three and four. Any variation of this potentiometer would slightly change the tuning of these units, whereas the number five unit which is not so treated, would still have its normal output and detector grid return. Thus the number five unit would continue to function at a pre-determined frequency with the units preceding tuned to whatever frequency might occur as the operator twirled the potentiometer. Another reason for the elimination of the potentiometer was the desire to conserve on the plate current required to operate the set. (Our laboratory model ran a total of 12½ milliamperes on the 45 volt tap which supplies the intermediates.) What further development work will be done on intermediates peaked in the neighborhood of 480 kilocycles we are not in position to know, but we feel a vote of thanks should be extended the Madison-Moore interests for their trail blazing work in this respect.

Another vote of thanks should be extended by the "quality hound" to the Thordarson company for the production of the 210 compact (they also have a 171 compact described in the March issue of Radio Age) but chief interest centers now in the 210 combination for plugging in the power compact on any receiver instead of having to build the receiver for the power compact. This departure should permit every fan to have a standard power set onto which he may hitch any type of receiver he desires without any more exertion than the taking out of the last tube in the receiver and plugging into the vacant socket an adapter which carries the grid input into the 210 tube. This scheme is shown pictorially in the diagram on page 28.

Having bestowed proper credit where it is due, we will now take up the discussion of the various diagrams in this article and try to make them clear for our readers. The old timers will realize the value of the stunt at first glance, but some of our newer readers may need a little help.

Upon referring to blueprint Figure 1 the reader will find the front panel layout and that of the subpanel. All unnecessary gadgets and dewdads have been eliminated in the interest of economy of parts and simplicity of operation. On the front panel there are only two major controls; the loop dial on the left and the oscillator dial on the right. The upper knob controls the rheostat governing the filament of the intermediate stages, while the lower one determines the brilliancy of the first detector filament and thus affords that critical balance between regeneration and os-

This arrangement of the power pack is more desirable for those who wish one power amplifier to fit all receivers. All you do is to remove the last tube of any receiver and plug in the adapter for the power compact. The pictorial layout is shown here instead of the schematic for greater simplicity.

LIST OF PARTS

Parts listed below were used in the construction of the RADIO AGE model One Spot Superheterodyne. Other parts of equal merit may be used if desired.

The Receiver
1 Set (No. 1 to 5 inclusive) Madison-Moore units
1 Thordarson R-76 output transformer
1 Thordarson R-200 audio transformers
8 Benjamin UX cushion sockets
1 pair Benjamin panel brackets
2 Remler variable condensers, 1-0005 mfd 1-00035 mfd
2 Frost rheostats, 1-10 ohm, 1-20 ohm
2 Radiall No. 5/4 Amperite
1 Radiall No. 1-A Amperite
1 Silver-Marshall RF choke coil
1 Sangamo 1 mfd bypass condenser
1 Sangamo .00025 mfd grid condenser
1 Sangamo .002 mfd fixed condenser
1 Durham 2 megohm grid leak and mounting
1 Jones base mounting plug
2 National type C vernier dials, O-200 clockwise
6 Carter tip jacks
2 Formica 7x26x3/16 panels
1 Qualitone loop
1 Abex filter
1 Balkite type AJ rectifier

Separate Power Compact
1 Thordarson R-210 power compact
1 Tobe Deutschmann condenser block for 210 compact
4 Ward-Leonard resistors, 1-800; 1-10,000, 1-2000, 1-1000 ohm
3 Daven mountings
2 Benjamin UX cushion sockets
3 X-L Pushposts
1 UX-210 power and amplifying tube
1 UX-216-B half wave rectifying tube
1 UX 874 voltage regulator tube
cillation, which balance is so essential for bringing in to the best volume those distant stations that every experimenter continually seeks. With this set the quality on distant stations was found nothing short of remarkable.

Unit number one, shown in the center of the subpanel, is the oscillator, having only grid and plate windings. There is no pickup coil used, since the plate feed for the first detector (Unit two) and that of the oscillator are seriesed and run to the 45 volt tap. Mixing is accomplished in this fashion without the necessity of a pickup coil. Units two, three, four and five are the 480 kilocycle intermediates with the second detector feeding into a 200-A tube instead of the conventional 201-A. Two audio transformers and an output transformer are placed at the right of the fifth unit. Since the intermediates and the oscillator are completely shielded their position in the layout does not matter. Ours was arranged in the manner shown for the purpose of getting everything on a seven by twenty-six inch subpanel, with the subpanel set back further from the front panel than usual so as to clear the two tuning condensers. The braided wire extending from one condenser to another is the twisted pair carrying the 6 volts of filament current for the illumination of the two National type C vernier dials. Body capacity in both dials is absent regardless of how much the set may be forced—the Remler twin rotor condensers serving to bring about that objective.

Judging from the appearance of the subpanel in blueprint Figure 2 there is very little to be seen, which is more or less true. All sockets have been mounted in the subpanel using the Benjamin unassembled type (the same as their UX except for subpanel mounting). A few Amperites, a San-gamo bypass condenser, Carter cord tip jacks and the Jones base mounting plug are about all that have to be placed under the panel. The wiring is simplicity itself, only a few lengths of spaghetti being required to cover crossover wiring.

Schematically in blueprint Figure 3 may be seen the method of connecting up the Thordarson 210 compact, the Tope Deutschmann condenser block for same, Ward Leonard vitrohms (fixed resistances) voltage regulator tube, 216B half wave rectifier tube, and the fixed resistance for giving the grid bias to the 210 power amplifying tube. On account of the compactness of all these items it is possible to build the entire power outfit into a small space of about 6 by 12 inches. The use of the UX 874 voltage regulator tube makes certain that no voltage fluctuations will occur in the 45 or 90 volt lines. On account of using the superheterodyne where a heavier pull is made on the 45 volt line than in conventional receivers, the resistance between the 45 volt and 90 taps in Schematic Figure 3 is made 2,000 ohms instead of 10,000 ohms as is customary in other types. This insures an ample voltage and current on the 45 and 90 volt tubes. On the 210 power tube a 400 volt potential is applied with an automatic bias on the grid, this value being determined by the amount of current drawn in the plate of the 210 tube. All of the apparatus shown within the dashed lines in the drawing is contained inside of the Thordarson 210 compact. In this diagram all connections are arranged so the builder may make the unit up for use with the One Spot set. However by consulting the pictorial diagram on page 28 the builder may see how this compact may be constructed so it will serve as a power supply for any type of receiver that it may be desired to use, since the compact furnishes the power tube voltage as well as the B voltages for the balance of the receiver.

Most attention should be directed by the reader to the blueprint Figure 4 which is the schematic of the receiver. It will be seen at first glance that only two terminals of the loop are shown. As such the loop would not be regenerative. However on account of the series arrangement of the plate coil of the first intermediate and the plate coil of the oscillator, together with the fact a rheostat is provided for altering the filament current of the first detector, it is possible to cause regeneration and oscillation.

Neat arrangement of parts and clean cut wiring predominate in this subpanel assembly of the One Spot super. Here the output transformer is located in the set itself and use is made of the power compact shown schematically in the blueprint, Figure 3.
FIG. 3
210 POWER COMPACT FOR USE WITH RADIO AGE MODEL ONE SPOT SUPERHETERODYNE

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in the first detector. Under the former condition signals will come through fine and no repeat points will be found on the oscillator. However if the first tube is thrown into oscillation then repeat points will appear, but the output will be so hashed that no one but an escaped inmate of the nut factory would listen to it for a moment. Thus this receiver penalizes the chap who has an erroneous idea that oscillation is necessary for reception. Let the oscillator do the oscillating instead of supplying added confusion by throwing the first tube into oscillation. The resistance R1 is a quarter ampere Amperite and is placed there to prevent an abnormal voltage being placed on that tube. The resistance R2 is a 20 ohm rheostat. Filament control for the intermediates is through a three-quarter ampere Amperite in series with a 10 ohm rheostat so that in this case too much filament current may not be placed on the tubes. Do not get an idea in your head that you can dispense with these Amperites and handle it all on a rheostat—these current limiting devices were put in those positions for the very purpose of making sure you would not have any trouble in tuning the set, so take our word they are necessary. The filament control for the oscillator, second detector and the first audio is placed on a three-quarter Amperite since it will not be necessary to adjust these voltages. This resistance is shown as R5.

As shown in this schematic the oscillator is of the tuned grid-filament type and if necessary an ordinary grounded rotor condenser may be used, the same applying to the loop tuning condenser. Our preference happened to be for the .0005 mfd Remler for the loop and the .00035 mfd Remler for the oscillator. The plate coil of the oscillator is a straight series feed and no choke coil will be necessary as is usually included in the parallel feed oscillators. It will be also noticed the plate potential for the plate of the first detector is only secured after it has passed through the plate coil of the oscillator. It is here the mixing action of the locally created frequency is accomplished against the received signal frequency. Please note that grid returns of units two, three and four go direct to the negative filament. The grid return for unit five goes to the tube direct instead of going direct to the negative of the filament. However for unit one, which is the oscillator, the grid return is direct to negative. Remember these points when building the set and do not deviate from the schematic. The balance of the set is not difficult to arrange and little need be said. A Silver-Marshall RF choke coil was placed in series with the plate of the second detector and bypassed to the filament—this was done on general principles. The two Thordarson R200 audio transformers are shown in the diagram with the bias of the first audio grid being obtained through a C battery while the negative return of the second stage is direct to the negative A and B line, which when connected to the power compact will give the proper bias to the grid of the 210 power tube regardless of whether the common AB negative line is grounded or not. Terminals are provided for the 75/4 volts AC supplied by the compact; other taps are shown for the loud speaker and the loop. Instead of using binding posts on the loop, loud speaker and filament terminals we used the Carter cord tip jacks which greatly simplified our work. The second detector uses a grid condenser and leak for rectification instead of the grid biased rectification method used in our previous models. Since the 200-A is utilized this form of detection is believed to be better.

Now for a description of the 210 compact when used as a separate unit to be applied for use with any type of receiver regardless of its make. This idea appeals to us as best of all for the real experimenter because of the facility with which he may slap on any receiver and be assured of quality output as long as he has a set of decent transformers in the set under test. Of course no power amplifier will be a cure for poor audio transformers in a set, but from our experience with this combination it will certainly make quite a difference in a large number of sets now on the market.

This unit may be built up in a metal box if desired, or it may be laid out on a wooden base with rubber feet placed underneath to prevent its scratching any surface on which it may be placed. The sockets for the 216-B half wave rectifying tube and the 874 voltage regulator are placed at the left of the power compact. The condenser block is placed in front of the compact, while the Edison base receptacle for the 8000 ohm resistance, the output transformer and the socket for the 210 tube are located at the right of the compact. The Canotex adapter for plugging into the last stage socket of any set is shown at the upper right of the drawing and is attached to the grid of the 210 tube. It will be furnished with the compact. This adapter is available on the market now. If desired it may be made by breaking off the glass on a UX tube, finding the grid prong and soldering a wire to it (inside the socket) then attaching the other end of the line to the grid of the 210 tube. Thus you can make your own adapter. The resistances in this compact are those chosen for operation of superheterodynes instead of tuned RF receivers. The 8000 ohm vitrohm made by Ward-Leonard will handle 40 mills, while the 10,000, 2,000 and 1,000 ohm cartridge resistances made by the same concern will handle the desired current rating in that portion of the circuit. Only three binding posts are required on this assembly because the high plate potential lead goes direct from the condenser block to the B post on the output transformer.

Operating instructions on this set are simple. You will expect and you will get ten kilocycle separation regardless of whether the locals are on or not. You will find no repeat points unless you are unwise enough to let the first detector oscillate. The left hand condenser will govern the loop readings, while the right hand one will be for the oscillator settings. With given tubes and given voltages as supplied by the power unit, the set may be logged and regardless of where it is carried the oscillator loggings will run the same. Different types of loops will give different reading on the left hand dial. The filament setting of the first detector will be the critical one. The filament setting of the intermediates is not so very critical though both of these controls may be turned too far and either the detector or the intermediates thrown into oscillation. This condition will at once be manifest to the operator due to the squeals that will result.

This set was operated with complete A and B elimination, an Abox filter being placed on the output of a 3 ampere rectifier. This furnished is our filament current. The power compact furnishes A, B and C voltages for the power tube. This gave

(Continued on page 36)
THE Magic OF IT!

RECEPTION AT ONE-Spot ONLY ON THE DIAL WITH THE
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Marvelous Selectivity - Accuracy - Distance - Quality!

ACTUAL EXPERIENCES: Mexico City logged 180 stations, 6 of which were Canadian; Kobe, Japan, from Los Angeles; Buenos Aires, S. A., from Breckenridge, Texas; Pacific Coast from Boston; Atlantic Coast from Los Angeles, Seattle and Portland. That's distance!

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Please Mention Radio Age When Writing to Advertisers.
Our attention has recently been called to a condition against which many radio fans might desire to protect themselves in the operation of a charger. J. G. Lindsay, 2452 Geneva Terrace, Chicago, III., nearly burned up his radio set through the use of an old type bulb charger in which the winding was that of an auto-transformer instead of the true transformer consisting of a primary and a secondary, inductively coupled. The accident occurred when Mr. Lindsay turned on the charger (after someone else in the family had reversed the cord plug) so the high side of the 110 volt circuit was grounded through the charger itself. Very few old style chargers remain, however, but if you happen to have one it would be a good idea to either provide yourself with a polarity plug so the 110 volt plug could not be put in wrong; or else turn in the old style charger and get a new one. At the time the old type was made they were used only for charging batteries in service stations. The sudden rush of radio interest swamped the manufacturers so it took nearly two years before the proper type of isolated windings were placed in rectifiers, thus effectively barring the possibility of accidents through placing the high potential side of a line to ground through the charger.

Owen Bailey, 522 Reynolds Ave., Columbus, Ohio, amuses himself by compiling a list of distant reception which carries in addition to the station call, the wattage of the transmitter. His list is a formidable one, reception having been accomplished on a three tube set within the space of three weeks.

Radio signals on 32.79 meters, inaudible 200 miles from the transmitter, were heard and copied with 100 per cent accuracy by a listener in Australia, 11,400 miles from the transmitter.

This fact is brought out in the report of engineers of the General Electric Company, following a series of propagation tests on modulated or voice signals and telegraph signals, on 32.79, 65.16, 109 and 140 meters.

Channels comprising wavelengths shorter than those of the 66.3 to 75 meter channel will not give economical service at points within 100 miles of the transmitter.

The 66.3 to 75 meter channel, the 85.7 to 105 meter channel, and the 133 to 150 meter channel are capable of rendering economical service at points within 100 miles of the transmitter.

For daylight communication at distances not greater than 90 miles from the transmitter, the 133 to 150 meter channel will give better service than the 85.7 to 105 meter channel. Similarly the 85.7 meter channel will give better service than that which can be obtained under the same conditions using the 66.3 to 75 meter channel.

The above conditions are reversed when distances between 90 and 200 miles are considered. In this case the 66.3 to 75 meter channel will give better service during daylight than the 85.7 to 105 or 133 to 150 meter channel.

Dr. Miles R. Bruemmer, 2629 Grand Ave., Milwaukee, Wis., reports excellent results with the Ideal Model of the World's Record super illustrated in the blueprint section of the March issue of this magazine. He says the tone of that set is unsurpassed and its distance consistently remarkable. He believes in it so much he has helped three of his friends to make similar sets.

S. O. S.

Radio Age would appreciate having the address of W. Lemkin who drew the cartoon which appeared on page 54 of the February 1927 issue of this magazine. Should Mr. Lemkin see this note we would be glad to have him furnish us with his address.

—Editor
Portable Direction Finder Has Many Government Uses

(Continued from page 7)

The use of seven heterodyne coils is required to embrace the wavelength range from 39 to 3,300 meters. This, as previously stated, necessitates seven cans, each of different shape; these with their respective heterodyne generator coils and corresponding direction-finder coil antenna cover the wide band of wave lengths. These generator coils, like the direction-finder coils, are of the plug-in type; having six terminal plugs, four of which constitute the terminals of the plate and grid coils, the other two being the terminals of the coupling coil, which is in series with the direction-finder coil. The turns of wire on this coupling coil vary for each of the coils. The generator coils are wound on tubes 23/4 inches outside diameter and 23/4 inches long. They are protected with a layer of varnished cambric and by two bakelite disks, one over each end of the coil. A socket is provided to receive these coils, to which the wires of the receiving set terminate. In each of the heterodyne generator coils the plate winding is on the lower half of the coil form with the outside end of the coil connected to the plate. The grid winding is on the upper half of the coil form with the outer end connected to the grid. The grid and plate coils are wound with the same size wire and have the same spacing.

The receiving set used with this direction-finder is a super heterodyne, employing a standard Signal Corps amplifying unit. It is known as Type BC-116 and makes use of seven Western Electric Company Type 215A electron tubes, the amplifier being operated from a 4-volt storage or dry battery. This amplifying unit consists of the usual first detector stage, three stages of 4,500-meter wave length intermediate-frequency amplification, second detector, and two stages of audio-frequency amplification. The amplifier is enclosed in a wooden box which is contained in the rear-left corner of the shielded aluminum box.

Extreme sharpness in tuning for minimum signal when locating the source and direction of a transmitting station is obtained by use of an auxiliary antenna. "Tests made in an open field," reports the Bureau of Standards, "one mile from a 500-watt transmitting station show the small antenna connected to the movable plates of the balancing condenser made possible in perfect null point on the minimum. With these plates grounded it was difficult to obtain a good minimum.

This direction-finder in its completeness is not of a complex design, rather it is of the simple rotating coil type which is common with most equipment of this kind. The bakelite shaft supporting the direction-finder coil is made of insulating tubing in two sections, one of which is removable. The fixed section accommodates the slip rings, plug terminals for connecting to the removable section, and a socket in lower end for receiving the operating handwheel. The removable section has four socket connections in each end for connecting the slip rings to the terminals and center of the direction-finder coil and to the antenna on the direction-finder coil. The magnetic compass is designed to plug into the opening which receives the movable shaft section before the latter is put into position. As this would imply, radio bearings are taken with respect to magnetic north. Not unlike the operation of a camera, this device makes use of a tripod and it may be put into service readily afield.

"The radio direction-finder," comments the Radio Laboratory of the Bureau of Standards, "is an effective means of locating the source of a radio signal whether it comes from a ship in distress, from a radio beacon, from an airplane in flight, or any other source."
Toronto Water Faucets
Act As Radio Receiver
By JAMES MONTAGNES

A PHENOMENON in radio reception has been recently noticed in a florist shop underneath one of the large Toronto broadcasting stations. It appears for some unknown reason that the broadcast or finds its way into the microphone while the radio transmitter is on can be heard quite clearly through the faucets in the florist shop with the metal sink acting as a loud speaker.

Although a number of telephone and radio engineers have investigated the possible connections between the broadcasting station and the hot and cold water taps in the shop, nothing has been found which would account for this peculiar effect. It is thought by some to be magnetism.

Music is received with much more volume than speech, although the latter can be heard at a distance of three feet when the speaker is talking with less than average force into the microphone. The operator of CFCA, E. J. Bowers, reports one evening while a concert was being broadcast by remote control the music could be heard very plainly outside the locked door of the shop, some ten feet away from the water taps.

The owner of the shop, when asked as to whether the continuous flow of music was irksome, replied he did not find it so, and often came to the shop at night to hear a good concert. He has listened in this manner to church services broadcast through CFCA.

"The only time that it is bothersome," he said, "is when the radio and music store across the street opens with its loud-speaker and rebroadcasts above the noise of traffic. Then I am in between two fires."

Just what is the cause of this freak reception* has not been definitely established. Samuel J. Ellis, radio inspector for the Toronto district, has investigated with telephone engineers in an effort to solve the mystery.

"We tested every pipe near by and in other parts of the building, but nowhere was the volume as great as at the taps. Near-by pipes would record to a slight extent when a fiddletick was used," said Mr. Ellis.

This, Mr. Ellis explained, was a small wooden rod, some eighteen inches long and similar in appearance to an ordinary broomstick. One end had been sawed off diagonally and a small wooden disc, the size of one's ear, nailed onto it. The other end was grooved to fit on a pipe. When the fiddletick was placed against a pipe and held to the ear, music and speech were audible.

"It is either magnetism or mechanical vibration," said Mr. Ellis. "Just what it is we have not yet determined."

E. J. Bowers, operator of the broadcasting station, holds somewhat similar views. Since he explained that the station is in no way connected with the pipes, it being thoroughly grounded where necessary and the leads from the motor generator to the tubes contain more than the required number of radio frequency choke and by-pass condensers, it would seem that mechanical vibration is accountable for this "tap music."

The case has aroused considerable interest among Toronto radio fans. Reports from England tell of a similar case in which a metal lamp pole near Station 2LO in London acts in a like manner and daily brings crowds about it.

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* Mention Radio Age When Writing to Advertisers.
Putting It Over—On the Mike
(Continued from page 8)

NO WORDS ever written could hope to convey the agony of those first few moments. A horrible feeling that you are shouting overcomes you. You have the terrible consciousness that this voice, this body, these hands, these lips, do not belong to you. And then that singular, ghastly sensation of fighting against an anesthetic.

Just as you are positive that you cannot endure another moment of it and that, come what will, you can NOT go on, a change takes place. A blissful, soothing, heartening change. You discover, to your amazement, that the studio is righting itself. That the announcer’s face is beginning to assume normal proportions. That there is being injected into the room, a comforting quality of familiarity.

Why there is your voice! Going ahead smoothly, easily glibly. Not bad at all. In fact, it’s rather good. You had never liked women’s voices over the air, but yours . . . a depth, a resonance . . . not at all bad.

You are gaining confidence every minute. You’re almost liking it. You think . . .

There! What’s that down in the middle of the page? That word. What IS it? You’ve seen it a million times, you’ve spoken it as many, but there’s something about it now that eludes you. How do you pronounce it? How in heaven’s name, DO YOU PRONOUNCE IT?

A kind of sickness takes possession of you. A nausea in the pit of your stomach. Hot water in your throat. You give the announcer a pale, fleeting smile, a smile at once pleading and despairing. Two more sentences. One more. The word! Well, you’ve pronounced it. How, you have not the faintest idea. But it’s out. It’s gone. Your knees become stabilized. Your nausea passes. Besides, even if you hadn’t pronounced it correctly, who would know it? What person is there that could distinguish the mispronunciation of one word out of a hundred others? What person . . .

And then, for the first time, you become fully aware of your audience. For the first time you realize that thousands of people are listening to you. Millions perhaps.

A wave of such terror assails you that you are almost suffocated. Oh, why had you ever done this thing? Why had you not gone home this afternoon and cleaned up the house and baked a cake—blessed drudgery! Why had you ever wanted to be anything but an unknown? If you could only be some place else. Any place.

With a start you realize that in another few minutes, unless something happens, you are going to blubber into the microphone. Now that would be fine, wouldn’t it, with everybody listening in?

Some latent pride that has in it no quality of courage, comes to your rescue. You clutch at your reeling senses and somehow, some way, you stumble on.

This paragraph finished. Another. And another. And then—

Oh, what can that be down there at the bottom of the page? Surely not the little mark you had unconsciously set there to designate the end of your talk. Surely heaven could not be so benign as that. Surely . . .

But it is the mark! One more paragraph, four more sentences, six more words—finish!

As you grope your way out of your chair you hear the announcer naming the next number. Carefully you make your way across the studio, through the door and into the ante-room beyond. You are trembling, quivering in every muscle.

Save for you, the room is deserted. O beautiful solitude! O lovely silence! How long had you talked? Surely it must have been an hour at least. Your wrist watch says only thirteen minutes, but that’s wrong of course.

And then the studio director bustles in. Perhaps he senses something of what your experience has meant to you for he approaches you and beams, “Fine! Absolutely perfect! Not a trace of nervousness!”

Not a trace of nervousness!

Suddenly you begin to laugh. Violently, hysterically, bitterly, you begin to laugh. Not a trace of nervousness! Why you are a nervous wreck. You are prematurely aged. Your courage is shattered, your moral fiber rotted. But what does that matter? What do nerves, age, mental collapse or blasted courage matter? At last you are a power in the earth! You have broadcast!

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Please Mention Radio Age When Writing to Advertisers.
Free Edge Cone Speaker Quite Easy to Build

APPEARANCE of an article on the construction of a 36 inch cone speaker in the February issue of this magazine quickened the interest of readers on the subject to an extent where it has become necessary to describe another form of speaker, known as the free edge cone speaker. On account of the use of but a single cone sheet the construction of the outfit is materially simpler. Of the several forms on which constructional data is available we preferred the 36 inch wall type which is illustrated in this article.

In Figure 1 the lower section of the drawing shows dimensions for cutting of the paper. Line A for the 36 inch size should be 19 inches; line B should be 18½ inches and distance from edges at C should be 6¼ inches. Cutting is performed along the full lines. The direction of the grain of the paper is shown by the arrows in the sketch. In the upper right corner of the sketch is shown the method of cutting out the small paper cone for the apex. At top of the sketch can be seen the method of assembly of the small paper cone and the metal cones which are supplied with the unit. A ½ inch flange is left which should be bent back as shown in the upper diagram.

Supports for the cone may be a pair of cross sticks 36 by 1½ by ½ inch of any wood, as illustrated in Figure 2. The cone is fastened with wood screws and washers at the four ends of the sticks. Mounting of the unit itself is upon a block called the spacer, 5 by 3 by 2 inches. Since but a single cone is used the placement of the unit into position is much easier than in the double cone.

Figure 3 shows a sketch of the mechanism of the speaker unit which is interesting because it is probably the simplest device we have yet seen. N and S in the sketch represent the bar magnet of tough tungsten steel. C is the coil winding in series with the plate of the last audio stage. The air gap shown at G is located at the center of the coil to reduce magnetic leakage. Action of the armature is up and down, the long threaded rod carrying the two nuts at the top being the driving rod of the unit. Adjustment of the air gap is quite simple. If the air gap is too small the speaker will chatter. Reduced vol-

Figure 1. Simple sketch to show method of cutting paper for a three foot cone speaker. For this size the distance from center through line A should be 19 inches; center through line B is 18½ inches and distance from edge to edge at C is 6¼ inches. Dimensions for other sizes are included in the literature accompanying the speaker units.

Figure 2. Wall type speaker diagram showing method of mounting to wall, and scheme of unit attachment to block in rear of cone.

Figure 3. Pictorial sketch of the speaker unit used in making up of a thirty-six inch cone speaker. Nuts A and B are for altering the air gap (G) which is located at center of the coil to cut down magnetic leakage. N-S is the steel bar magnet.
Wins Honors

Miss Audrey Call, the seventeen year old violinist of Edison Studio, Westinghouse Station KYW won the first high honor of a promising career when she made her debut recently with the Chicago Symphony Orchestra at Orchestra Hall, playing D’Ambrosio Concerto, and receiving a tumultuous applause.

The privilege of appearing as soloist with the Chicago Symphony Orchestra is an honor bestowed each year on the winner of the competitive test of pupils of Chicago music teachers. This prize is, of course, one most keenly striven for, and the winner who is selected by Frederick Stock, director of the Symphony, has well earned the honor bestowed upon her.

To followers of KYW, Audrey Call is well known. She appears on the station’s daily programs, as soloist and as a member of the Edison String Trio, a group which has also firmly established themselves with KYW’S fans.

Making Terminals For Storage B Batteries

LeAD plate storage “B” batteries usually are not furnished with binding posts of any sort. The two terminal plates have an inch or so of their posts protruding through the cell cap, and a clip or some other makeshift method of connecting the battery to the set is resorted to. In time, due to the acid, the clip and post become so corroded there is practically no contact left. A nickel plated composition top binding post provides an ideal terminal, but necessitates drilling a hole, which is likely to result in damaging a new battery.

With a fine file, rub the top of the post until you expose a bright, clean and flat surface. Solder a tinned lug on the end of a piece of bus bar, about an inch and a half long. On the other end, using a pair of round nose pliers, make a loop of the same diameter as the battery post. The loop end of the piece of wire is soldered in place, flat on the cleaned top surface of the battery post. The leads from the set should be provided with lugs, and small nuts and screws are used to join them with the lugs on the batteries.—John C. Heberger.

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BREIT RADIO COMPANY

417 Lake St.,
MAYWOOD, ILL.

Please Mention Radio Age When Writing to Advertisers.
RADIO

Super Heterodyne Without Repeat Points

(Continued from page 28)

us eminently satisfactory operation without any battery troubles. In fact such an arrangement is now standard equipment at the laboratory and is used on all sets tested.

For the benefit of those to whom the One Spot idea is new we would again say to be sure to use good tubes. Especially is this true in the case of the first detector, and even in the intermediate stages. Poor tubes in these positions will almost completely nullify any good results which might otherwise be expected from the set.

Loop operation on this set was used to secure maximum benefit from directional qualities. The loop shown below, the Qualitone, was found admirable for use with the model described.

For supplying the A current we found the Balkite interests have made a special type AJ rectifier which when combined with the Abox filter, furnishes enough current for sets containing up to and including ten tubes. In using such a device on smaller sets it is advisable to have a master rheostat in one of the loops from the filter so the voltage to the tubes may be thereby regulated. A two and a half ohm rheostat will suffice for that purpose.

For the benefit of our readers located in places where they are unable to secure standard advertised radio parts locally, we are this month establishing the

Set Builders’ Quick Shopper

Those interested in our April feature, the One Spot Super, described in the blueprint section, may secure any or all parts shown in the list below by remitting to this office the list price shown beside each item. These articles will then be purchased for our readers and shipped immediately, passing through our laboratory before shipment.

This is not a local service but one designed for the reader in isolated sections where goods advertised in our columns cannot be secured.

Goods are shipped the same day order is received. Be sure to send exact price shown in the list.

The Receiver

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Separate Power Compact

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<tr>
<td>1 UX 874 voltage regulator tube</td>
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$235.40

Radio Age

Set Builders’ Quick Shopper

500 North Dearborn St.,

Chicago, Ill.

Please Mention Radio Age When Writing to Advertisers.
Does the Moon Affect the Weather  
(Continued from page 20)

In fact, he is not sure of it at all, and frankly tells us that no matter what our argument the real proof of the pudding is in the eating, and he is absolutely certain that when the moon changes the weather changes, and that it seldom changes without a change of the moon. In both these cases he is absolutely right, not because the moon changes the weather, but because as both are always changing they have to change together. You see, there are only about 28 days from new moon to new moon, and in that time the moon shows four changes, as they ordinarily are counted, that is, first quarter, full moon, third quarter, and new moon; in short, one change every seven days. Besides, these changes are not abrupt affairs, but, as we usually observe and note them, each is spread over at least two or three days. Then, too, those who forecast the weather in this manner generally give it a leeway of a few days in which to make good. Our moon friend, therefore, however honest his belief, really is playing the game of "heads I win, tails you lose," for as all the time is used up, it would be impossible to find any date on which a change of the weather could occur without being close to some change or other of the moon.

Well, then, if we can't trust the change of the moon to bring a change of the weather, what can we trust? We can trust two things: In the first place, weather commonly goes in short spells, at least over the more densely populated portions of the temperate zones. That makes for abundant vegetation and good crops—one reason why these places are densely populated. Here the weather usually is fair a few days, and then cloudy to foul a day or two. This is the rule, and so whatever the weather, it is apt but not certain, to change sometime soon, but not for long—another change will quickly come, and others without end. The second thing we can trust in this connection, not as an infallible guide, but as by far the best we have, is the official forecast of the coming weather issued by the Weather Bureau. These forecasts are not infallible, as just stated, but their failures nearly always concern trivial matters. When a cold wave, a killing frost, a destructive hurricane, a devastating flood, or any other major weather phenomenon of real importance is officially predicted it is practically certain that the prediction will be 100 per cent correct.

But, says our friend, what about dry moons and wet moons, that tell us what sort of weather we are going to have for nearly a whole month? You know, he says, that when both horns of the new moon point up it can hold lots of water without spilling and therefore brings enough to furnish a dozen rains or more. On the other hand when the new moon
Quali-Tone Loop
Specially recommended for use with the
"One Spot Super"
described in this issue; also
in Line World's Rec-
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stands on end, or nearly so, it is a dry
moon. It can hold but little water,
and of course for the next three or
four weeks there will be very few
rains, and even these will be light.
Yes, we tell him, we heard all that
long ago, and we also heard forecasts
and explanations just the reverse of
his: That is, we heard some people
say, as he does, that when both horns
of the new moon point up, there will
be lots of rain; and we heard others
say, just as positively, that the whole
month would be dry, because when
both horns are turned up, very little
water can spill out. Similarly, these
others called the tilted new moon wet
and not dry, because being tilted it
must spill out abundant rains. In
short, while the moon weather-proph-
ests all agree that there is a wet moon
and a dry moon they differ completely
as to which is which; what the one
insists is a dry moon the other de-
clares to be a wet moon, and what the
first calls a wet moon the second calls
a dry moon. Each is wholly wrong,
but their average is exactly right, for
there is no wet moon and no dry
moon. If there were, then since the
pointing of the new moon's horns is
the same everywhere along any
parallel of latitude, wet spells and
dry spells would not be scattered ir-
regularly over the earth as they ac-
tually are, but form continuous belts
around the world, which certainly
they do not. Furthermore, careful
studies of the records kept at hun-
dreds of weather stations all over
the earth show that neither the point-
ing of the new moon's horns, nor any
of the moon's changes, has the slight-
est relation to warm weather or cold,
and dry, or fair or foul.

The moon is a wonderful theme in
song and story, in love and war, in
sentiment and science, but it never
did and never will, have anything to
do with causing or changing the

FRESHMAN
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CHICAGO RADIO
APPARATUS COMPANY
415 South Dearborn St.,
Chicago

RADIO AGE for April, 1927
Transparent Steel Recently Obtained

THIN sheet-steel, as transparent as the clearest glass, has been recently obtained by a German physicist. This new method of making sheets of metal of unprecedented thinness seems likely to prove of far-reaching industrial as well as scientific importance. Test plates, such as are used to determine the transparency of optical glass, and which were ruled with cross-lines 2500 to the square inch, were photographed thru such a metal sheet and, when enlarged to 400 diameters, the scale lines showed distinctly with no trace of distortion. This absence of aberration proves conclusively that the structure of the film was perfectly even and equal in all directions.

The delicate sheets are made by depositing an extremely fine film of the metal on a smooth surface by means of an electric current, then separating the film from the foundation on which it is fixed. The metal film or sheets are so thin that atoms will penetrate them without impediment, yet so strong that when fastened in a frame they may be bent by blowing to the extent of one-sixteenth of an inch without rupture. Such sheets will have an important place in many kinds of scientific and industrial research since they may be used as membranes for the separation of gases, or lend themselves to the progress of television and telegraphy.

PETER J. M. CLUTE.

A Time-Saving Hay Rack

This hay rack was built with the end against the barn so it could be filled directly from the mow. A fence runs close to the outer end, yet there is room enough to fill the rack from a wagon rack during the summer.

The particular advantage, however, lies in the fact that during the winter months it is not necessary to hitch up a team, throw the hay onto the hay rack and haul it to this rack. Instead hay can be thrown down from the mow and out the side door and into the rack, as needed.
<table>
<thead>
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<td>All-American Radio Corp.</td>
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<td>WEPB</td>
<td>Matheson Radio Co., Inc.</td>
<td>Gloucester, Mass.</td>
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<td>St. Louis University</td>
<td>St. Louis, Mo.</td>
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<td>Dallas News &amp; Dallas Journal</td>
<td>Dallas, Tex.</td>
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<td>WFAM</td>
<td>Times Publishing Co.</td>
<td>St. Cloud, Minn.</td>
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<td>WFAV</td>
<td>University of Nebraska</td>
<td>Lincoln, Neb.</td>
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<td>First Baptist Church</td>
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<td>WBFH</td>
<td>Phillips Pub. Co.</td>
<td>Chicago, Ill.</td>
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<td>WBNJ</td>
<td>The Wm. F. Gable Co.</td>
<td>Altoona, Pa.</td>
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<td>WBJF</td>
<td>St. John's University</td>
<td>Collegeville, Pa.</td>
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<td>WFLB</td>
<td>The Onondaga Co.</td>
<td>Syracuse, N. Y.</td>
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<td>WBFM</td>
<td>Merchants Heat &amp; Light Co.</td>
<td>Indianapolis, Ind.</td>
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<td>WSBT</td>
<td>B. T. National Guard</td>
<td>B. T. National Guard, Md.</td>
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<td>WFBZ</td>
<td>Knox College</td>
<td>Galesburg, Ill.</td>
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<td>WFCI</td>
<td>Frank Crook, Inc.</td>
<td>Pavlov, T. R.</td>
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<td>WFPF</td>
<td>F. D. Fallain</td>
<td>Flint, Mich.</td>
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<td>WFFH</td>
<td>Fort Harrison Hotel</td>
<td>Clearfield, Wyo.</td>
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<td>WFW</td>
<td>Strawbridge and Clothier</td>
<td>Philadelphia, Pa.</td>
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<td>WFTW</td>
<td>The Acme Mills, Inc.</td>
<td>Hopkinton, Mass.</td>
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<td>WFKB</td>
<td>Vesta Battery Corp.</td>
<td>Chicago, Ill.</td>
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<td>WFLA</td>
<td>Boca Raton Radio Corp.</td>
<td>Boca Raton, Fla.</td>
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<td>Flatbush Radio Labs.</td>
<td>Brooklyn, N. Y.</td>
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<td>H. H. Carman</td>
<td>Freeport, N. Y.</td>
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<td>WGBF</td>
<td>Fink Furniture Co.</td>
<td>Evansville, Ind.</td>
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<td>WGBL</td>
<td>Scranton Broadcasters, Inc.</td>
<td>Scranton, Pa.</td>
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<td>WGBS</td>
<td>Gimbel Brothers</td>
<td>Astoria, L. I., N. Y.</td>
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<td>WGBU</td>
<td>Illinois Cities Finance Co.</td>
<td>Fulford By-The-Sea, Fla.</td>
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<td>University of Maine</td>
<td>Orono, Me.</td>
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<td>Radio Inc.</td>
<td>Lincoln, Nebr.</td>
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<td>Oak Leaves Broadcasting Corp.</td>
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<td>G. H. Phelps</td>
<td>Detroit, Mich.</td>
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<td>WGL</td>
<td>International Broadcasting Corp.</td>
<td>New York, N. Y.</td>
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<td>WGM</td>
<td>Verne and Elton Spencer</td>
<td>Peabody, Mass.</td>
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<td>WGMU</td>
<td>A. H. Grebe &amp; Co.</td>
<td>(Portable) New York</td>
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<td>WGLC</td>
<td>The Universal Hotel Co.</td>
<td>Portland, Me.</td>
<td>263</td>
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<td>WGR</td>
<td>Federal T. and T. Co.</td>
<td>Buffalo, N. Y.</td>
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<td>WGST</td>
<td>Georgia School of Technology</td>
<td>Atlanta, Ga.</td>
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<td>WGWB</td>
<td>Radiobroadcast Corp.</td>
<td>Milwaukee, Wis.</td>
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<td>WGY</td>
<td>General Elec. Co.</td>
<td>Schenectady, N. Y.</td>
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<td>WIL</td>
<td>University of Wisconsin</td>
<td>Madison, Wis.</td>
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<td>WILC</td>
<td>Marquette University</td>
<td>Milwaukee, Wis.</td>
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<td>WHAM</td>
<td>Stromberg-Carlson Tel. Mfg. Co.</td>
<td>Rochester, N. Y.</td>
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<td>WHAP</td>
<td>W. H. Taylor Finance Corp.</td>
<td>New York, N. Y.</td>
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<td>WHAR</td>
<td>F. D. Cooks Sons</td>
<td>Atlantic City, N. J.</td>
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<td>WJRC</td>
<td>Courier-Journal &amp; Louisville Times</td>
<td>Louisville, Ky.</td>
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<td>WJAZ</td>
<td>First Baptist Pfarrliche Institute</td>
<td>New York, N. Y.</td>
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<td>WHB</td>
<td>Sweeney School Company</td>
<td>Kansas City, Mo.</td>
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<td>WHBA</td>
<td>C. C. Shaffer</td>
<td>Oil City, Pa.</td>
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<td>WHBC</td>
<td>Rev. E. P. Graham</td>
<td>Canton, Ohio</td>
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<td>WHBD</td>
<td>Chamber of Commerce</td>
<td>Bellefonte, Ohio</td>
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<td>WHBF</td>
<td>Bearslady Specialty Company</td>
<td>Rock Island, Ill.</td>
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<td>WHBP</td>
<td>Minneapolis, Minn.</td>
<td>(Portable) Chicago, Ill.</td>
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<td>WHBM</td>
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<td>First Ave. Methodist Church</td>
<td>St. Petersburg, Fla.</td>
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<td>Johnstown Automobile Co.</td>
<td>Johnstown, Pa.</td>
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<td>WHBQ</td>
<td>WHBQ, Inc.</td>
<td>Memphis, Tenn.</td>
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<td>WHBU</td>
<td>Riviera Theatre &amp; Bing's Clothing</td>
<td>Anderson, Ind.</td>
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<td>WHJ</td>
<td>D. R. Kienzel</td>
<td>Philadelphia, Pa.</td>
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<td>WHT</td>
<td>St. Norbert's College</td>
<td>West de Pere, Wis.</td>
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<td>WHJ</td>
<td>H. H. Dunwoody Institute</td>
<td>Minneapolis, Minn.</td>
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<td>WHJE</td>
<td>Hickson Electric Co</td>
<td>Rochester, N. Y.</td>
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<td>WHFC</td>
<td>Triangle Broadcasters</td>
<td>Chicago, Ill.</td>
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<td>WHK</td>
<td>The Radio Air Service Corp.</td>
<td>Cleveland, Ohio</td>
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<td>Voice of the People Church</td>
<td>Chicago, Ill.</td>
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<td>WHACS</td>
<td>Banker's Life Co.</td>
<td>Des Moines, Ia.</td>
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<td>Huntington Bdestrs. Assn.</td>
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<td>Howard R. Miller</td>
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<td>WIAS</td>
<td>Home Electric Co.</td>
<td>Burlington, Iowa</td>
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<td>Capital Scene Theatre</td>
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<td>WIB</td>
<td>St. Paul's Protestant E. Church</td>
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<td>Frederick B. Zittell, Jr.</td>
<td>Flushin', L. I., N. Y.</td>
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<td>WHBO Broadcasters, Inc.</td>
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<td>The Evans FW. Owings, Inc.</td>
<td>Virginia, Va.</td>
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<td>WIBS</td>
<td>T. F. Hunter</td>
<td>Elizabeth, N. J.</td>
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<td>WIBU</td>
<td>The Electric Farm</td>
<td>Clifton, N. J.</td>
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</table>
Talking Movies Now; Practical Scheme

TALKING motion pictures in which the simultaneous timing of action and sound is all times assured have been announced and demonstrated by the General Electric Company. The process, the result of several years of experimenting in the General Engineering Laboratory of the company, means but slight change in standard motion picture projectors, since it involves only the addition of a sound-reproducing attachment and a loud speaker suitable for auditorium use. Both the picture and the sound are recorded on the same film.

One of the demonstrations has been with music to accompany feature films, the music being by a full concert orchestra. Development of this field requires no change in the technique of making the original film. After the original picture film has been made and titled, the accompanying music is played by a concert orchestra and is recorded on a film. The picture and sound records are then printed on one film in the proper time relation.

Another type has been the showing of singers and instrumentalists while they are presenting programs. Thus, when an orchestra is shown on the screen, it is possible to follow the playing of each musician, and see his actions on the screen and hear him. Even cymbals—among the most difficult to reproduce faithfully—sound like cymbals. Similar demonstrations have been made with vocal and instrumental soloists, with string and with vocal quartets, and with speakers.

To the casual observer the talking film does not differ from the usual motion picture positive. It is of standard width, but along the left margin there is a strip a small fraction of an inch wide on which is a series of horizontal light and dark bands and lines, of varying widths and intensities. It is this series of bands and lines which produces the sound. The film is passed through the reproducer at constant speed, and, as these light and dark bands pass rapidly before a tiny slit in an optical system, the amount of light is varied. The ever-changing amount of light is received by a photoelectric cell—the electric eye—which is extremely sensitive to any change in the amount the light striking it.

When your radio antenna is installed care should be exercised to make sure that the aerial system is protected from lightning.

The Jewell lightning arrester is ideal for lightning protection. It meets the standard requirements for lightning arresters as set forth by Underwriters Laboratories, and is listed by that organization. It is compact and easily connected. The construction is substantial and it may be installed either indoors or outdoors.
These Coils Improve Any Radio Receiver!
T. R. F. KIT—List $12.00

THIS set of supersensitive Aero Tuned Radio Frequency Coils has never failed to improve the performance of any radio receiver. Tremendously increased power, extreme selectivity, and improved tone quality are sure to result from their use.

This kit of Aero Coils has a much lower high frequency resistance than other types of inductances. You should use them in any circuit, if you want the best possible results.

FREE Big 8-page 4-colored layout system (actual size blue prints) and complete instructions for building the 8-tube Aero-Dyne receiver free with each kit. Also insert showing how to wire for a power tube if desired. Extra kits.

Get these Aero Coils from your dealer. If he is out of stock, order direct from the factory.

AERO PRODUCTS, Inc.
Dept. AERO
1772 Wilson Ave.
CHICAGO, ILL.

An Improved Refuse Burner

The burner shown in the accompanying picture has two or three advantages which anyone with a garden will appreciate. It consists of a twenty inch length of a hot water boiler sawed off and attached to a three inch pipe which is set vertically in the ground. The pipe was attached to the box by a hole cut through the box of the right size, inserting the upper end of the pipe through and then spreading the pipe to hold it solid.

There are several holes through the side of this box to promote combustion. Refuse which is raked up at intervals about the place is placed in here and set afire. If the day is windy a sheet of screen is laid over the top to prevent flying sparks. Thus the fire burns out with no harm whatever and the ashes can be removed once or twice a season.

Higher Tones Easier For Ear to Detect

The reason why the notes of a cornet can be heard farther away than the notes of the bass horn has just been elucidated by B. A. Kingsbury, an experimenter of the Bell Telephone Laboratories. The shrill notes of the higher-pitched instruments “carry” better, musicians say, than do tones lower in pitch. The secret does not lie, however, in any difference in the carrying power of the tones through the air. It is a matter, Mr. Kingsbury finds, of the human ear; not of the tones or of the air that carries them. Comparative studies of the loudness of different tones, as judged by a number of persons with normal ears, show that high-pitched tones are heard more easily than lower ones. When the same amount of physical energy is present in two tones, one low and the other high, the higher tone will sound much louder to the average ear than does the lower one.

Radio's Leading Publications

The CITIZEN'S RADIO CALL BOOK is Radio's Greatest Publication. Contains all the latest information of construction so simply told anyone can build superheterodynes as easily as laboratory men. Large Picture section contains beautiful photos of leading station announcers and entertainers. Also contains the most complete list of the World's broadcasting stations—every one—their transmitting schedules, wave lengths, slogan and plenty of space under each to log that station for future reference. Really Radio's Greatest Publication. You'll be delighted.

Price only 50 cents postpaid.

The CITIZEN'S RADIO AMATEUR CALL BOOK is an international list of call letters, names and addresses of the world's amateur transmitters, compiled from official sources and the most authentic list obtainable anywhere. Remember, the whole world—U.S., Canada, England, Australia, France, Germany, etc. The whole international list. Also commercial ship and land stations.

Price only 75 cents postpaid.

If you are unable to obtain either of the above mentioned publications from your news dealer or radio store, they will be sent postpaid upon receipt of the amount in U. S. stamps, coins, check or P. O. money order.

Citizens Radio Call Book
50 S. Dearborn St.
Chicago, Illinois

Please Mention Radio Age When Writing to Advertisers.
Ancient Wooden Clock Still Keeps Excellent Time

Carved by hand out of wood, this strange clock of ancient origin is keeping very good time for its owner, Hans A. Bergstrand, of St. Paul, Minn. The "works" are composed of four wooden wheels and the pendulum is at the top of the clock, or perhaps, more properly should be called the governor of the clock. Small metal pins driven into the wheels constitute the escapement action. The clock has only the hour hand, the spaces between the numbers being divided into quarter hours. The timepiece is motivated by a weight which is lifted once every 24 hours. Photo shows Mr. Bergstrand with his ancient clock.

Hissing Sounds Made By Northern Lights

HUNTERS and others who frequent the northern forests of Canada have often reported hearing hissing or crackling sounds accompanying the Aurora Borealis or Northern Lights. Scientists have been skeptical of these reports, for the aurora is known to be an electrical discharge high up in the air; never less than fifty miles above the ground and usually higher. Even if the aurora does produce a noise, which is doubtful, the sound could not reach the earth from so great a height. Nevertheless, the controversy now appears to be settled in favor of the unscientific observers, who reported merely what they heard. A scientist of distinction, the Norwegian meteorologist, Dr. Hans Jelstrup, has heard the sound himself. On the night of October 15, 1926, Dr. Jelstrup and an assistant were observing the aurora from a hill-top near the city of Oslo. Suddenly the often-described hissing sound was noticed. It seemed to rise and fall in intensity, keeping time with the changes of intensity in the light of the aurora.

Inexpensive Eliminator For Home Constructor

(Continued from page 6)

It sometimes happens that when a chemical rectifier is first attached to a receiving set, rectification will not immediately take place. This is because the plates of the rectifier have not had a chance to form which usually takes several minutes. Do not become alarmed if this should happen but lift the electrodes up out of the jars and then immerse them again slowly. This operation will enable the necessary film to form more quickly on the aluminum plates and when this is accomplished the cells will function properly and further attention will be unnecessary.

The various voltages necessary to take care of the average receiving set are obtained by the use of variable resistances, as illustrated. While the approximate output of the described eliminator is forty milliamperes at 150 volts, a greater output can be readily obtained by increasing the depth of the electrodes in the rectifying solution and increasing the capacities of condensers C-1 and C-2. Do not, however, cut down on the specified capacities of either the condensers or choke coils shown if you expect secure satisfactory results.

Before closing this article it would perhaps be well to call the reader's attention to the fact that while the grid leak used in the average receiving set functions quite efficiently when regular "B" batteries are used, it will usually be found too high in value when an eliminator is employed to furnish plate current and produces a hum in the loud speaker unit. This condition can be easily remedied by inserting a leak of lower value, or what will prove more satisfactory, a variable leak, which can be accurately adjusted until all trace of hum is eliminated. When the proper value is once determined further adjusting will be unnecessary.

SUBSCRIBE NOW!
RADIO AGE $2.50 a Year

Please Mention Radio Age When Writing to Advertisers.
An Index to the Best in Radio Hookups!

How long have you postponed making that favorite hookup of yours because you couldn't find reliable and clear diagrams? We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

February, 1925
- A Three Circuit Regenerator.
- A Real Low Loss Set.
- Blueprints of a 5-tube Reflex.

March, 1925
- A 5-Tube R. F. Receiver.
- How to Wind Low Loss Coils.
- A Short Wave Receiver.
- Blueprints of a Two-Tube Audion and Regenerative Reflex.

May, 1925
- A "Quiet" Regenerator.
- How to Make a Tube-Tester.
- A Unique Super-Set and an Improved Reina.
- A Six-Tube Portable Receiver Illustrated with Blueprints.

June, 1925
- Reducing Static Disturbances.
- A Seven-Tube Super-Heterodyne.
- Browning-Drake Receiver.
- Overcoming Oscillations in the Roberts Receiver.

July, 1925
- Learning Tube Characteristics.
- How Much Coupling?
- Blueprints of Conventional Radio.
- Symbols and Crystal Detector Circuit.

August, 1925—50c per copy
- How to Attain Smooth Tuning.
- Alternating Current Tubes.
- Deciding on a Portable Super.
- And a big 60-page blueprint section.

September, 1925
- Thirty-one ways to prevent self-oscillation.
- Tuning efficiency with two controls.
- Ideal Audio Amplifier Circuit.
- Blueprint section.

October, 1925
- Auto-Transformer Coupling.
- Some Facts about Quality.
- An Improved Slip-Wire Bridge.
- Blueprints of Circuits Using Single and Dual Controls.

November, 1925
- A Good Audio Oscillator.
- An Efficient Short-Wave Transmitter.
- Blueprints—Adding R. F. Stages.

December, 1925
- Tuned R. F. and Regeneration.
- Radio Age Model Receiver.
- Inductive Gang-Control Receiver.
- Tuning with Chart Curves.

January, 1926
- Radio Age January Model Set.
- A Four-Tube Toroid Set.
- Power Supply Device—Blueprint Feature—Finishing Your Radio Cabinet.

February, 1926
- February Radio Age Model Set.
- Plug-in Coil Receiver.
- Universal Testboard—Blueprint.
- Eliminating Audio Distortion.

March, 1926
- Improving the Browning-Drake.
- Rheostatless Tubes in a Set.
- Which Type Intermediate?
- How to Make a Wavemeter—Blueprint.

April, 1926
- Shielding Your Receiver.
- Home Testing Your Tubes.
- Balanced Capacity Receiver.
- Several Sets on One Antenna.

May, 1926
- Short Wave Transmitter—Blueprint.
- Simplifying Battery Charging.
- List of European Broadcasters.
- Protecting your Inventions.

June, 1926
- Antenna Design.
- Simple Crystal Set.
- Improving the Neutrodyn.
- Golden Rule Receiver—Blueprints.

July, 1926
- Compact Portable Super.
- Short Wave Receiver.
- Shielded Golden Rule Set.

August, 1926
- Receiver, Transmitter and Wavemeter.
- Beginners 300 mile Crystal Set.
- History of Amateurs.
- Changing to Single Control.

September, 1926
- How to Make a Grid Meter Driver.
- Short Wave Wavemeter.
- Power Amplifier for Quality (Blueprint)

October, 1926
- Crystal Control Low Power Transmitter (Blueprint).
- Raytheon Design for A B C Elimination.
- What Type Loud Speaker to Use.
- Nine Tube Super Brings Back Faith

November, 1926
- Blueprints of the Henry-Lyford.
- World's Record Super With Large Tubs.
- How to Use a Power Tube in Your Set.
- Illuminated Controls on 4 Tube Receiver.

December, 1926
- Starting Radio with Crystal Set.
- Six Tube Shielded Receiver.
- Types of Rectifiers Discussed.

January, 1927
- Full Data on World's Record Set.
- Dual TC Receiver.
- Clough Super Design.

February, 1927
- Building the Hammond-Roberts.
- Making a 36 Inch Cone Speaker.
- Data on the B-T Power Six.
- Browning Drake Power Operated.

March, 1927
- Ideal Model World's Record Super.
- Building the Hammond-Roberts.
- Ridding Supers of Repeat Points
- Loop and Four Tubes.

Radio Age, Inc., 500-510 N. Dearborn St., Chicago
Classified Advertisements

If you have anything to buy or sell, don't overlook RADIO AGE'S classified advertisements.

The classified advertising rates are but five cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, making rate of 4 1-2, 4 and 3 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the May issue must be sent in by March 25.

Radio Age Classified Ads Bring Results

Please Mention Radio Age When Writing to Advertisers.
A B and C Radio Power

from house current outlet direct into the radio with no more attention
or thought than you bestow on a vacuum cleaner or your electric iron.
This wonder box weighs only 13 lbs., stands 9 inches high and is 4 inches wide,
and is about half the size of an ordinary A storage battery. It is a mechanical
device transforming ordinary 110 volt, 60 cycle house power into smooth, quiet
radio energy for the new Crosley radios without
slightest interfering hum and with the certainty of an electric motor.

PRICE $50.

Crosley radios designed for use with this marvelous power supply
are the AC-7, a 6-tube table model at $70, and the AC-7-C, a 6-
tube console at $90. See these wonderful sets at any Crosley
dealers, or write Dept. 63 for descriptive literature.

Crosley sets are licensed under Armstrong U. S. Patent No. 1,113,149, or under patent applica-
tions of Radio Frequency Laboratories, Inc., and other patents issued and pending. Prices
slightly higher west of the Rocky Mountain.

The CROSLEY RADIO CORPORATION
Powel Crosley, Jr., Pres. Cincinnati, Ohio

No more batteries to fuss with.
No more batteries or battery charger
to water.
No failure of the power plant just as
you sit down to a fine program.
No batteries to recharge.
No batteries to renew.
No apologies to make to callers because
“the batteries must be getting low.”
No upsetting the house to have the radio
serviced.

NO MORE annoyances from the vital
power supply end of the radio. A
snap of the switch is the only de-
mend your radio makes upon you
from NOW ON.
Trouble-Shooting on Supers
You don't have to be water boy to this battery charger

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Radically new.—Sound in principle.—Proven in performance.

The Thordarson Battery Charger makes its bow as a welcome relief to the army of butlers to thirsty battery chargers.

Dry.—As dry as they make 'em. In fact, the rectifying element is contained in a moisture proof cartridge.

Silent.—No vibrating parts. Current is rectified through a patented electro-chemical process.

Safe.—There is no hazard to rugs or woodwork for there is no acid to spill. The tubes of the set are safe even if turned on when charger is in operation.

Compact.—Fits into battery compartment easily. Only 23 1/4" wide, 5 3/4" long and 4 3/4" high, over all.

Efficient.—This charger is always ready for service. No overhauling required. Rectifying element can be replaced in thirty seconds.

Guaranteed.—The rectifying unit is guaranteed for 1,000 hours full load operation, or approximately one year's normal service. The Transformer will last indefinitely.

Charging Rate—2 amperes

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Price Complete $12.50

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1345-1355 Wabash Avenue, Chicago, Ill.

World's Oldest and Largest Exclusive Transformer Makers

“Brewster & Kingsbury Streets — Chicago, Ill.”
I Thought Success Was For Others

Believe It Or Not, Just Twelve Months Ago
I Was Next Thing To "Down-and-Out"

TODAY I'm sole owner of the fastest-growing Radio store in town. And I'm on good terms with my hanker, too—not like the old days only a year ago, when often I didn't have one dollar to knock against another in my pocket. My wife and I live in the snuggiest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlady when she came to collect the rent for the little bedroom I called "home"!

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the "end of a blind alley." I thought I never had had a good chance in my life, and I thought I never would have one. But it was waking up that I needed, and here's the story of how I got it.

I was a clerk, working at the usual miserable salary such jobs pay. Somehow I never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—still the really well-paid positions I ever heard of seemed to be out of my line, to call for some kind of knowledge I didn't have.

And I wanted to get married. A fine situation, wasn't it? Mary would have agreed to try it—but it wouldn't have been fair to her.

Mary had told me, "You can't get ahead where you are. Why don't you get into another line of work, somewhere that you can advance?"

"That's fine, Mary," I replied, "but what line? I've always got my eyes open for a better job, but I never seem to hear of a really good job that I can handle." Mary didn't seem to be satisfied with the answer but I didn't know what else to tell her.

It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about myself. A fee burning words that were the cause of the turning point in my life!

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors—the people who knew me best—really thought of me!

"Bargain counter shelf—look how that out fits," one fellow had said in a low voice. "Bet he hasn't got a dollar in those pockets." "Oh, it's just 'Useless' Anderson," said another, called "Red" Smith. "He's got a wish-bone where his hatch-bone ought to be."

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so dissatisfied with my answer that "I hadn't had a chance?" "Did Mary secretly think that?" And after all, wasn't it true, that I had a "wish-bone" where my hatch-bone ought to be? Was that why I never had a "chance" to get ahead? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed the pages of a magazine on the table, searching for an advertisement that I'd seen many times but passed up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, I've had a Radio business of my own! At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making real money. I drive a good-looking car of my own. Mary and I can't own the house we live in. I've made a substantial down payment, and I'm not striving myself any to meet the installments.

Here's a real tip. You may not be as bad-off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well-paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. E-91, Washington, D. C., and the book will be mailed the same day your coupon reaches him—you can have it right in your hands in a few days if you mail the coupon now.

J. E. Smith, President, National Radio Institute, Dept. E-91, Washington, D. C.

Dear Mr. Smith:
Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesman will call on me.

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**FOR May-June ISSUE**

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**For New Readers**

Coincident with an increase in the number of readers of this magazine there have been numerous requests for a complete treatise on the particular type of superheterodyne which we have found most popular in the past eighteen months.

As a consequence we have set aside a limited number of back numbers, those of most recent date having the greatest amount of data. Having gone through several models of the Worlds Record super we believe the following numbers will be of most interest to super prospects:

- November, 1926
- January, 1927
- March, 1927
- April, 1927
- May, 1927

These numbers, which include the present issue, will form a complete library on the superheterodyne question, including that type using intermediates peaked so as to prevent repetition of stations at more than one point on the oscillator dial. In the present number there is an excellent trouble-shooting article on supers by E. H. Scott which should command the attention and commendation of every radio enthusiast who has ever built, experimented with or intended building a superheterodyne.

These back numbers may be secured for thirty cents each in stamps or coin.

Of all the circuits run in this magazine the series on the Worlds Record model drew the greatest amount of comment and by far the greatest number of letters from readers. Further work will be done along these general lines and for that reason the issues mentioned above should be particularly useful as the ground work for all readers interested in that type of receiver.

---

**Editor of RADIO AGE.**
MANY fans are now building supers and the majority of these receivers are giving their owners every satisfaction. This is due to the fact parts or kits now available are properly designed and carefully made and tested by the manufacturers before leaving the factory. Constructional plans of thoroughly tested designs can be obtained through the leading magazines. These show you in detail how to build the set. If, however, you have had no previous experience in building a superheterodyne you will save yourself a great deal of trouble and disappointment by following exactly the design you select. After you have had some experience you can use your own ideas in designing, but until you have built a few sets, better stick to the design furnished by the magazines. The more experience you gain the more you appreciate the importance of placing certain parts in certain positions in relation to other parts. Many a super is performing poorly that could, by a rearrangement of the parts and the shortening of certain leads, be made into a receiver that would surprise its owner.

It is disappointing, but need not be discouraging, if when you connect up the batteries, insert the tubes and connect the speaker, that the set does not operate at all, or if it does, the noise that comes from the horn does not sound like music. In this article you will find a chart for trouble shooting which shows under the various headings, the principal reasons for that particular trouble. Forty possible troubles in supers are listed herewith in the order of the complaints. The numbers refer to the test methods outlined in the latter part of the article.

**Set Dead. Just Hooked Up.**
1. Wrong wiring.
2. Poor soldered connections or loose connections.
3. Connection shorting against other connection.
4. Poor tubes.

**Set Dead, But O. K. Previously.**
5. Batteries low.
6. Poor tubes.
7. Wrong B battery voltages on osc., detectors, I. F. or audio.
8. Wrong C battery bias, or battery reversed.
10. I. F. transformers not properly matched.
11. Poor audio transformers.
12. High resistance joints or connections.

**Makes Crackling Noises.**
2. Loose or broken connection.
4. Leaking or shorted condensers.
5. Leaks caused by using soldering paste.
6. Static or outside interference.

**Makes Howling Noises.**
19. Microphonic tube or tubes.
20. Open grid circuit, either loop or C battery.
22. No bias on I. F. or audio transformers.
24. Excessive plate voltage.
25. Feedback between I. F. and audio stages.
26. Feedback between audio stages.

**Oscillates Badly.**
24. I. F. transformers too close.
25. Poorly designed I. F. transformers.

Schematic for trouble shooting; numbers refer to numbers shown in the accompanying articles

---

**AT LAST!**

For some time past builders of superheterodynes have been desirous of having a manual on trouble shooting that would be simple enough to permit them to find their own errors and remedy them.

In casting about for an author we immediately thought of E. H. Scott, who has done nothing but play with superheterodynes for the past few years. Mr. Scott was approached on the subject, agreed to furnish an article, and we are printing it in this issue.

We frankly believe it is the most complete and simple trouble shooting article we have seen and know that it will be relied by all those who build superheterodynes.—Editor.

---

5. Batteries too low or dead.
6. A, B or C batteries wrongly connected.
7. Voltages on osc., detectors, I. F. or audio tubes not correct.
8. C battery reversed.
10. Short circuit in phone or speaker jack.
11. Primary or secondary of transformers open.

---

**Volume Poor.**
5. Batteries low.
4. Poor tubes.
7. Wrong B battery voltages on osc., detectors, I. F. or audio.
8. Wrong C battery bias, or battery reversed.
13. I. F. transformers not properly matched.
14. Poor audio transformers.
15. High resistance joints or connections.

---

**Makes Crackling Noises.**
2. Loose or broken connection.
16. Leaking or shorted condensers.
17. Leaks caused by using soldering paste.
18. Static or outside interference.

---

**Makes Howling Noises.**
19. Microphonic tube or tubes.
20. Open grid circuit, either loop or C battery.
8. No bias on I. F. or audio transformers.
21. Excessive plate voltage.
22. Feedback between I. F. and audio stages.
23. Feedback between audio stages.

---

**Oscillates Badly.**
24. I. F. transformers too close.
25. Poorly designed I. F. transformers.
Feedback condenser in plate of first detector too high capacity.

Loop leads too close to I. F. transformers.

Poor Tone Quality.

5-A or B batteries too low.

Filaments on audio stages too low.

Tubes overloading.

7-Not enough B voltage on audio stages.

8-Wrong C bias on I. F. detectors or audio stages.

Reversed C battery.

Transformer peaked too sharply, cutting side bands.

Poor audio transformers.

Intermediate transformers not properly matched.

Poorly designed I. F. transformers.

No Distance.

Poor tubes.

Batteries too low.

Tubes overloading.

I. F. transformers not properly matched.

Poor quality intermediate transformers.

Inefficient or shorted loop.

Loop not connected properly.

Oscillator not functioning.

Poor Selectivity.

I. F. transformers not properly matched.

Wiring poor, leads too long or too close together.

Bad tubes.

Oscillator not working.

Poor condensers.

Inefficient loop.

Oscillator Dial Does Not Tune.

Disconnected plate or grid lead to variable condenser.

No B battery on oscillator.

Shorted or high resistance connection.

Reversed connections on oscillator coupler.

Bad oscillator tube.

I. F. transformers not properly matched.

Loop Dial Tunes Broadly.

Loop wrongly connected.

Inefficient loop.

Poor wiring in set, leads too long, etc.

Dials Do Not Tune Together.

If oscillator dial tunes above loop dial the coupler has too many turns. If it reads below the loop dial it has not enough turns.

Wrong capacity variable condensers.

Loop may be too large or too small.

Will not Cover Wave Band.

Where center tapped loop is used, the center lead may be connected to an outside post instead of the center.

Loop too small.

Oscillator coupler does not have enough turns.

Body Capacity.

Wrong type condenser.

Grid connected to rotor of condenser.

Rotor not grounded to negative filament.

How to Make Tests

Experienced constructors will find the list of faults given under each heading a sufficient guide in locating the source of trouble. There are, however, many who are not familiar with the best methods in checking for wrong connections, and for the assistance of these I have placed oppo-
site each fault a number. Below you will find instructions detailing just what to do to test for each kind of a fault.

The testing equipment required is a voltmeter, preferably one having a double reading, 0-7.5 and 0-150; two flexible rubber covered leads about three feet long and a C battery. If no voltmeter is available you can test with a pair of headphones in series with a C battery. (See illustration.)

Now touch the voltmeter lead to the jack marked 4. This completes the checking of the B battery connections.

Next check up the filament wiring. To do this connect the positive post of the voltmeter to the positive side of the A battery and turn all rheostats on. Then touch the contacts on each of the tube sockets, shown at 5. The voltmeter should show 6 volts on each side if your wiring is correct. If the reading shows 22½ or more volts then you have a B battery wire shorted against one of your filament leads. If no reading at all is shown on one or more sockets then you have a wrong connection or a loose connection, or a bad socket.

Check up the secondaries of all I. F. transformers and the first and second audios and the wiring between them. To do this place the positive lead from the voltmeter on the plus post of the C battery and touch all points marked 6. In making this test use the 7.5 volt scale on the voltmeter. As long as the pointer moves at all the transformer is o. k.

Check out the coupler. First test out the pickup coil. For this test you require a separate C battery in series with the voltmeter and one of the flexible leads. Touch one lead to the point circled 7 and touch the other lead in turn to the points marked 7. To check up the grid coil and connections, place one lead on the circled 8 and then touch in turn the other parts marked 8.

Test wiring between loop and feedback condenser by testing between points marked 9. Then test between condenser and plate of first detector by touching leads between points marked 10.

If a B eliminator is supplying the voltages the reading will not be correct unless you are using a special high resistance voltmeter, but you will get a reading which will show if the connections are complete or not. All B eliminators will not work successfully on a super. If after you have checked everything and can find nothing wrong, try a set of B batteries in place of the eliminator and note results.
(2) Poorly soldered connections. A poorly soldered or loose connection will cause all kinds of trouble. Always use a good hot soldering iron leaving it on the joint for a second or so after applying the solder to make sure it runs into the joint thoroughly. Always use rosin core solder. Never use an acid flux for although this may appear at the time to make a better joint it will surely cause trouble later.

(3) Connection shorting against another. If a wire runs within an eighth of an inch of another wire, use a piece of spaghetti to eliminate any chance of these wires touching. Only battery wires may be run as closely as this, all other leads being kept separated as far as possible.

(4) Poor tubes. Very often a tube may appear to be o.k. The filament may seem as bright as a perfectly good tube, but it may not have sufficient emission. A simple check if you have one or two spare tubes, is to take out each tube in turn replacing it with one of the spares. Be sure your spares are good. (Or better still, read the article on testing your tubes in this issue and rejuvenate them yourself.—Editor.)

(5) Batteries too low or dead. Check up B voltages with a voltmeter. A 45 volt battery should be discarded when it falls to 38 volts or less, and a 22½ volt battery when it shows 19 or less volts. Test the A battery with a hydrometer. It should read between 1250 and 1300 on the hydrometer scale. If you have a B eliminator the voltages must be checked with a high resistance voltmeter and the tubes in their sockets. An ordinary voltmeter will not give you a true reading.

(6) A, B or C batteries wrongly connected. This fault should have been detected when checking up as shown in test 1.

(7) Voltages on oscillator, detectors, I, F, or A, F. transformers not right. Generally the voltages shown on the wiring diagrams are correct. It is sometimes a good idea to try the effect of varying your voltages. Never use more than 45 volts on the oscillator or first detector, or more than 67½ on the second detector. If more than 90 volts is used on the intermediates the tubes will tend to oscillate and the B battery drain will be excessive. If too much C battery voltage is used on the amplifier tubes they will start rectifying and cause distortion.

(8) C battery reversed. If the C battery is reversed the tubes will take an excessive amount of B battery current, and amplification will be very low. C battery voltages required for the different plate voltages should always be as specified by the tube manufacturers.

(9) Oscillator tube not oscillating. One of the simplest tests is to take a pair of pliers and touch the tip of the pliers to the grid of the oscillator tube. A click in the telephones should result. Another is to tune in a station (if one can be heard) and pull out the oscillator tube. If the signal can still be heard the oscillator tube is not functioning. A more positive test which will indicate whether the first detector as well as the oscillator is functioning, is to insert a pair of phones between the P of the detector tube and the P terminal of the first intermediate. If the detector is working properly a local station can be tuned in on the loop dial. After the station is tuned in the oscillator dial should be turned and if the oscillator is working properly a series of whistles will blur the station to which you are listening. If the turning of the oscillator dial produces no whistles then the tube is not oscillating. The trouble may be caused by a poor tube. Try a spare and see if it makes any difference. Another possible source of the trouble is a reversed plate and grid coil. Both coils are wound in the same direction. Either the two inside terminals may be connected to grid and to plate, and the outside terminals to the B positive and the filament; or the grid and plate may be connected to the outside terminals with the B battery and filament to the inside terminals. But in no case will an oscillator work if the grid terminal is connected to the outside winding and the plate to an inside winding. Shorted turns on either plate or grid coil sections will also prevent the tube from oscillating. Absence of voltage on the oscillator plate may be detected by the test method outlined in number 1.

(10) Short in phone or speaker jack. Test across the jack with the voltmeter and C battery. If o.k. no reading will be shown. This trouble is generally caused by allowing some solder to run down and connect the contact blades.

(11) Transformer primary or secondary open. Test with C battery and voltmeter. When leads are touched between P and B reading should result. A reading when G and F are touched will show the secondary windings are o.k. Absence of readings show open circuits.

(12) Broken connection in set or between set and battery. Test out for this trouble as shown in 1.

(13) Intermediate frequency transformers not matched. It is essential that the I.F. transformers be matched exactly if you are to get either distance or selectivity. In most cases poor selectivity is the direct result of transformers that do not peak alike. Fig-
ure 2 shows a series of curves illustrating the efficiency of an amplifier with four stages. Curve A shows the total amplification of the amplifier and the selectivity, or band pass, with four perfectly matched transformers. Curve B shows the effect on the amplifier when the filter transformer is taken out and another used which did not match the other transformers by a difference of only 5 kilocycles. It will be noted that the amplification dropped nearly fifty per cent and the selectivity was also considerably reduced.

(14)

Audio transformers bad. High grade audio transformers should be used if you expect good reproduction. When transformers having a poor frequency characteristic are used, it is impossible to get good reproduction regardless of how efficient the rest of the receiver may be. A good transformer cannot be put in a case the size of a match box. A transformer to reproduce the lower notes of the voice and musical range must have a large iron core in order to have a sufficient impedance at the lower frequencies. All of the present day transformers that are scientifically designed are twice as bulky as the transformers of a few years ago. The best guide in the selection of a transformer is to select one manufactured by a firm that has been in the transformer business for some years and has a reputation behind it.

(15)

High resistance joint or connection. Very often a joint or connection may appear to be O. K. but it is really touching only at one spot. When this happens the set may function but will operate very poorly. If you have tested everything and suspect this trouble the best thing to do is to go over every connection with a good hot soldering iron. It sometimes can be detected by testing each connection with the fingers. But be sure you do not carelessly short a filament wire against a B voltage wire in so doing. Listen to the signals while doing this, if signals are available.

(16)

Leaking or shorted condensers. Test small capacity condensers with a voltmeter and a 45 volt B battery. At first contact you will get a slight flicker of the meter needle. This is on discharge of the condenser. On second contact there should be not even a flicker of the needle. If the meter does register the condenser is either leaking badly or shorted. The test for bypass condensers is slightly different. Take two 45 volt batteries in series and apply across the terminals of the bypass condenser. Snap them two or three times to charge the condenser. Wait about two minutes and place the voltmeter terminals across the condenser. If a flicker ensues the condenser is o. k., having held its charge. If no flicker is noted the condenser has leaked and its use in the set is not advised since its presence will gradually cause the B batteries to run down.

(17)

Leaks caused by using soldering paste. All soldering pastes or fluxes (except the one made from rosin and alcohol) contain injurious acids and should never be used on any part of a radio receiver. Use nothing but a rosin core solder.

(18)

Static or outside interference. Very often defective connections are blamed for noisy reception when the trouble is due to atmospheric or electrical disturbances outside the set. To test whether the noise is outside the set, short-circuit the loop terminal posts and listen to the speaker. If the noises continue it is caused by bad connections or batteries. If it disappears when the loop terminals are shorted, the disturbance is outside of the set and you have no control of it.

(19)

Microphonic tubes. When the speaker is placed too close to a powerful receiver the vibrations emanating from the speaker will start the filaments of the tubes to vibrating and the result will be a continuous howl. This trouble can generally be cured by placing the speaker away from the receiver, or placing the receiver itself on a felt pad. Sometimes the rubber hoods now being sold to fit over the tubes will stop the howling. To test which of the tubes is the microphonic one, tune in a loud signal and grasp each tube in turn with the hand. Generally you will find tubes in the detector socket cause this trouble. If the howling is an audio one and very persistent, put the receiver in its cabinet and see if that stops the noise. In some cases the volume from cone speakers is sufficient to start the condenser plates on the oscillator vibrating at an audio frequency rate. Encasing the receiver in its cabinet and closing down the lid usually stops such a case of trouble.

(20)

Open in grid circuit. When you have an open grid circuit you will hear a constant spluttering or put-put-put-ing in the speaker. Look to see if loop is connected. If o. k. make sure your C batteries are properly connected. If o. k. examine all leads running from posts on transformers marked F (or the grid returns) to see that all are connected. Sometimes a high resistance joint at this point will cause the trouble. Also make sure it is not your regenerative midget in the loop circuit that is too far in, causing a spluttering noise.

(21)

Open plate circuit in detector tube. This trouble will often cause a howl in the speaker. Test with voltmeter for continuity of primary winding and connections.

(22)

Feedback between audio and I. F. stages. Sometimes the audio transformers will couple with the I. F. stages and amplify the intermediate frequency. This generally results in a set that has a tendency to squeal when the volume control is turned up too high. In almost every case it can be cured by grounding the metal case of the audio transformers to the next transformer and then grounding to negative filament. All good transformers are placed in steel or iron cases. Some times an 85 mh choke in series with the primary and bypassed with a .002 mfd condenser, will curb the howling tendency. (See schematic figure 4 in the blueprint section for the method used in the 9 tube model—Editor.) Never use impedance or resistance coupled audio amplifiers with a superheterodyne.
(23) Feedback in audio stages. Unshielded audio transformers are likely to howl when closely coupled. Metally encased audio transformers may be connected together as shown in 22 if they howl. Grid and plate wires when too close together will encourage audio frequency howling. Battery eliminators of certain types are sometimes the cause of howls and squeals in a super.

(24) Intermediate frequency transformers too close. In certain types of transformers too close proximity of one to another will cause howling. It is a safe rule to keep I. F. transformers at least an inch apart. Especially is this applicable to air core intermediates.

(25) Poorly designed I. F. transformers. Transformers that are designed to operate with a stabilizer or “losser” have a tendency to oscillate when the amplification is increased. They will sometimes oscillate when the filaments are turned up to normal. This usually results in an unstable set. Transformers designed to operate on a high intermediate frequency will have a tendency to oscillate when the grids are operated at a normal grid bias and the filaments operated at a normal filament voltage. Tone quality will be poor when transformer is designed to give extreme selectivity. The higher audio frequencies are cut off so they are not present in the loudspeaker output and naturally the tone quality is poor.

(26) Feedback condenser in plate of first detector too high capacity. When the receiver is first tested the small feedback condenser should be adjusted for minimum capacity (plates out of mesh) and capacity should be increased to point where signals are loudest and yet the detector tube will not slip into oscillation. This condenser should have a minimum capacity of not to exceed 15 or 20 mfd (.000015 mfd). If the set persists in oscillating after you are sure intermediate stages are not oscillating, feedback condenser may be removed altogether.

(27) Loop leads too close to I. F. transformers. The wires leading from the loop binding posts to the variable condenser and tube should be well separated from the intermediates. When the loop leads are too close to the last I. F. transformer some energy from a local station will be induced in the transformers and associated wiring before going through the tuning network and a loss of selectivity will result.

(28) Filaments on audio stages too low. On some of the older types of receivers a separate rheostat on the panel was used to control the filaments of the audio stages and so control the volume. It is better to use a fixed resistor. (For controlling the volume see method used by our laboratory as shown in blueprint section—Editor). A high resistance (variable) across the secondary of the first audio transformer may also be used for audio volume control.

(29) Tubes overloading. A receiver should not be crowded for volume as invariably the tubes will overload and cause distortion. When good loud speaker operation is desired use either a 171 or 210 power tube with the correct power voltages in the last audio stage. When the 201-A tube is used in the last stage and any volume desired, it will be found the quality is poor. Another cause of poor quality on the locals is the overloading of the second detector by running its filament at too high voltage. (See method of control in the blue print model in this issue—Editor).

(30) Intermediate peaked too sharply. I. F. transformers too sharply tuned sometimes cut sidebands so greatly the quality will be poor. Such a condition is illustrated in Curve C in figure 2. It will be observed the frequencies are only amplified as high as 2500 cycles, just about half the range necessary to produce good quality. Such transformers, however, will be very selective.

(31) Inefficient or shorted loop. A shorted loop will result in no tuning control on the loop dial. An inefficient loop might cause the same trouble. Poor insulation, shorted turns, open center taps, etc., might be considered as causes of trouble.

(32) Loop not properly connected. When the loop has a center tap be sure the two outside leads are connected to the variable condenser. The lead from the center tap is connected to the negative filament or the negative of the C battery depending upon whether or not you are utilizing biasing for detection in the first detector.

(33) Wiring poor—leads too long or too close together. Always make the grid leads as short as possible. Keep them well separated from other wires. (The scheme used by Radio Age in its 9 tube model does away with the grid and plate leads altogether—Editor). The plate leads are next in importance, should be kept as short as possible and away from other wires. Run leads from the variable condensers near the front of the subpanel or baseboard and keep these leads away from the transformers.

(34) Disconnected plate or grid lead to variable condenser. Disconnected plate or grid leads will prevent the oscillator functioning and may be located when wiring is checked as shown in 1.

(35) Oscillator dial tunes above or below loop dial. If you have a rheostat controlling the oscillator tube, the dial reading on the oscillator dial will shift slightly as you vary the tube’s filament voltage. If oscillator dial reads too high above the loop dial grid and plate sections have too many turns. Remove one turn at a time and see if dials match better. If the oscillator dial reads very much below the loop dial then turns should be added to the oscillator grid and plate sections, or take off a turn from the loop winding.

(36) Wrong capacity variable condenser. Make sure your condensers are each .0005 mfd, if that is the value speci-
Try This Circuit With Some Old Parts

EXPERIMENTERS who have a number of coils and condensers lying idle on their hands may find in this following brief article a new outlet for some of their energy.

Diagrammatically we are showing the simplified regenerative detector invented by Edward H. Loftin and S. Young White in their paper on "Combined Electromagnetic and Electrostatic Coupling and some uses of the combination" delivered before the I. R. E. June 30, 1926.

Quoting from their paper: "Here we use the grid circuit as the only tuned circuit of the system and couple the plate circuit to the tuned grid circuit with a combined coupling. The antenna may be coupled to the tuned grid circuit in any suitable way, but a combination of constant coupling as shown is preferable. The ordinary connection to the grid leak around the stopping condenser cannot be made as the tuning condenser on one side and the coupling condenser on the other effectively interrupt the grid circuit against a grid bias, so that the grid leak must be connected directly between grid and filament. By properly adjusting the combined coupling between the grid and the plate circuits constant regeneration or tickling with frequency is had, and by including a limiting element such as the resistance R1, it is easy to hold the system without repeated adjustment below oscillation for spark or broadcast work, or in oscillation for CW or heterodyne reception.

"It will be noted that the connection across the coupling condenser is in the opposite sense to that shown in previous figures, but this is necessary as the feedback must be such as to aid the current in the grid circuit. Care must be taken so as to pole the inductive coupling so it will aid this new arrangement of capacitative coupling. This alternative capacity connection permits of connecting the rotary side of the tuning condenser to ground. Such a connection becomes necessary in multiple tube receivers using single dial control where all of the rotary elements must be at the same potential, usually ground potential. There results a slight reduction in voltage applied to the grid, since grid and filament are connected across the tuning condenser alone, which connection diverts the overall available potential in the inverse ratio of the tuning and the coupling condenser capacities."

An old three circuit tuner might be utilized in making up this set. Resistance R2 may be a fixed resistance for a quarter ampere tube; the grid leak may be some value from 2 to 5 megohms. The choke may be a secondary of an old transformer. The resistance R1 may be about 100,000 ohm variable. These values given are largely experimental and will depend upon individual results. The coupling condenser C may be tried at various values, 1 mfd, ½ mfd, etc. Inductance L1 is the secondary spanned by a 0.0035 mfd, L3 is the antenna coupling coil and L2 is the plate regenerative coupling coil.

Schematic circuit of the Loftin-White system of simple regenerative detector

Westinghouse interests, disclosed his method, from which we quote:

"The object of my invention is to provide a system in which a two element vacuum tube may be employed as a generator of high frequency oscillations suitable for use in wireless transmission systems. The use of the three element vacuum tube as a generator of high frequency oscillations is well known. In such systems the vacuum tube may be brought to a condition of self oscillation by suitably coupling the plate-filament and grid-filament circuits through a so-called feedback or regenerative transformer. I have discovered that with a suitable arrangement of circuits, an efficient and reliable electron oscillation generator system may be constructed which will utilize the effect of a transverse magnetic field upon the path of an electron."

"In a vacuum tube comprising a filament and an adjacent placed anode the electrons emitted from the heated filament travel in substantially straight lines to the anode. Upon the application of a transverse magnetic field (see sketch) it is found that the path of the electrons become slightly curved and that the degree of curvature depends upon the intensity of the magnetic field. Thus with a magnetic field of sufficient intensity the electrons may be caused to curve backward toward the cathode in cycloidal paths but never are permitted to reach it."

"EVER since the invention of the Fleming valve (years and years ago) radio experimenters and scientists have been trying for some method of making a two element tube oscillate. Success seems at last to have crowned the efforts of J. Slepian, of Swissvale, Pa., who in a recently assigned patent to the

Here's Way to Make 2 Element Tube Work

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Loop or Aerial—and Why?

By H. MELCHIOR BISHOP

This question is one which has been asked by the set buyer and broadcast fan since the days, not so long ago, when the art of broadcasting was in its early but lusty infancy. It is an important question and it is a logical one—but it is also one which is very difficult to accurately answer.

This difficulty of answering is due to the fact that this question, in common with many other queries pertaining to radio in general, must be answered not directly, but by asking certain other questions. Then, by properly balancing the answers—or near answers!—to these counter questions, it is possible to arrive at a compromise between the various different factors entering into the satisfactory operation of a radio receiver, and to tell thusly, with a marked degree of accuracy and certainty, just what type of receiver is most suited for use under the given conditions.

With a comprehensive understanding of these various "operation factors" as a basis for judgment it is possible for anyone, with or without technical radio knowledge, to make an intelligent and efficient selection of the proper type of radio receiver for his, or her, or anyone's else use; provided, of course, that the conditions under which the set is to be operated are reasonably well known.

It is the purpose of this paper to endeavor to discuss the various "operation factors" and their bearing on the performance of both loop and aerial type sets in such a manner as to serve as an effective guide to the inexperienced radio buyer, thus making an intelligent and thoroughly satisfactory choice possible.

In the first place, it is necessary to dispel the notion, if it still exists, that the antenna types of set are superior to the loop types, or vice versa. Accepting as a foregone conclusion that the receivers under consideration are equally scientific in design and equally excellent in workmanship, the selection of the proper one resolves itself into a question of expediency, rather than of superiority. In other words, the point to be decided is not which type of receiver is best, but which is most suitable.

Any good set will work in any location with a fair degree of success, but to attain really superlative results it is necessary to use the type of set which is best suited to the locality in question. While this statement is merely one of ordinary common sense, it is, however, overlooked entirely in the great majority of cases.

To get down to "brass tacks," let us see just what constitutes the principal differences between loop receivers and aerial receivers.

Loop receivers, as a class, are very sharp tuning; have great amplifying power; employ, relatively, a large number of tubes and many batteries; are moderately portable; are comparatively expensive to operate; but are very adaptable.

Aerial receivers, taking all types in general, are moderately sharp tuning; have a very fair degree of amplification, not needing as much power as a loop set, since more energy is "picked up"; employ comparatively few tubes, but just as many batteries as loop sets; are not portable, except in a few special cases; are rather inexpensive to operate, due to the small number of tubes and the consequent low drain of battery current; and are not so adaptable as loop sets, due to the necessity of erecting an antenna for successful operation of the set.

There are many places either type of set will give equally satisfactory results, and in these localities, which are usually in the suburbs or country, the selection of a suitable set is merely a question of personal preference.

Suppose a set is to be used in a place where there is a great deal of interference (man-made interference, such as that caused by leaky power-lines, rough street car trolleys, partly broken down transformers, radiating receiving sets, etc.) This, of course, is a very difficult condition to overcome, due to the fact that a radio set is the most sensitive detector of small electrical disturbances in existence.

If the interference is directional, however, a loop set can very often be employed with a very reasonable degree of satisfaction by attempting reception only from those directions which will tend to keep the loop at right angles, or nearly so, to the interference. The noise to signal ratio, when the loop is so positioned, will be such that the signal is so much stronger than the noise that the resulting tones will be fairly satisfactory unless the interference be uncommonly strong.

A modern apartment, fireproof house, or office building, with its steel skeleton and steel lathing tending to greatly damp down the signal, presents another great problem. A loop set to be satisfactory for use in such a location would necessarily need to be extremely powerful and this fact naturally leaves us an antenna set as first choice. Many of these apartment houses, however, prohibit the erection of aerials. In a case of this sort, it is necessary to employ a very sensitive radio frequency or superheterodyne loop set, and experiment with its placement in an endeavor to find the position in the apartment in question in which it operates with the highest efficiency. If the loop can be located near a plain brick wall or window it will be less shielded, and consequently more efficient, than if placed near a wall in which steel lathing is employed.

Another problem is the house located in a thick grove of trees. In the winter, when there are no leaves on the trees and the sap (which is the conducting medium) is down in the roots, practically no interference is caused by them.

In the summer time, however, these same trees cause a blanketing effect which is oftentimes almost as pronounced as that produced by a steel
Man—Know Thy Tubes!

Were it possible for all radio fans to heed the injunction at the top of this little article, many a magazine’s technical department would have a sigh of relief; many a set manufacturer would feel his product was being given a fair deal, and the fan himself might realize that at least he was contributing a little towards solving his own difficulties.

So many of the letters of complaint regarding a given set refer to the fact that reception gradually dimmed as the age of the set increased. The querulous one immediately opines it must be the set. He shies his complaint at the nearest radio magazine or dealer and then waits impatiently for an answer.

The funny part of it is (if there is any humor at all in such a situation) that the listener or fan does not stop to think he might find out the trouble through his own experimentation unless of course it is something deep-seated. And most of the fans seem to think it is deep-seated.

So if you would relieve the burden of the Question and Answer men scattered over this broad land, do a little checking on your own initiative before burdening others with your troubles. Take the little matter of tubes, for instance—

Nine out of ten listeners will assume that when reception drops off something must be wrong with the set. In nearly every instance it is with the tubes. Mr. Fan in his keen desire to log everything this side of Walla Walla, Wash., has kept turning up the faithful old rheostat until the tubes are as bright as possible. At first this worked out nicely, but after a while the same fan found that to keep up the level of reception he had experienced before, he required a rheostat with an endless turning ability. When all of the resistance was cut out of the rheostat, and the signals did still not come in with their usual volume, Mr. Fan went into executive session with himself and decided the set was on the blink.

As a matter of fact several things may have happened. The tube filaments may have become dethoriated through application of excessive voltage; the potential of the storage A battery may have dropped because Mr. Fan had been using the set too long without recharging; by the same token the voltage of the B batteries may have dropped to very low value. All three of these conditions could have caused a diminution in signal strength. Likewise a change in the weather might have been the cause. The last named cause is the only one over which the listener has no control. If his A battery is low he may charge it with a rectifier. If dry B batteries are used and their voltage is low, new ones may be secured. If wet B batteries are used, he merely has to recharge them. Thus only the tube is left to be accounted for.

Checking and reactivating tube filaments is such a simple process that we are surprised more of the fans have not made use of the scheme. For some time manufacturers have marketed tube checkers and tube reactivators or rejuvenators, both of which are available at a very reasonable price. Their use will save the average fan a great deal of expense in tube replacement as well as considerable time spent needlessly in trying to find a trouble.

You may check your tubes from the receiving set you are using and thus determine which of the tubes is poor. Nine chances out of ten the tube which you find in poor condition is responsible for the most of your trouble in getting good signals.

Vacuum tubes using the thoriated filaments, such as the 201-A, 112, 199 and 120 can readily be checked by the tube checker illustrated in this article. Also these same tubes, if found to be low in emission, may be reactivated by the tube rejuvenator shown.

In the case of the tube checker, it consists simply of a socket, a DC milliammeter reading from zero to fifteen milliamperes, a plug and cord whereby the outfit may be plugged into a socket in your set, and a single pole, double throw switch, in the form of a button, which serves to alter the bias placed on the grid of the tube under check. Knowledge of vacuum tube characteristics has permitted the makeup of a chart showing difference in readings for a given tube. Thus with 90 volts on the plate of a 201-A tube, two readings of plate current may be secured one with a negative bias and the other with a positive bias on the grid. The difference between these two values is fairly indicative of the condition of that tube’s filament emission. For

(Please turn to page 39)
The story thus far

Col. Maximilian Minimil sets $10,000,000 aside, out of his personally acquired colossal fortune, for the purpose of financing the Fortunatus Gazette for his son Daly. The younger Minimil, while the great project is being organized, has some difficulty in making other people believe he intends to publish a newspaper that is to be free from the smut and hysteria of certain other dailies. He believes a clean journal will win out. Bill Rosom, publisher of the Clarion, is a former movie actor. A horse stepped on his face and, although putting him out of the picture game, so transformed his countenance that he has the appearance of a super-man. People do what Rosom wants because of the compelling power of the Rosom face. Rosom tries to prevent the sale of the first issue of the Gazette. The Minimils win their circulation battle by a ruse and the Gazette is successfully launched.

IX

Daly Minimil’s first visit to the local room of the Gazette reminded him of the first time he made a flight in an airplane. The paper was taking off with a roar and a rush. Stub Graham, city editor, was superintending the assignment of reporters and photographers. Daly, attracting only casual notice from reporters and sub-editors, took a chair near Graham’s desk and was fascinated by the sure precision of the city editor’s methods. Telephone bells were throbbing with incoming calls and typewriters clicked on all sides. Copy for the early edition was being dumped on the city desk. Graham seemed to be able to talk to a reporter at his elbow, listen to another over the telephone and read a story and mark it for space and headline, all at the same time.

“Hey, there, Farnsworth,” yelled Stub, as a photographer passed his desk on the way to the door, his camera slung over his shoulder. “Just a minute, Farnsworth, when you snap that dame tell her to pull her skirts down. She might have the idea you want a Hearst pose. Legs used to be news but those days are gone forever as far as this newspaper is concerned. That last society pic of yours should have carried two credit lines ‘Legs by Farnsworth’ and ‘Underwear by Pure silk, Inc.’”

Daly could not entirely suppress a smile. He cherished the hope that he could make of the Gazette a Holy Grail, a sacred font from which man, woman and child in Fortunatus might quaff material and spiritual sustenance. One of his dreams was that his calm, dignified, alert newspaper might be written and edited by Sir Knights and Ladies of Journalism, captains both courageous and cultured. But he would not have expressed this thought quite so trenchantly as had Graham. It depressed him to reflect that the tall lady reporter, sitting over there by a window, was even now hoping that the next telephone call would bring a tip on a first-class murder, one with a sex angle which would require the expert touch of a lady reporter’s skill. She yearned for a slaying that might enable her to visit the jail and write that she had loaned the fair, frail, little murderess a handkerchief and a powder puff after the fair and frail had confessed to the Fortunatus Gazette exclusively that she had shot her man in the back as a measure of self defense.

The chief of the office boys ushered a large, blowzy woman into the local room. She had a story to tell and it mattered not to her that the confessor assigned to listen to her was the smallest and youngest reporter on the staff. He was Asbury Lunt, bespectacled, spatted, combed-back. Diminutive as he was he calmly flapped one enormous pant-leg over the knee of his other limb and waited for the lady to announce. Mr. Lunt was a graduate of a school of journalism, a novitiate. He knew that for weary months to come he was doomed to sit about the office seeing those visitors whom nobody else wanted to see, listening to dreary stuff with an air of polite interest and throwing his memoranda on the floor the moment the visitor departed. Some day he would be a regular, journeyman go-getter. He would fare forth and cover big news events and some other youth would be sitting in his place in the local room, being polite to the bugs.

This particular caller seemed to be somewhat more balmy than the average, Mr. Lunt reflected. She had a fog-horn voice that rose triumphantly above all the other din of the local room as she broadcast the announcement:

“T want justice!”

As she made this time-honored declaration she leaned forward and glared right into the horn-rimmed spectacles of Asbury Lunt. That impeccable boy, whose soul had never yet been stung by the scourge of out-
raged love, but whose heart was ripe with sympathy and a desire to understand, settled back in his chair.

"You have come to the right place for it, Mrs. Corridon. Tell me please."

"I helped that man through veterinary college and gave him his start," she boomed. "I took in washing and carried his meals to his office so that he could save time and restaurant expenses."

A lull in the noisy confusion made it evident that this woman's message was getting more than local circulation.

"When he got prosperous a lady barber vamped him." With this the great frame of the unhappy matron slumped forward and her tears fell unchecked on Mr. Lunt's shoulder. Suddenly she arose and into the far corners of the Gazette building the winds of vengeance carried a lusty shriek.

"Write her up, Mr. Reporter, and print my picture on the front page. A woman like that ought to be hung. A husky barber! Steve was a good husband until she began to shave him!"

Stub Graham sent an office boy to tell Mr. Lunt that he was wanted at the city editor's telephone. As soon as Asbury was within confidential distance Stub said: "Take her back to the studio and have 'em shoot her picture just to stall her along. Then let her out the side door."

Mr. Lunt squired Mrs. Corridon to the rear of the big room. He had just stepped aside courteously to permit Mrs. Corridon to pass through the door, when a caliper-legged gentleman with a Sir Thomas Lipton mustache backed excitedly away from a printing telegraph machine that was bringing in bulletins on the results of baseball games, horse races, hog receipts and stock movements.

"Monkeyface," yelled the bowlegged gentleman, who, as Daly learned later, wrote the Gazette's housekeeping column under the name of "Aunt Clarice," "Monkeyface!"

Mrs. Corridon hit Clarice once but footwork saved him from further punishment. Mr. Lunt stepped in between them and Mrs. Corridon's second swing caught him on what the sporting editor calls the button and Asbury went down. He sat in a waste basket waiting dazedly for the meadow larks to stop singing.

Dingle, head office boy, next squeezed into the sketch. "He wasn't calling you any names, lady," said Dingle, "he had two bucks on Monkeyface's beeper and the old goat staggered in first in the second at Jamaica."

By this time Mrs. Corridon was drifting far out beyond the safety-ropes. Lacerated in spirit she tossed a contemptuous glance at the staff of the Gazette.

"This newspaper's a fraud," she boomed. "I'm going to the Clarion where the place ain't filled with dudes and thugs."

NOW Daly Minimil's knowledge of how news was developed from the crude state to the finished product had been vague indeed, and he was not prepared for the revelation that the city editor's department of a daily paper resembles an internal combustion engine more than it resembles a drawing room occupied by earnest young persons engaged in transforming today's chronicles into the literature of tomorrow. Daly was surprised and not altogether pleased at the discovery that the handling of spot news had an obligato of noisome pops from the exhaust pipe. Looking about the office at the Sir Knights and Ladies of Journalism he was forced to the conclusion that, so far from being litterati, some of them were devoted students of but one volume—the telephone book. Of course Daly did not know that no considerable portion of the modern newspaper's local staff do little or no writing, but limit their efforts to obtaining facts which they turn over to rewrite men or other reporters to be "whipped into shape" as the saying goes. Unhappy the fact that comes to this whipping post under the suspicion of being unimportant, uninteresting, lacking in imagination, devoid of humor or of human interest. Such an unworthy fact, seized by the rewrite man, is tied to the whipping post and lashed with typewriter key-bars until it either withers in pain and dies or until it heaves amain and, breaking its bonds, stands forth transformed. No toilet preparation can do so much toward helping women to keep that schoolgirl complexion as can the rewrite man who makes all the women attractive, demure, pretty, beautiful and vivid. No promoter of real estate values can so magically transform a residence district of mediocre houses and Group II citizens as can the rewrite man. His heroes and heroines always live in exclusive districts, regardless of the price of vacant per-front-foot property. No tailor could clothe so well the speak-easy bartenders who are found dead in the tonneau of the high powered and generally black touring car. Until it is disclosed that the victim of the mysterious murder is only another rum-running gangster it seems inevitable that his clothing shall be of excellent material, even his linen indicating great wealth and culture. The coroner, rushing forth to hold an inquest, finds that the shoes of the corpus delicti have not been polished since Maine went democratic, his pants have not known the smoothing influence of a goose since they were marked down to $4.98. And the lady murderess! How kind the reporter and the artist! "Dramatize her," says the city editor to the reporter, and "Touch it up to make it look like something" says he to the art department director who is to superintend the making over of the lady's photograph into a worthy slab of etched zinc.

"So this is journalism," reflects Daly as he watches his own show from back stage.

Stub Graham, sensing the chief's feeling, turns to say:
"Readers like it and we gotta give 'em what they want."

"I wonder," said Daly, making mental note of the desirability of a long talk with his editorial chief, Mr. Dana Greely Franklin.

At a desk somewhat removed from the milling group about the city editor sat a sad faced man. Daly had observed that this individual had seemed bored by the adventure of Mrs. Corridon and Mr. Asbury Lunt. He raised gloomy eyes only to see what all the commotion was about and then returned to grief-stricken contemplation of his lower waistcoat button. A lady reporter stopped near the shrine of sorrow and said something in a small voice. "Hell's delight," exclaimed the melancholy one, "don't you ever buy any cigarettes of your own?"

"That's what they all ask me," piped the lady over a pert shoulder as she seized the churlish gift and made off for the rest room.

"Who is he?" asked Daly.

"Conductor of the humorous column," replied Stub.

Daly started with surprise. So this misplaced mortician was the famous "H. A. W."

Near the copy desk lounged the religious editor of the Gazette. As a side line he was pastor of a church and he still believed in hell and sideburns. "Doc," as all religious editors are called in newspaper offices, was trying to convince a half-jingled copyreader that prohibition prohibits. The h. j. copyreader was giving only indifferent attention for he was concerned at the moment in trying to devise some new and unusual reason for applying to the city editor for an order on the cashier. It was the copyreader’s day off and he had not the wherewithal to finance certain activities which, to copyreaders, bring happiness. The Doc was saying:

"It's harder to find liquor than it ever was and it's getting scarcer every day. And it's a lot more expensive and not so good."

"Lordy, yesh!" agreed the copyreader, "so you've notished it, too."

* * *

XI

Presently, after reporters and photographers had gone their ways, the local room of the Fortunatus Gazette assumed that atmosphere of pregnant quiet which marks the interval between the assignment of the staff and the arrival of the first bulletins from the news front. Typewriters were deserted, paper littered the floor, telegraph keys rattled pleasantly in some distant room, the cop's traffic whistle sounded clearly from the street far below. The column conductor was mournfully reading over a bit of verse which would make thousands laugh next morning. The city editor was making up his preliminary news schedule for the early make-up man and his assistants were cutting up the afternoon papers.

Only one girl remained of the crew that had so noisily swarmed about the rows of desks occupied by the reportorial staff. Daly had been studying her and had come to the conclusion that she had no business there. He felt reasonably confident that she had no business anywhere except on a Sargent canvas. An exquisite being! Daly arose and yawned. He had had his eyeful and his earful and now he would go back to his own sanctum and ponder there the things he had seen and heard. Changes would be necessary undoubtedly. It was not conceivable that his newspaper could achieve its high purpose with such a local staff and such a lack of ethical niceties. He would have Franklin in and they would thrash it out.

He nodded at Stub Graham as a perfunctory signal of departure. As he did so he glanced again at the girl, He sat down again. After all Daly was a human being. And he was not 24 years old. Nor was he blind.

"Who is that young lady?" he asked.

"A new reporter," said Stub. "Haven't tried her out yet. Ought to be the berries with that face and those clothes. She can crash in anywhere."

"Discharge her," said Daly.

Stub looked up in amazement. "Do you mean that I am to fire her?"

"Yes."

"It's all right, of course. She came here with dandy recommendations but if there is something about her that I hadn't—"

"Not at all," said Daly, "I know nothing against her but she will have to go."

"All right, Mr. Minimil." Stub said no more.

Daly glanced about the big room. He was visualizing the scene of a few minutes before. He was rebuilding the structure of sophistication and disillusionment which was the Gazette’s local staff. This flower against such a background! He looked at her again. Impossible! He must give Graham a reason for his instructions to discharge her. What reason could he give that would not sound ridiculous, quixotic?

"She is entirely too beautiful," he said at last. Stub looked at him again, not concealing his surprise. "Too good-looking," went on Daly. "She'd disorganize things here. The city hall reporter would be holding her coat and helping her on with her rubbers. The financial man would be asking her out to dinner. Dingle would be forever doing just what he is doing now, looking up telephone numbers for her or some such nonsense. The rewrite men would be using her as a pattern for fair fiction characters. They would be in competition for the honor of fetching her copy papers and ribbons. It wouldn't work, Graham. I know you'll see it my way. If she wants the reason tell her the truth. She's entitled to that, anyhow."

Stub Graham smiled quickly and nodded in acquiescence. He watched the figure of the publisher recede into the shadows of the corridors leading to the inner sanctum. Then he looked at the girl reporter and after a moment of thought he uttered softly a deep truth.

"The higher they get the harder they fall. Holey Mackerel, how am I going to get this bad news across to her?"

(To be continued.)
Ontario Power Commission Adopts Short Waves
By JAMES MONTAGNES

SHORT wave radio now links the Toronto offices of the Ontario Hydro Electric Power Commission with the generating station at Cameron Falls on the Nipigon River, and other parts of the Commission's Thunder Bay System, north of Lake Superior.

During the winter months of 1926 the engineers of the Toronto laboratories with the co-operation of several of the Canadian amateurs, investigated the possibilities of communicating directly between Cameron Falls and Toronto by means of short waves. These tests showed the proposition to be quite feasible and the Commission then authorized the construction of the two radio stations.

The stations have been in constant communication since last autumn, work being carried out every night. The Department of Marine and Fisheries, Radio Branch, granted the use of two special wavelengths—29.94 meters for daylight and 50.0 for night transmission—and the sets are in operation under experimental licenses by operators who have first class commercial certificates.

The Toronto station, 9AI, is installed on the sixth floor of the Administration Building, with the aerial on the roof. The station at Cameron Falls, known as 9AQ, is temporarily located in a school house building on the west side of the Nipigon River. The two stations are approximately eight hundred miles apart, the distance between being for the greater part thinly inhabited.

Messages are sent in Morse code only and loud clear signals are received in either direction. A very considerable saving in time is effected through the use of radio equipment as messages are received at their destination three or four days earlier than by the usual mails. It is for this reason mainly that these stations are in existence.

The transmitting and receiving apparatus was designed by the Commission's engineers and built in the laboratories at Toronto.

The transmitting equipment is mounted on the rear of an upright hardwood frame, the panels of which have been boiled in paraffin to improve their insulating properties, thus forming a material which is recognized as superior to the usual materials supplied for radio-frequency insulation.

The power tube, type UV-204-A, having an output rated at 250 watts, is mounted on a horizontal panel. Above the tube are the inductances and condensers, forming the radio-frequency circuits, and below are the filters and control equipment.

Everything has been done to make the apparatus safe for the operator, one of the features of construction being the connections of the condenser shafts, as well as those of the rheostats and the cases of the instruments which are at ground potential.

The keying system in both transmitters employs a small adjustable condenser, which is connected in parallel with the main grid-turning variable condenser whenever the key is pressed. This causes a slight variation in the wavelength of the radiated waves, the longer wave being the true one, and the shorter one being the spacing wave. The receiving operator tunes to the true wave and does not hear the spacing wave at all. The receiving apparatus is similar to that found in most amateur short wave stations, that is, a regenerative receiver using two tubes, detector and one stage of audio.

The operation of these transmitters since their installation has aroused favorable comment from the executives of the Ontario Hydro Electric Power Commission. Stations work each other on prearranged schedules, calling in the usual way, and handling messages relating to operation of the power system.

Dry Rectifier

ABOVE is shown the latest release in the rectifier field announced by the Thordarson Electric Manufacturing Co., embodying a Raytheon rectifying element and a Thordarson transformer. The sketch shows the inside of the new device which is marketed as R-175 of the Thordarson line.

Several features will at once be appreciated by radio enthusiasts. First the rectifier delivers 2 amperes; it is dry, has no moving parts or liquids. It is also small and compact. Tried out in the laboratory of this magazine it made an ideal 2 ampere charger which could be put to work and forgotten.

New Tube Out For Resistance Coupling

BECAUSE of the widespread interest of fans in resistance coupling a high mu tube especially designed with a view to providing high amplification, and suitable as a detector as well as an amplifier, has been announced by the Radio Corporation. This is the UX-240 which in general appearance and physical dimensions is similar to the well-known UX-201-A.

It is a storage battery tube, with a one-quarter ampere filament of the thoriated tungsten type. A standard UX base is provided. This tube is intended to provide the highest practicable voltage amplification so essential in resistance-coupled amplifiers. This method of amplification, in contrast with the transformer-coupled method, depends entirely upon the tube for the step-up effect. The UX-240 has been designed to provide an amplification factor of 30.
FANS who may have a good collection of old issues of this magazine and who wish to help the New York public library will confer a favor on that organization by sending the library a copy of the July, September, October and December issues of the year 1923. These issues are out of print. If any reader happens to have one of these issues the library would appreciate having it if the reader no longer cares for it. Address Director New York Public Library, 476 Fifth Ave., New York, N. Y.

THE broadcast listener usually complains that he is unable to hear a certain station because it is too far away; the amateur radio telegrapher, on the other hand, often makes the complaint that he cannot hear another amateur station because it is too near! A striking example of this is furnished in the story of a radio message that a San Jose amateur wished to send via short waves to his friend at Carmel, California. The distance between the two points is slightly more than fifty miles, but due to the habit that short waves have of angling into the upper atmosphere before being reflected back to earth, the two stations were unable to hear each other at all. Finally, the San Jose station, 6HB, recollected that 6HM, at Carmel, kept a regular schedule with an amateur in Singapore, Asia, and, since this point was quite easy for each to reach, he sent the message to the Singapore amateur.

A NOther slant on readers' wishes is contained in a letter from Carl L. Streich, R. F. D., Miamisburg, Ohio, who says: "I have been a reader of your magazine for several years and I notice you want comments on what interests us radio fans. I live on a farm and read all the radio magazines. I like things like the Browning-Drake layout and the articles about McNamee and the prize fight (Dorothy B. Stafford). I like these articles in preference to the pictures. I pass my magazines around after I read them and everybody likes Radio Age." Thanks, Mr. Streich; we are recording all opinions so we can determine the very best possible content of each issue. Who will be next to state their preferences?

PETER FARMER, Blairmore, Alberta, Canada, tells us he finds a balancing condenser from the filament to the plate of his r. f. set (the Haynes r. f. set) helps him control volume. The placing of the condenser in this position, from plate to filament, acts as a regenerative condenser in part, both on the r. f. tube and the detector tube. However, it will only increase oscillation but will not reduce it unless the condenser is removed.

A. G. BRUBAKER, Denver, Pa., tells us he prefers the broadcast list which we publish each month but would like to have us add a column giving the wattage of the various transmitters. At the present we cannot do this on account of the chaotic condition of the broadcast game, but later on when matters begin functioning in an orderly manner it might be possible to include that data.

A NOther fan would like data on short wave receivers; also a list of the few stations that broadcast on short waves. Information is also wanted by John F. Illick, 1336 Lehigh St., Easton, Pa., on the construction, use and abuse of the choke coil; likewise the fixed condenser, blocking, bypassing, etc. Our correspondent is also a regular reader of this magazine, having a complete file from May, 1924, up to the present date.

Herald Lawrence, Box 186, Parry Sound, Ont., Canada, using a four tube Regenoflex tuned in 206 stations to say nothing of 16 short wave amateur sets on phone work in an incredibly short time. His DX list was so good he is being awarded one of the D. T. buttons.
FOR the past few weeks the high-
powered transmitter of WGY, at
Schenectady, N. Y., has been using a
100 kilowatt vacuum power tube. This
marks the first practical use of a
tube of this size by any broadcasting
station. The tube, which takes the
place of eight 20 kilowatt tubes
in WGY's transmitter, is a develop-
ment of the General Electric Com-
pany and engineers are now securing
data on its performance. With its
water jacket the tube stands seven
and one-half feet high and weighs
100 pounds, or one pound per kilowatt.
With such a tube available
radio engineers of the General Elec-
tric Company will be able to carry on
their investigations in broadcasting
on higher powers than have hereto-
fore been possible. Up to the present
time 50 kilowatts in the antenna has
been known as "super-power," but
with tubes of an output of 100 kilo-
watts at hand investigations will be
possibly up to 500 kilowatts or even
more.

DO NOT be too greatly impressed
with press reports heralding the
arrival of an A. C. tube which elimi-
nates the use of all batteries, for such
is not the case. Any A. C. tube so far
developed (and there have been sev-
eral) is called an A. C. tube because
its filament is either directly heated by
alternating current from the socket,
or a special heater coil (run by alter-
nating current) is used which trans-
fers heat by conduction to a regular
filament for electronic emission.
Regardless of the method used for the
operation of the tube's filament, there
still remains the necessity for the
plate potential which is furnished
either by batteries or by an elimina-
tor. So do not worry about your present
tubes becoming obsolete over night.

ANOTHER reader comes forward
with a letter of appreciation
for the 4 tube Counterphase re-
ceiver which we published in the Janu-
ary, 1926, issue of this magazine.
A. DesRosiers, 256 Bridge Ave.,
Windsor, Ont., Canada, built the set
and gets fine DX with it as well as
excellent quality. That particular re-
ceiver was very popular with our
readers as is indicated by the number of
letters on that subject.

DURING the summer months will
be a good time for those de-
sirous of entering the amateur game
to get their start. Especially when
a 201-A and a B eliminator will do
for a short wave set there is no ex-
cuse for not getting into the trans-
mittting game. Those interested
should consult an article on page 17,
May, 1926, Radio Age, giving data
on application for transmitting li-
censes. In our next issue we will
have a short wave transmitter and
receiver shown in the blueprint sec-
tion; it will be a simple and inexpen-
sive crystal control outfit. Watch for
it.

STATION WLY, at Cincinnati,
now is on the air regularly with
broadcasts on a 52.02 meter wave
length in addition to its standard
wave length of 422.3 meters. Both
programs are broadcast simulta-
ously.

These short wave broadcasts were
instituted by Powel Crosley, Jr., as
an experiment in the development of
the high frequency channels.

These tests have revealed a num-
er of interesting things. For ex-
ample, the short wave broadcasts are
heard with ease in distant countries
but it is quite a trick to pick them
up near Cincinnati, in the neigh-
borhood of the transmitter.

This is due to the "skip distance"
characteristic of short waves. In the
case of WLW, it is approximately
70 miles. It can be overcome by an
increase in power, which strengthens
the ground wave and overlaps with
the sky wave.
HAVING covered practically all of the combinations of the Worlds Record superheterodyne using eight tubes, in this article we will concern ourselves with the nine tube model which we are content to call the best arrangement yet constructed both for simplicity of operation, long distance ability and quality output. These three essentials have been approximated in the previous models but in the one to be described they have been completely fulfilled.

Those interested in the super question should refer to the November, 1925, January, 1927, and March, 1927, issues of this magazine for the ground work on the Worlds Record series. In this issue is the culminating achievement, together with an excellent trouble-shooting article which appears in the fore part of this magazine.

On account of the lack of space we will not be able to devote a great deal of text to the description of the set but would instead refer the reader to the previous issues mentioned above. Therefore in this article we will confine ourselves to the enumeration of the features which this receiver possesses as contrasted to the previous models.

Primarily it was our intent to work out a super design in which there would be sufficient intermediate amplification to bring the signal level up to a point where it would cover both the winter and summer season. Ordinarily the 8 tube model would handle the good reception season in a fine manner, but when the signal level begins to fall there would be a drop in the reception value. To counteract this condition we decided upon the addition of the ninth tube, this being the insertion of an additional iron core intermediate stage. The presence of this extra intermediate permits a higher amplification of the desired signal without the necessity of forcing the long wave stages to a state bordering on the regenerative. In practice the added intermediate stage brought in same stations as eight tube model but accomplished this feat without strain or distortion which might creep in on a smaller model when long wave stages are forced.

Another feature of this model is the economy of controls. Where in other models there were numerous controls, in this nine tube job we reduced controls to one. The two condensers, one for the loop and one for the oscillator, are the major controls, while the rheostat governing the filament of the second and fourth tubes, acts both as a volume and sensitivity control. The X-L balancing condenser is located on the subpanel where it is removed from the temptation of the owner to be constantly changing it. Another feature which has been incorporated is the fact that with the voltages as given it will not be possible for the operator to make the intermediate stages squeal. The inclusion of these features is a direct result of the many letters received by the staff in which readers wished to have a further simplified super. The log shown on these pages will give an idea as to the selectivity of the set—ten kilocycle reception every night.

Blueprint figure one shows the top view of the subpanel. On page 24 will be found the drilling template for the subpanel. Blueprint figure two shows the bottom view of the same receiver. Blueprint figure three shows the pictorial representation of the complete A, B and C elimination sys-

The following parts were used in the Radio Age Worlds Record Super Nine model. Other parts of equal merit may be used if desired.

Receiver
1 Panel 7x26x3/16
1 Subpanel 7x25x3/16
1 Pair Benjamin adjustable brackets
9 Benjamin UX cushion sockets
3 Selectone R400 long wave transformers
2 Selectone R410 long wave transformers
1 Silver-Marshall 515 coil socket
1 Silver-Marshall 11-A plug-in coil
1 Silver-Marshall 275 RF choke
2 Thordarson R200 audio transformers
1 Frost 20 ohm bakelite rheostat
1 Frost 2½ ohm bakelite rheostat
1 X-L type N variodenser
2 Remler .0005 mfd condensers
2 Karas micrometric dials for same
1 Jones base mounting plug
5 Carter tip jacks
1 Carter imp pilot switch
1 Sangamo 1 mfd condenser
1 Sangamo .002 mfd condenser
1 Bodine loop
1 Eveready 7½ volt C battery
1 112 Amperite
1 Thordarson 210 power compact
1 Potter condenser block for same
1 Set Carter resistance strips for same
2 Frost sockets
5 X-L pushpulls
1 Balkite type AJ rectifier
1 Abox filter

Front view of the latest model super

Photographic view of the 210 power compact

Using 9 Tubes on Worlds Record Super

By F. A. HILL
Associate Editor
FIG. 2
BOTTOM VIEW RADIO AGE
WORLDS RECORD SUPER 9 MODEL
tem used with the nine tube model. Blueprint figure four shows the schematic diagram of the set by means of which it should be wired.

Reference to the schematic will disclose no great change over previous models other than simplification of control and economy of parts. The loop circuit is the conventional center tapped loop with a .0005 mfd Remler across the extremities of the loop. The X-L type N variodenser is used for making the loop semi-regenerative. For detection in the first detector the center tap in series with the pickup coil goes to the 4½ volt negative C battery terminal from where the second detector is also biased for detection. This value may also be used for the grid of the first audio. The bias on the intermediate stages is shown as 3 volts although in practice (and with 45 volts on the intermediate plates) it was found either that a zero bias or a 1½ volt bias was preferable. The bias for the grid of the last tube should be about 27 volts for a 171, or if the power compact scheme is used the power compact furnishes its own bias for the 210 power tube.

To prevent the intermediate stages from being thrown into oscillation the resistance R1 is a 20 ohm rheostat in series with R2 which is a half ampere Amperite. Resistance R3 is a 2½ ohm rheostat for master control of all the tubes except the second and fourth which are on R1. This system of rheostat control is necessary to insure five volts on the tubes, especially when using the A elimination system outlined in the third blueprint figure.

For convenience in knowing both your voltage and the current draw we recommend two meters, one a zero to eight volt dc voltmeter (Jewel) and the other a zero to fifty milliampere meter of the same make. The first one will give you voltage readings on the tubes while the second will permit your knowing the current drawn by each section of the receiver. The positions shown by a bent line and the letter J are jacks for plugging in the milliammeter. This will enable you to tell at a glance whether the different sections of the receiver are working properly.

It will be noted that two iron core stages are first used followed by an air core, then another iron core and finally the last air core. By using the filament control on the first iron and first air (the second and fourth tube) perfect stabilization of the long wave stages is possible. This is due to the use of 45 volts on all intermediate stages, and likewise simplifies the wiring. By the manner of placing the intermediate transformers under the subpanel with the grid and plate binding posts forming the connecting link between grid and plate terminals on the sockets there results a great saving in the number of leads that have to be run. It also simplifies the assembly of the units since the intermediate space the sockets exactly. The template for the subpanel is
shown in this article and dimensions are given for all necessary holes.

Only two bypass condensers are used, the first across the 45 volt line and the second across the C battery terminals. The .002 mfd bypass condenser is used across the rf choke coil used in series with the primary of the first Thordarson audio transformer. On account of using the series feed in the Silver-Marshall plug-in oscillator, no bypasses are required in that position. Also the grid to filament method of tuning is used on the oscillator instead of the grid to plate as is customary in the other models. The oscillator should be hooked up in conformity with the numbers shown in the schematic.

Using the Thordarson power compact (210 type) the connections are the same as those shown in the blueprint section of the April issue but without the voltage regulator tube, and using the Carter strip resistances instead of previous types. This particular compact will take care of all normal sets including the nine tube job. For those who wish a larger power plant we expect to have the 210 job in full wave form in a forthcoming issue.

Taking up the consideration of the log on the set we observe that ten kilocycle separation is secured on all portions of the wave band. The figures shown for the loop and the oscillator where a figure is repeated should be read as minus that figure and plus that figure. This was done to cut out fractional representation of dial settings. For example WGN shows at 35 on the loop and 26 on the oscillator. KOIL shows the same figures. Hence WGN would in practice be 35, while KOIL would be 35 plus. The same would hold true on all settings where values are repeated—otherwise with the Karas micrometric dials the columns would show a large number of quarter, half and three-quarter degree settings.

A great deal of credit for the performance of the set is due the designers of the long wave transformers, these units being so carefully matched and peaked at such a good frequency value that none of the usual trouble is encountered in undesired repeat points. The amplification of these transformers is at a value consistent with common sense. In other words all of the grief has been removed before the set builder starts to work; all he has to do is follow instructions faithfully and a corking good super will result. Frankly in reviewing our work on this series we find the present 9 tube model the best performer we have had in the laboratory, having been continuously operated both under good and bad conditions. In each and every case the 9 tube delivered the goods. Tried side by side with the 8 tube set the new one delivered more volume on KFI with less side noise; it tuned easier and altogether presents a much more attractive and efficient appearance than its predecessor. We do not know of any stronger recommendation for the design than the foregoing.

In operation of the set from the alternating current lines we found no difficulty. The rectifier used (Balkite) is a special unit made for use with the Abox filter. Its output is about three amperes. After passing through the filter there is sufficient filament current to operate up to eleven tubes, although this set only used nine. The power compact is arranged for plugging into the last socket and thereby taking the set output and running it through the 210 power tube. The variable resistances (Carter) permit the desired voltages being set for each individual receiver used. In this case the 45 volt tap was used for all stages except the second audio, while the 90 volt tap was used for the second audio; the plug-in arrangement of the power compact placed 400 volts on the 210 power tube. A tap was also made for the 22 volt section if desired. Part of the resistance strip containing 1000 ohms was used to secure the drop for the grid of the 210 tube.

To further reduce oscillator harmonics readers might try a 75,000 or 100,000 ohm resistance in series with the 45 volt line and the plate of the oscillator. In many instances too much oscillator energy is created at 45 volts, and the added resistance will serve to cut down the oscillator volume thus eliminating a number of harmonics. This scheme also reduces to a minimum amateur code interference where the short wave fundamentals beat with the oscillator harmonics.
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TYPE R.400. Has specially designed iron core which limits stray fields and makes it possible to place transformers quite close together without danger of coupling or causing instability. Coils before sealing in case are vacuum impregnated so that all characteristics of coil remain constant. Price $6.00.

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TYPE R.410. A sharply peaked filter transformer that insures remarkable selectivity. The condenser used to tune the primary is sealed inside the case with the coils. This makes it possible to supply a filter that we KNOW is exactly tuned to the peak frequency. Price $6.00.

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Name
Street
City
State
HAVE you ever studied a soap bubble? Perhaps when you were a child you were fond of playing with a dish of suds and a clay pipe, but the bubble is more than a toy, for grown-up scientists at the U. S. Bureau of Standards in Washington have been studying them, even to the point of shooting bullets through them, and photographing them as they break.

The photographing has been done by Dr. Philip P. Quayle, and uses light furnished by an electric spark, so that the bullet and half broken bubble are photographed as clearly as if they were at rest. And from these photographs it has been found that the bubble is not the simple thing that we used to imagine it, but some very complicated processes go on within its walls. Some of these are of considerable practical use, as in the mining industry, where they are used to separate precious metals from the ore.

Dr. Quayle’s work has been in the sound laboratory of the Bureau, which is under the direction of Dr. Paul R. Heyl, whose studies along a different line in a subterranean vault under one of the Bureau’s buildings have given a more accurate value of the mass of the earth.

“When a bubble once gives way its complete disappearance is so rapid as to lead to the common impression that it is instantaneous,” said Dr. Heyl. “The very rapid spark photographs taken of a breaking bubble by Dr. Quayle shows that the bursting of a bubble is a progressive process, though a very rapid one. Photographs have been obtained of a bubble which has had a bullet fired through it. For a few millionths of a second (long enough to be photographed) the bubble stands as if in amazement with a hole in each side. The holes rapidly increase in size, the water film spraying off at the edges into fine drops, until in a thousandth of a second or so the bubble is gone.

“One of the first things to catch the attention when a bubble has been successfully blown is the shimmering play of colors reflected from its surface. These colors, we notice, are formed somehow in the act of reflection of the colorless light of day from the surface of the bubble. It is possible, with a little practice, to detach the bubble from the pipe by which it was blown, and to catch it upon a piece of cloth, where it may remain for some time. If we closely examine the distribution of colors on such a quiet bubble we may be fortunate enough to see colored bands moving downward from the top of the bubble to the bottom. The north pole of the bubble seems to be the storehouse whence the bubble draws these colors in succession. And if we are excep-
tionally lucky we may see at the north pole, just before the bubble breaks, a black spot. It is as if the store of colors had been exhausted.

“It may be perhaps a new idea that anything can be so thin that it cannot reflect light; but the study of thin films such as found in bubbles teaches us that light is not reflected strictly from the surface of bodies, but that it must penetrate a very little way into the substance of the body itself before it can be turned and sent back. Like a motor car, the beam of light requires a little room in which to turn. And if this necessary turning space is not to be found, the light will not be able to turn at all, but will pass through the film and out at the other side.

“This is true in the case of bodies ordinarily considered to be opaque, such as polished surfaces of metal. But even metals are transparent in thin enough layers, as is evidenced by ordinary gold leaf.

“In penetrating the reflecting surface to this minute depth certain qualities characteristic of the reflecting material are impressed upon the light, so that by examining the reflected beam, even many miles away from the reflecting body, we can tell something about the material of the reflector. In fact certain scientists have attempted to gain by this means some idea of the different materials composing the surface of the moon. The moon shines by reflected sunlight, and the idea is that the light reflected from different areas of the moon’s surface may, by its characteristically altered quality, betray the nature of the material which has reflected it.

“How thin is this black spot in a bubble, and what sets a limit to it? Why cannot a bubble thin out indefinitely? These questions lead to one of the most interesting things which a bubble can teach us. Water is made up of molecules, particles so inconceivably small that a soap bubble when freshly formed may be many molecules thick. But as the film thins out it is gradually reduced to a thickness of but a few molecules; and obviously this process cannot go on forever. The film cannot be less than one molecule thick. Any further thinning out is bound to break it.

“Every liquid acts as though it were encased in a stretched elastic skin. Liquids in quantities such as are ordinarily handled do not show this property because so much of them is inside and so little on the outside, and the surface properties are masked by the properties characteristic of the inside. But a soap film is nearly all surface, and very little inside, and the contractile property of the surface becomes evident. This contractile property (surface tension is its scientific name) is responsible for a great many happenings in nature. It is the cause of the globular shape of a dew drop, of a rain drop, of water sprinkled on a dusty floor; it causes the ascent of oil in a lamp wick and is responsible for the absorbent property of a towel or of blotting paper. It governs the curious changes of shape in that wonderful little speck of protoplasm called the amoeba, and it is suspected of having much to do with the contraction of a muscle.”

But bubbles are useful in everyday life. “They play an important part in modern mining industry,” said Dr. Heyl. “Often the valuable mineral is mixed with much rock from which it must be separated. Various methods of concentration are employed to effect this purpose. One which has been developed in comparatively recent years makes use of bubbles to this end. The mineral bearing rock is crushed to a powder and stirred up in water to which a very small amount of a special oil is added. The agitation of this mixture produces a froth of bubbles which rises to the surface, each of these little bubbles bearing attached to itself a particle of mineral, while the worthless rock is left at the bottom of the liquid. This froth is skimmed off, and a valuable concentrate obtained from it. This process is called flotation, and is one of the most important of modern developments in the art of mining.

“And the moral of all this is, as the Duchess might have remarked to Alice, that there is nothing in Nature so simple and commonplace as to be unworthy of our serious attention.”

Grid Control Tube Is a New Marvel

A DEVICE more sensitive than anything yet developed in electrical research, a grid tube that operates on an infinitesimal fraction of energy—approximately one-billionth of an ampere—was recently demonstrated.

Termed the "grid controlled glow discharge tube" the device, perfected by D. D. Knowles, shown above, a young scientist in the research laboratories of the Westinghouse Company, is so sensitive that a human hand placed near a grid plate is sufficient to operate it. This act causes the tube to glow and discharge energy efficient to actuate a relay.

Analyzed briefly the apparatus consists of three electrodes—a negative electrode and a positive electrode, the latter being surrounded by a grid, which constitutes the third electrode. Differing from the ordinary vacuum tube, this glow tube has no heated filament and therefore does not consume any energy when not operated. If a voltage is applied between the positive and negative electrodes particles of electricity called "free electrons" attach themselves to the grid. When this grid is thoroughly insulated these minute charges of electricity cannot escape, thus preventing the tube from passing any current.

When a spectator's hand nears the plate a means is thereby provided for removing the small charges of electricity. The result is that the tube immediately passes a current large enough to operate commercial relays.
Some Light On Radio Transmission

InVESTIGATIONS conducted by Dr. Breit and Dr. Tuve, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, during 1926, throw much light on the peculiarities of radio transmission. For nearly a quarter of a century it has been supposed that there is a layer in the upper air that is a good conductor of magnetic energy. It is believed that the layer contains free ions and electrons which may have emanated from the sun, and that it is the presence of these that makes it a good conductor. Dr. Breit and Dr. Tuve have not only experimentally demonstrated that such a layer exists, but they have measured its effective height above the earth and learned somewhat of how it affects transmission. Other investigators also have obtained good evidence of the existence of the layer, for example, Messrs. Taylor and Hulbert, in the United States, and Messrs. Smith-Rose and Barfield, in England.

The Assumptions

It has been suggested that if there were such a layer, the upper portions of a given radio wave would move through the earth’s atmosphere at a greater velocity than the lower portions of the same wave where conductivity is not so good. In consequence, it was thought, the top of the wave front would be accelerated beyond that of the lower part, causing the wave to bend forward, ultimately bringing it to the earth. Ocean waves toppling over forward as they approach the beach crudely illustrate what was thought to be one effect of this conducting layer in the upper air. According to theory, the layer acted as a “ceiling” bending or reflecting radio waves back to earth.

The investigators reasoned that if this theory were correct, then a receiver at a given point on the earth’s surface would record at least two pulses for every pulse at the sending station. One of these would reach it by a direct horizontal path through the air; the other would travel by way of the “ceiling,” reaching the receiving station as an “echo” or “reflection.” They reasoned further that if this were the case then the reflected wave, since it traversed a greater distance, would reach the receiver a little later than the direct wave, and that this difference in time might be measured.

The Experiment

To test these assumptions the investigators set up a receiving station, R, 8 miles from the transmitting station, T. Interrupted trains of waves were sent from T, each train having a duration of about 1/1000 of a second. At the receiving end the signals were detected, amplified and recorded by photographing the tracings made by an oscillating marker.

The photographic records showed conclusively that under certain circumstances each signal was registered twice, and that, in accordance with the assumption, there was an appreciable interval of time between them. In this manner, through a series of experiments extending over many months, a technique was developed which enabled the investigators to demonstrate experimentally that a transmitted signal, depending upon conditions, reached the receiving station by two paths: the direct path, TR, and the path by way of the “ceiling,” TLR. Furthermore, knowing the distance between stations and knowing the retardation of the reflection and the speed of radio waves, the height of the layer was readily computed and found to be...
about 100 miles, though it appeared to rise and fall during the period observed within a range of from 50 to 130 miles.

Although these experiments do not tell whether radiowaves are actually reflected or refracted by the layer, they do explain some of the peculiarities of transmission.

"Fading," for example, one of the chief woes of the radio fan, is seen to be due not alone to interference between ground and reflected waves but to changes in the height of the layer and in its effectiveness as a reflecting surface. The measurements obtained by the investigators showed that these changes are often very sudden. They also indicated that variations may take place with the season and with the time of day, the layer probably being at a greater height in fall than in summer and in the afternoon than in the morning.

Again, the character of the reflecting or refracting surface would naturally affect the quality of the reflected waves. A bumpy or corrugated surface would tend to produce "multiple reflections," causing interference, confusion and even "fading" where waves happen to neutralize one another.

For a long time scientists have been trying to learn what the forces are which surround the earth, circulate within its interior, and penetrate its atmosphere. Gradually progress is being made. It is now clear, for example, that the earth itself is surrounded by a magnetic field. It has also been shown that the sun has a magnetic field similar to that of the earth. It is probable that all celestial bodies are surrounded by such fields. Indeed, it has been suggested that every large rotating mass, such as the earth, in a manner not yet determined, is an electro-magnet causing magnetic force. Verification of the existence of a conducting layer in the upper air is another notable step forward in man's effort to understand and master the Titanic forces which surround him.

The existence of this layer has additional significance in the possibility that its movements in the earth's magnetic field may induce electric currents which, in turn, may have far-reaching effects. Again, the motion of the layer as a whole may affect the condition of the lower atmosphere producing important changes in electric pressure. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington, among other research agencies, is vigorously attacking these problems in its laboratories at Washington.

The experiments described herein were made with the cooperation of the Naval Research Laboratory, the Radio Corporation of America, the American Telephone and Telegraph Company, the Westinghouse Electric and Manufacturing Company, and the Bureau of Standards. The possibilities of the importance of the ionization of the upper atmosphere were pointed out first by Professor A. E. Kennelly, of the United States, and later among others, by Oliver Heaviside, of England.

Freezing Helium Gas

A DUTCH scientist has announced to the scientific world that he had at last succeeded in freezing the gas, helium, in the form of a transparent mass. At a temperature of 7 degrees F. above absolute zero (452 degrees below zero F.), and a pressure of about 150 atmospheres, or 2175 pounds per square inch, liquid helium solidifies. And at a temperature of about 2 degrees above absolute zero, a pressure of only 400 pounds per square inch sufficed. In all probability, helium would solidify at ordinary atmospheric pressure, about 14.7 pounds per square inch, at a still lower temperature. However, the temperatures attained in the above experiments were the lowest ever reached. Absolute zero has never been attained. There is good reason to assume that at that point the molecules of a gas would have no motion, and, hence, it is the coldest that it is possible for any substance to reach.—Peter J. M. Clute.
Earth’s Axis Wabbles 20 Feet Per Year

By S. R. WINTERS

The earth’s axis may shift or wabble from its mean position as much as a total of 30 feet during the course of a year, the Naval Observatory states as the result of observations of the variations in latitude, which studies have been in progress for eleven years. The shifting of the pole in the earth from its mean position, however, has averaged about 20 feet each year during the last ten years, with the greatest variation in latitude occurring in 1915.

A vertical photographic zenith tube, the only instrument of its kind in the world, is employed in determining the variations in latitude. These observations are made each cloudless night of the year, when the stars are exposed to view, this work being under the direct supervision of Capt. F. B. Litell, Mathematics, U. S. Navy. The observing instrument is housed in a small building on the grounds of the Naval Observatory, at 34th and Massachusetts Avenue, Northwest, Washington, D. C. This institution, where the time signals originate, is under the direction of Captain Edwin T. Pollock, U. S. Navy.

The variation of latitude observations are published annually in The Astronomical Journal, the compilation comprising about sixteen pages, in which is detailed the date of each observing night, the name of the observer, the number of stars observed, and the variations in latitude as noted by means of the observing instrument—the photographic zenith tube, which was designed by Dr. Frank E. Ross, a noted astronomer. These tables showing the variations of latitude for the last eleven years is the corroboration of a new theory, it is said. This theory, advanced by Captain E. J. J. See, an astronomer of the Navy at Mare Island, attributes the shifting or wobbling of the earth’s axis from its mean position to tidal waves in the Pacific, Atlantic and Indian Oceans. The Naval Observatory tables, together with similar results obtained at other astronomical observatories, furnish corroboration of his theory which is said to explain the origin of the displacements which cause them.

This novel theory, is supported by new proof, according to this naval astronomer, that the tides originating in the Pacific Ocean, and propagated as a world wave through the Indian and Atlantic Oceans, are the cause of the variation of the latitude with the observed circulation of the earth’s pole about its mean position in 427 days. The Naval Observatory, it is pointed out, is not the father of this theory but its variation of latitude observations were used by Professor See, in his astronomy studies at Mare Island, for promulgating this new conception of the wobble of the earth’s position. The shifting of the pole in the earth was originally discovered, it is stated, in 1890 at the Bonn Observatory of Germany, but during the intervening 36 years no scientist produced proof as to the cause of this wobbling.

Now, according to Professor See, his studies have traced the motion of the earth’s axis to the tides originating in the ocean hemisphere with the pole at New Zealand—the tidal relief being through the passage south of Australia. This mystery, according to this Government astronomer at Mare Island, has challenged the scientists of the world for more than a third of a century. Furthermore, he contends, that his new theory gives plausible reasons for believing that the rigidity of the nucleus or center of the earth is three times as great as formerly thought. Its rigidity, he states, is twice that of the hardest nickel-vanadium steel used in the armor plate of a battleship. The text of Professor See’s statement follows:

“It has not heretofore been given out that I found that the careful height of the tides, treated as world waves in motion, actually is over twice the average height calculated by the equilibrium theory of Newton. This great advance discloses to us a new law of nature, not heretofore even suspected to exist. Thus the new mathematical theory will mark a notable improvement in all directions, and clear up completely one of the most difficult of all the branches of physical science.

“One of the greatest improvements relates to the new method for calculating the rigidity of the earth, which at once supersedes the methods of Lord Kelvin, Sir George Darwin and S. S. Hough. Instead of the nucleus of our globe having a rigidity equal to that of standard steel, we find by definite and very exact calculation that the rigidity is three times that heretofore accepted. By carefully separating the yielding due to the tidal oscillations of the oceans from that of the nucleus of the earth, if any, we prove that the nucleus shows no yielding whatever so that its rigidity comes out twice that of the hardest nickel-vanadium steel used in armor plate.

“As the earth is now known to have existed in quiescent equilibrium for billions of years, with the internal particles everywhere adjusting themselves mutually under the enormous pressure acting on all sides, this great rigidity of the nucleus will not surprise the experienced natural philosopher, but it will forever put a stop to any further discussion of liquid in the interior of the globe. It is not only solid throughout, but twice as rigid as armor plate.”
See Hoover at End of Telephone Line

ACTUAL television, several times attended with indifferent success, has become an established fact with the recent test between New York and Washington which enabled Bell Telephone engineers and executives to talk to and see Herbert Hoover, who was seated before one of the experimental television machines in Washington. The image cast, while not perfect in all respects, was clear enough to easily distinguish features. The apparatus is shown in the accompanying picture.

This feat, coupled with the recent inauguration of the trans-Atlantic telephony system via radio, and the April 18 experiments at Whippety, N. J., when station 3XN, operating on 191 meters, transmitted voice and images over a single carrier, brings television to its highest form. The band of 20,000 cycles was used for the transmission of the image and a 5,000 cycle band for the speech.

Heretofore the chief obstacle in television has been the thought that perhaps it would not be possible to duplicate wire channel conditions over an ether wave, but the Bell Telephone experiments at Station 3XN seem to settle that question favorably. With the image and speech bands combined in a single carrier via radio the last barrier to the complete usefulness of television has been swept away.

Waste of Energy Reduced in New Power Plant

A REMARKABLE engineering accomplishment has been announced by the Columbia Gas and Electric Corporation of Cincinnati. Electric power from the new power station of that city has been produced so efficiently that one kilowatt-hour of electric power is made, on the average, from a single pound of coal. Among the greatest wastes in the industrial world is the waste of the energy of coal in the course of transforming it into electricity or other useful forms. According to physical theory one pound of average coal contains enough energy to produce about four kilowatt-hours of electric power, which is enough to operate an ordinary electric lamp three hours each evening for about three weeks. Unfortunately, however, the best combinations of steam boilers and engines and electric dynamos which the world’s engineers have been able to devise cannot save much more than one-fifth of this energy which theory indicates that the coal possesses. The remaining four-fifths goes off up the chimney as smoke or is wasted in other ways. Ordinary steam engines and small electric power plants do not save even as much as one-fifth of the coal’s energy. A saving of one-eighth to one-tenth is much more common. The new Cincinnati plant, by its record of one pound of coal for one kilowatt-hour of power, shows itself to be saving about one-fourth of the theoretical energy of the coal.

Anger and Fear Make Blood Sweeter

THAT anger makes the human body sweet, not sour, is the conclusion of recent experiments by a German physician, Dr. W. M. Hackebusch. A very minute amount of the kind of sugar called grape sugar is usually present in human blood. Slight variations of the amount of sugar from time to time are now used by physicians as an aid in the diagnosis of disease. Dr. Hackebusch aroused various emotions, such as anger or fear, in the human subjects of his experiments. He then drew off a small sample of the blood for a sugar test. In all instances the amount of sugar was found to be noticeably greater during and after a fit of emotion than it had been beforehand. This fact supplies additional confirmation of the theory, now widely held by students of the human body, that such emotions as fear or anger are intended by Nature to prepare the body for either combat or flight. Sugar in the blood is known to provide a quick food for the muscles. The higher percentage of blood sugar during anger thus provides the muscles with more food in case it becomes desirable to fight or to run away.

“Spring Fever” Blamed on Lack of Vitamines

THAT minor diseases, like colds and mild fevers and rheumatic twinges, are much more frequent during the winter months than in summer is well known to all dwellers in the cooler parts of the earth. That this fact may be explainable by an absence of vitamines in winter foods was suggested to the British Science Master’s Association recently by Dr. R. A. Peters. Vitamines are the mysterious substances which are present in green vegetables, fresh milk and, some other fresh foods and which are known to be important to health, although none of them has been isolated, as yet, by the chemists. Some of these vitamines, notably the one present in cod liver oil, are now believed to be related to sunlight. There is apt to be a deficiency of vitamines during the winter, Dr. Peters told the Science Masters, both because there is less sunlight then and because fresh foods and green vegetables are then more difficult to obtain. This lack of vitamines may react on the general health, he thinks; producing the general debility which used to be called “Spring fever” because it began to be noticeable when the long winter was closing. In that weakened condition the body is more easily attacked by disease germs and by minor ailments of any kind.
K. Y. W. Adds Features

The Congress Carnival from KYW has recently taken on a new character, for the entire hour and a half is now presented as a production with new features each Saturday. John Clark, the chief announcer, in collaboration with Wilson Wetherbee, and Ed Barroff, writes a series of swiftly changing scenes with musical backgrounds, and highlights—and calling for many entertainers. The popular melodies are featured, together with a few classics by way of musical contrast, and this type of program is proving its worth. According to the KYW announcer, it takes a "little of this, and a little of that," and a high speed program to keep the dials from turning.

For the benefit of readers located in isolated sections who desire to build the

Worlds Record Super Nine

the Set Builders' Quick Shopper section of this magazine is in position to ship at once parts specified in the list below. This is not a local service and is intended only for those who cannot secure these parts in their own town. Goods are shipped same day order is received. Be sure to send exact list price shown in the list:

**RECEIVER**

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**RADIO AGE**

Set Builders' Quick Shopper

500 N. Dearborn St.,
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Best Hookups—Thirty Cents Each!

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed the best hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

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- Improving the Browning-Drake.
- Footballless Tubes in a Set.
- Which Type Intermediate?
- How to Make a Wavemeter—Blueprint.

May, 1926
- Short Wave Transmitter—Blueprint.
- Simplifying Battery Charging.
- List of European Broadcasters.
- Protecting your Inventions.

June, 1926
- Antenna Design.
- Simple Crystal Set.
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- Beginners 200 mile Crystal Set.
- History of Amateurs.
- Changing to Single Control.

September, 1926
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- Crystal Control Low Power Transmitter—Blueprint
- Raytheon Design for A B C Elimination
- What Type Loud Speaker to Use
- Nine Tube Super Brings Back Faith

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- World’s Record Super With Large Tubes.
- How to Use a Power Tube in Your Set.
- Illuminated Controls on 4 Tube Receiver.

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- Six Tube Shielded Receiver.
- Types of Rectifiers Discussed.

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- Dual TC Receiver.
- Clough Super Design.

February, 1927
- Building the Hammerlund-Roberts.
- Making a 36 Inch Cone Speaker.
- Data on the B-T Power Six.
- Browning Drake Power Operated.

March, 1927
- Ideal Model Worlds Record Super.
- Rousing the Hammerlund-Roberts.
- Ridding Supers of Repeat Points.
- Loop and Four Tubes.

April, 1927
- Ideal Model Worlds Record
- Inexpensive B. Eliminator
- Single Control Victorion
- One Spot Superhet.

New Microammeter For Testing Lamps

A new instrument that indicates a change in current as small as a tenth of a thousandth of a millio nth part of an ampere has been developed in the standardizing laboratory of the West Lynn works of the General Electric Company as a part of the equipment which replaces the human eye in making tests on incandescent lamps, currents in insulators, radio tubes, etc. The instrument, known as a thermonic microammeter, has a full-scale reading of a tenth of a millionth of an ampere, with subdivisions of one five-hundredth of this amount. It is the most sensitive instrument of such a long scale length working on jewel bearings that has ever been built.

The lamp divisions of the General Electric Company at Harrison, N. J., and Cleveland have combined this microammeter with the photoelectric cell in the development of photometric apparatus which is far more susceptible to variations in intensity of light than is the human eye.

A Quartz Crystal Motor Runs by Radio

A new variety of electric motor, of great scientific interest although not apt to prove revolutionary in practical power production, was described to the Institute of Radio Engineers recently in a paper by the distinguished German radio engineer, Dr. A. Meissner, of the Telefunken Company, in Berlin. The rotating part of the new motor is a small plate cut from a crystal of quartz, ordinarily called rock-crystal. When placed in a radio circuit, in which electric currents are surging back and forth many thousands of times a second, this small quartz plate is set into rapid rotation. Unless it is held in place by some kind of fixed axis, like the shaft of a flywheel, the crystal will jump entirely out of its socket. The effect is explained by Dr. Meissner as due to winds of air created by the vibration of the crystal. It is well known to radio engineers that small quartz plates like this are set into mechanical vibration when placed in radio circuits.
Expensive cars sometimes come equipped with snubbers which prevent the body of the car from bouncing too high. But the light, cheap car seldom knows them.

Tom Chase, who lives in the Rio Grande Valley of Texas decided that he could prevent excessive bouncing over the country roads in his Ford by putting homemade snubbers on the front end of the car. He found a piece of old thresher belt in the farm shop and split two strips from it, each two inches wide. The belt was 5 ply and good and stiff. Each strip was long enough to run over the front end of the frame and under the front axle, with one inch to spare and allowance for a five inch splice. Ordinary harness rivets were used to hold the ends together.

In two years of service, these snubbers have not given away and they do pay. They not only prevent broken front springs (before the snubbers were installed, three front springs were broken in 6 months) but they save wear and tear on the car and kill a lot of unwelcome jolting.

Self Starter for Planes

An airplane engine equipped with a self-starter is the newest aid to the aviator. The apparatus, which was invented by C. F. Heywood, of Detroit, Mich., weighs less than twenty pounds and will enable the pilot to take off with the least possible delay and without necessitating an assistant to turn the prop. The engine is turned into firing position by compressed air and forces a properly carbureted mixture of gas into the cylinder. Mr. Heywood, the inventor, is shown demonstrating the device.

200-Pound Electric Roadster

A light electric roadster, weighing 200 pounds and measuring 62 inches from hub to hub, is being exhibited at the New York Edison Company’s show. The machine is designed for short trips about town and is equipped with wire wheels, balloon tires and is extremely easy to operate. A motor drives the rear wheels by a gear train and a storage battery supplies the power for a thirty mile run without recharging.

Stopping Charger Vibration

Battery chargers are often quite a nuisance because of the vibration from them being transmitted through the floor and walls of the house. By using the little scheme outlined above, you can take advantage of the very convenient "over night" charge, and be in no danger of disturbing anyone’s slumber.

This neat and tidy structure repose beside the kitchen door of a home in Texas. It was built at the same time as the house and is integral with house and stoop. The walk extends around to the right hand end of this structure and a door at this end opens upon a compartment two feet wide, four feet high and four feet long. It is ideal for keeping not only over shoes, rubbers and boots from weather, but also provides storage for small tools.

Care should be taken to concrete the floor and have this several inches above the surrounding ground so that it will always tend to remain dry. The roof slopes away from the house and the upper edge of the roofing paper sets under one of the siding boards so that no water can possibly drip inside.

Practically every farm home needs this sort of a small structure for taking care of the odds and ends that would otherwise accumulate around the kitchen door. The cost cannot be accurately estimated, but it should not run to more than $10 or $12 when made from new material entirely, whereas if built from scrap lumber or material at hand, it would cost only the amount of time required to build it.

New R. R. Track Cleaner

Walter M. Spring, a research engineer, has invented a vacuum cleaner for trap-rock roadbeds which is said to save millions yearly for railroads. This machine mounted on a railroad car will clean a railroad bed of cinders and refuse at the rate of thirty miles an hour. It consists of three galvanized suction chambers, the bases of which run just above the rails and the ground. Photo shows the machine in action.
How To Build Your Garage

BILL HOLDEN insists that he got more fun and genuine "kick" out of building his garage than he did the day he beat his boss on the links. That may be a point which will vary according to individual standpoint. But Bill did save some money and if he enjoyed the work, why so much the better.

Although our profession may be far from driving nails, most of us do enjoy making something if for no other reason than to do something different. If you need a garage, there is no reason in the world why you can't arm yourself with a few tools (if you don't already have them) chat with the lumberman, spend a few dollars, then put those boards together yourself. You'll save approximately half the cost, and it will be fun. A garage, well made and of good appearance, is an asset to any home which adds much more than its actual cost to the value of the place.

Space won't let us give you the bill of materials and caution keeps us from stating even the approximate cost of this garage, but you can get these figures from your local dealer. In most communities the materials for the garage shown will not exceed $125.00 and you may find that the total will be under this. Yet the structure would cost twice this to have done.

Except in unusual cases, all garages, regardless of exterior finish, are made of frame. First of all comes the foundation. This should extend below the frost line. Dig your trench then set the blocks in line and cement them together with a mortar made of ½ part lime to 2 parts cement to 4 parts screened sand. Or you can save some of this expense and build forms of lumber (sheathing will do) spaced five or six inches apart and fill to the top, carefully leveled, with cement mortar mixed to the proportions of one part cement to three parts sand to four parts crushed rock. If the solid wall is used, be sure to reinforce the corners with woven wire or iron rods. Have the foundation top several inches above normal ground level.

The garage pictured on this page is twelve feet wide and eighteen feet long. If your car is small, this space will leave enough room for a small bench at the rear. If your car is large, by all means add two feet to the length so that the bench can be installed. Here you can make most of the home repairs as well as those minor ones required for the auto. The really ambitious home owner, craving the use of tools for spare time can well afford to even add enough to the length for a small room in which a small, but rather complete shop will be possible with an electric motor to turn the small machines. A small heater will come in handy during cold weather, or you can get a wash boiler, pipe it for the exhaust from the car and run the outlet outside. The engine exhaust then will in this way heat the room.

When the foundation is finished off, quarter inch bolts, eight inches long, should be set in the top, spaced four feet apart along the sides and where necessary at the ends. Otherwise the building may be shaken slightly ajar at some time.

After the sills have been bolted down the studding, spaced two feet on center, are erected as shown, excepting the space for the front and side doors. The corner posts should be of doubled two by four inch pieces, nailed together. Note that in the front, bracing is accomplished by one by four inch boards, mortised into the studding flush with the surface. The dotted lines of the side elevation show how additional bracing can be used if deemed necessary.

The plates are also of doubled two by four inch pieces. The studding are eight feet long, giving a height of approximately eight feet, six inches from foundation top to the top of the wall. The type of roof shown required three kinds of rafters and several cuts which must be accurate, but this roof is one hundred per cent better looking than the regular roof and will cost only about $10 more. The pitch used is one third with the rafters spaced two feet on centers. You can tell just how these are cut and fitted from the rafter framing plan shown. The ends project fourteen inches past the garage walls and the cornice framing detail, also shown, shows how the finish pieces finally fit together to render a pleasing appearance.

Sheath the roof, spacing the boards one inch apart and cover with shingles or prepared roofing. The sides are sheathed and then covered with siding or stuccoed, depending upon the finish of the home. A novel and wholly suitable garage wall can be made by leaving off the sheathing from the sides, but bracing well and then covering with metal lath which are coated with two or three coats of stucco. Then the inside is finished with a gypsum product to render it fire-safe. This also makes the room as neat and tidy as you would wish at only a little greater cost. Moreover you now have a dead-air space in the walls which is important during cold weather. The inside will also be cooler in summer, particularly if you use the sheet product for the ceiling by nailing cross-members from one
side to the other at the top of the walls.

In placing the window, set the sill cut from a two by six inch piece, as shown, then fit the window between the studding. If you wish to be able to open the window, omit the upper two by four inch cross piece, and place stop strips with holes for the sash lock so that it can be raised or lowered.

Don't attempt to build your own front doors, unless you are skilled with tools and feel lucky. Instead, consult your hardware merchant and order through him a set of doors already built, together with the track and fixtures. The other door can be bought through regular local channels and should be hinged to open outward.

Build a concrete stoop or small platform outside the side door then build also the concrete approach with the top leading up to the floor line and the lower edge disappearing beneath the drive. This should be thick enough to prevent cracking and a few strips of woven wire for reinforcing will help a lot.

Cinders will do for the floor inside, but concrete will be much more satisfactory. Make the floor at least four inches thick and to prevent crack-

Magnet Saves Eyesight

The ingenuity of Captain George W. Jansson and Radio Operator W. R. Walston, of the S. S. Tomalva, in making an improvised electro-magnet saved the sight of Sailor Peter Kruif's right eye. Kruif was suffering excruciating pain from particles of iron that had penetrated the iris of his right eye while he was using a drill and the only way to extract the iron particles was by using an electro magnet. The ship having no magnet aboard Captain Jansson and Walston made one by winding 150 turns of wire around an iron nail and charging the coil with electricity from the ship's radio set. With use of the improvised electro magnet the particles were removed and the sight of Kruif's eye saved. Dr. Carroll Francus, of the S. S. American, banker, also helped in the operation when he informed Captain Jansson of the Tomalva by radio to discontinue cocaine treatments that were being applied to Kruif's eye.

MAR-CO Illuminated back-panel controls set the 1927 style.

Please Mention Radio Age When Writing to Advertisers.
How To Make That Garden Fence

THAT plot of ground may look desolate and unkempt as it is, but a nifty white garden fence, easily made and not very expensive, will make it look like a million dollars, more or less. Clever real estate men have spent a few dollars in this way and made a sale that represented ten dollars' profit for every dollar invested in lumber. Thrifty home owners, desiring a new location or a different home, have used the same idea and made it pay.

Whether you want to sell or not, you can enhance the appearance and increase the cold cash value of your place with a suitable fence around the garden plot. There are designs aplenty, and one which will fit the architecture of the house. But as important as the style of fence chosen, is the care to be taken in building it right—against rot, sagging, and depreciation.

The usual fence is held in place by wooden posts. These should be creosoted to at least five or six inches above the ground line. The creosote should be applied hot and if not dipped in the heated solution, several

while it is filled with a rather rich mixture of cement. By all means, reinforcing rods should be extended through the form from one end to the other. For a square post, four rods should be used. Triangular strips, nailed into the form corners will give the chambered effect shown, if this is wanted.

The combination pipe-and-concrete post is also desirable, and is neat and attractive. The pipe, of galvanized iron preferably two and one-half or even three inches in diameter, is set in a footing of concrete. The pipe can later be filled with concrete also. Before the pipe is set, you should know what type of fence you will build and then drill holes through the column where necessary for the supporting panel bolts.

Figure 1 also shows a common rot center. Paint protects against rot, but it is hard to get at places which retain moisture for a long time. The only real protection against rot in such places is to paint the pieces before assembly. If desired, creosote can be used instead, and then the whole painted after the fence has been completed.

Figure 2 shows three popular and distinctive types of garden fence which can be achieved with a supply of pine strips, saw and hammer. With a little imagination you can evolve no end of designs from this one type of material. At the top we see a simple design consisting only of pickets of three different lengths, the lower ends all being on the same level. While the illustrations shows only a short section, each panel should be from ten to twelve feet long. Each panel then, will require enough of the pickets to cover the distance, plus two two by four inch pieces of the proper length, and two posts set in line.

These pickets are cut from 7/8 inch stock, are two inches wide and of the desired length. The width can be reduced slightly if you wish so two pickets can be ripped from a four inch board, or three from a six inch board.

The center design is more ornate and, besides the pickets, a four inch board is used at the center of each panel. The lower design is another variation with pickets of two heights forming a pleasing curve at the top.
Although clear pine is the favorite garden fence material, pecky cypress is superior because it does, without the help of paint if necessary, withstand the intrados of rot. A home done in a gray stucco, or painted a neutral gray, will match ideally a pecky cypress fence because in a short time the wood, unadorned with paint, will assume a weathered gray effect, too. Of course the application of paint will give you any color you want.

Langley Joins Crosley
Powel Crosley, Jr., (left) President of the Crosley Radio Corporation and his newly appointed Assistant, Ralph H. Langley. Mr. Langley developed the first airplane transmitter several years ago and he is considered one of the leading scientists in radio industry. In his new capacity Mr. Langley will be Mr. Crosley's technical adviser. For the past six years Mr. Langley had been in charge of receiving set development for the General Electric Company

Locomotives on Vessel
The S S “Beljeane” at the Eddystone wharf of the Baldwin Locomotive Company at Philadelphia loading a cargo of 44 completely erected locomotives for shipment to Rio de Janeiro, the largest shipment of locomotives ever put on board one vessel. Three electric cranes are being used for the lifting of the engines from the rails to the deck of the steamer.

Some very attractive fences are made from poles and saplings, with the bark left on. Figure 3 shows a detail of such a fence which has been in use seven years and is now almost buried with rambler roses. Yet here and there the rustic fence shows through, thus lending that much-to-be-desired effect. The pieces are mortised and tenoned together, a spoke shave having been used to form the tenons. Here, however, creosote or paint must be used, else the wood will quickly rot off at the joints.

A more elaborate, and costly fence is shown at figure 4. The home is of brick, and the fence was made from brick which were left. It completely isolates the enclosure and gives a feeling of privacy from curious-minded folks. The walls are broken with posts at regular intervals and the top is finished with a simple design in brick that doubles its attractiveness.

Sketch out, if you will, your several choices of designs, then figure the length and breadth of the plot to be enclosed. These two dimensions will determine your panel width. Allowance must be made for one, or two gates. Figure five shows a simple but ornate gate which happens to be the entrance to the front of an exclusive Lincoln, Neb., home.

Just what type of fence you finally decide to build is not important. Making sure that you are protecting it against rot and depreciation, is. Now go ahead and enjoy making it!
Man—Know Thy Tubes!
(Continued from page 30)

an average tube the difference in readings at the voltage shown above should be 4.2 milliamperes. Tubes giving this reading, or readings slightly under it, may be considered as A-1. If the readings fall much below that figure, the tube should be reactivated.

In this last process, the rejuvenator is plugged in the light socket; a tube inserted, the switch is thrown on the flashing voltage for 45 seconds, then turned to the baking charge for 10 minutes. At the end of that time the tube, if it is any good at all, will again have its emission restored to the average difference value shown in the table herewith.

Especially if the listener is using filament operation from the light socket, he should test his tubes at least once a month, or oftener if desired, to see that none have fallen by the way in the course of operation. Such a method will give the fan first hand knowledge on the condition of his tubes and will probably cut down to a great extent the volume of the “trouble shooting mail” with which the radio industry has had to contend since its inception.

Full directions for use of either the checker or the reactivator are furnished by the makers with their products. Users of super-hets of all classes and vintages would do well to spend a portion of their money on these two instruments which will help them keep the favorite receiver pepped up to its maximum all the time.

Radio on Trains

Time passes quickly on the trains of the Canadian National Railways. Forty parlor and observation cars operating from the Atlantic to the Pacific have been equipped with 800 sets of headphones and with loudspeakers. The number of headsets in a car ranges from 12 to 40, according to the type of coach. A new compartment car being built will have two sets of equipment in each compartment. A central radio receiver supplies them all with music from different cities in Canada and the United States.

We Believe it’s the Invention of the Year.

No matter what radio you own... no matter where you live... no matter how many broadcast stations are nearby... the newly invented “DX” Radio Ground will positively do all these things for you...

Better Distance Reception
Increase Volume Amazingly
Insure More Selectivity
Sharpen Your Tuning
Improve Tone Qualities

This improved, positive ground connection is a recent invention... it is sweeping the western states like a cyclone. It will modernize any radio.

A Permanent Installation

The Preston “DX” Radio Ground will not wear out. The longer it remains in the ground near your radio set the better the performance it gives. As the good news spreads everyone will discard their obsolete water pipe grounds and, at last, enjoy real radio reception.

The Preston “DX” Radio Ground, ready for installation, sells for $8.00 postpaid. FREE literature and copies of letters from enthusiastic owners will be mailed on request...

DON’T DELAY—WRITE TODAY.

Radio Test Laboratories
3036 Fifth Avenue
LOS ANGELES, CALIFORNIA

SET BUILDERS—SUPER SELECTIVE NINE

Not builders, you will want this pure hook on Camfield’s Super-Selective Nine the greatest receiver ever built. The wonder of the season. Big profits are in store for you. Retail $25 higher now.

CAMEFIELD RADIO MFG. CO.
307-341 E. Ohio St., Chicago, Ill.

Tyman Branches Out

TYRMAN, formerly president of the High Frequency Laboratories of Chicago, has severed his connection with the old company, and organized the Tyman Electric Corporation with headquarters at 208 South LaSalle St., Chicago, Ill.

Mr. Tyman will be remembered as the sponsor of the Nine-in-line.

Please Mention Radio Age When Writing to Advertisers.
STATEMENT OF THE OWNERSHIP, MAN- 
AGEMENT, CIRCULATION, ETC., RE- 
QUIRED BY THE ACT OF CONGRESS OF 
AUGUST 24, 1912.

Of RADIO AGE, published monthly at Mount 
Morris, Illinois, April, 1917.

State of Illinois 3rd

County of Cook

Before me, a Notary Public in and for the 
State and county aforesaid, personally 
appeared Frederick A. Smith, who, having 
been duly sworn according to law, deposes and 
says that he is the Publisher, RADIO AGE 
Inc., and that the following is, to the best of 
his knowledge and belief, a true statement 
of the ownership, management, etc., of the 
publication, and of the sale, circulation, etc., 
of the aforesaid publication for the date stated 
in the above caption, required by the Act of August 
24, 1912, embodied in the form hereunder.

1. That the names and addresses of the 
publisher, editor, managing editor, and busi- 
dess managers are: Publisher, RADIO AGE 
Inc., Frederick A. Smith, President, 500 
N. Dearborn St., Chicago, Ill.; Editor, Fred- 
erick A. Smith, 500 N. Dearborn St., 
Chicago, Ill.; Managing Editor, Frederick A. 
Smith, 500 N. Dearborn St., Chicago, 
Ill.; Business Manager, M. B. Smith, 500 
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cago, Ill.

2. That the owner is: (If owned by a 
corporation, its name and address must be 
sta
ted and also immediately thereafter the 
names and addresses of stockholders owning 
or holding one per cent or more of total 
amount of stock. If not owned by a 
corporation, the names and addresses of the 
individual owners must be given. If owned 
by a firm, company, or other unincorpo-
rated 
8

2

rated individual, the names and addresses of 
the individual owners must be given.) RA-

DIO AGE, Inc., 50 N. Dearborn St., 
Chicago, Ill.; Frederick A. Smith, 500 
N. Dearborn St., Chicago, Ill.; J. H. Lohbeck, 
6429 Cates Ave., St. Louis, Mo.

3. That the known bondholders, mortgagees, 
and other security holders owning or 
holding 1 per cent or more of total amount 
of bonds, mortgages, or other securities are: 
If there are none, state so.) None.

4. That the two paragraphs contain 
statements embracing affiant's full know-

ledge and belief as to the circumstances and 
conditions under which stockholders and se-
curities holders, if any, have purchased the 
stock of the company, and if any, the 
value or consideration received therefor, and 
the dates thereof.

FRIDAY, MARCH 11, 1927

WEATHERWRIGHT

Electricity.

At present, perhaps undoubtedly, 
has been achieved by a prominent 
Japanese physicist.

In his experiments, he has taken 
a simple wax mixture, melted it and 
allowed it to harden while in a strong 
electric field between two metal 
plates, with the result that the wax 
cake retains a strong electric charge 
permanently. Some of these cakes 
prepared in this way have kept their 
charge nearly ten years, and show no 
signs of losing it. In some instances, 
a surface charge of 120,000 volts per 
square inch has been retained by the 
 wax cakes. 

A complete rearrangement of the 
atoms in the wax is believed to be 
the secret of this phenomenon, and 
follows investigation and research 
may result in important changes in 
the theory of the atom.—Peter J. M. 
Clute.

FROST-RADIO

Rheostats are Winners!

The acceptance by radio set builders 
of these new rheostats was one of the most 
astonishingly successful 
demonstrations of hitting the bull's eye that 
had ever been witnessed in the whole 
industry of radio 
engineering. Almost a nation wide, from coast to coast, demanded FROST-RADIO 
metal Frame and Bakelite rheostats. There were two reasons for this overwhelming demand which 
resulted in the sale of 
100% of the complete, 
accurate, and 
high-quality models. 
Frost-Rheostats have always been 
a FROST-RADIO policy.

FROST-RADIO

Type 700 Metal Frame Rheostats

The most phenomenally successful rheostat ever 
designed, sold or distributed by any manufacturer. 
This new line of metal frame 
rheostats, with the exception of a single model, 
completely eliminates the need for 
the use of Bakelite rheostats. 
FROST-RADIO Type 700 Metal Frame 
and Bakelite rheostats. 

FROST-RADIO Type 800 Bakelite Frame Rheostats

These air-cooled rheostats have the smallest, 
most compact and 
artistic interior. Outside diameter is 
1-4 in. Bakelite frame cases 
for all models and sizes. 
FROST-RADIO Type 800 Bakelite 
rheostats are available 
and Bakelite frame models. 

HERBERT H. FROST, Inc.

160 North La Salle St.

CHICAGO

Please make sure you describe 
your radio as Radio-Rheostat type. 
Name.

Address.

City.

State.
Loop or Aerial—And Why?
(Continued from page 9)

framed building. In this case, an aerial set will generally prove to be the best for the reason that it is usually possible to erect an aerial high enough to get it clear of the trees. Two of the tallest of these, in fact, or one of them and the building in which the set is housed can be used as supports for the antenna, always provided that one end of it is held by a weighted rope passing thru a pulley; or by a long, strong spring to take care of the tension strains produced by the swaying of the trees in the wind.

If a set is to be located very near to a broadcasting station the first requirement is selectivity. Here the loop sets reign supreme, with preference being given to the super-heterodyne. Even with a set of this high degree of reactivity a wave trap may be needed for use in conjunction with it when it is desired to cut out the local broadcaster in favor of a distant station on nearly the same wavelength, but it is necessary in this connection to remember that a wave trap is far more effective when used in conjunction with a loop operated set than with one which employs an antenna for signal pick-up.

If a set is to be used by a person who does considerable traveling, and likes to carry his or her entertainment along, a loop set is of course most convenient, and undoubtedly most practical, especially if it be built to be strictly self contained; that is, with speaker, batteries, and set, all in one portable case.

It will be seen from the above illustrations that the selection of the proper type of set depends merely upon the application of good common sense to the task, and not upon any definite general superiority of one type of set above the other with respect to ordinary operation in a good radio location.

By a simple analysis of the preceding instructions it is possible for anyone, regardless of the extent of his or her radio knowledge, to select the particular type of set best suited to the conditions under which it is to be used.
Trouble Shooting on Supers
(Continued from page 7)

ified for your particular circuit. Sometimes mistakes occur in packing and a 00035 mfd may be found in a .0005 mfd box, or vice versa.

(37)

Loop may be too large or too small. If the loop is too large you will have trouble in tuning in stations on the lower waves if it has not enough inductance it will not tune up to the higher bands.

(38)

Wrong type condenser. If a condenser with a metal shaft is used in a super with an oscillator tuned from grid to plate, you will have trouble with body capacity. With this type of tuning use a condenser having insulated rotor and stator so the shaft coming through the panel is not a part of the circuit. (See oscillator method used by RADIO AGE in its latest 9 tube design—Editor).

(39)

Grid connected to rotor of condenser. Always connect the grid to the stator of the variable condenser. If the grid goes to the rotor body capacity may be encountered.

(40)

Rotor not grounded to negative filament. The regular type of condensers can be used where the tuning is from grid to filament of the oscillator. In this case be sure to connect the rotor to the filament negative to eliminate body capacity when the set is being pushed for distance. Of course the grid goes to the stator as usual.

Notes On Above
Do not use the schematic in this article for wiring a set. It is only reproduced here for reference in trouble shooting. The test methods outlined here will help you considerably in solving your own problems. Many trivial mistakes made in originally building the set will show up under these tests and should serve as a guide for your construction of an excellent super of which you will be proud. Be sure to use quality material in a super. Its the best economy in the long run.

HARRY L. PAIGE'S business is going down to the sea in a diving helmet, but he insists upon taking his radio along—at least, he takes the ear phones with him below the waters of Corpus Christi Bay. Paige is a member of a crew running a barge and placing pipe for a sewer outfall on the bottom of the bay.

Harry's job is to go down and buckle the pipes together after they have been placed in their positions. He found after a while that the very programs he wished to hear usually were broadcast at those hours when he was engaged in diving operations.

He decided to remedy the situation. Others on the barge out in the bay, about a mile from the mainland, were skeptical about Paige's experiment. He procured some heavily insulated wire, ran it from the instrument to his sleeve and up to the ear phones. Then he tuned in on the particular station he wished to hear.

When he went down about fifteen feet to the place where he was working he found that he received the programs as clearly as if he were sitting on the deck of the barge. Now, whenever he has to wait for the heavy concrete piping to be lowered into place, he can while away the time beneath the waves by listening to jazzy tunes from far-away stations or he can take swimming lessons by radio from Gertrude Ederle.

Anyway, Harry says the radio adds to the companionship of the deep when the only visible animal life is jellyfish.—E. G. Fischer.
Short-Wave Station 2AG
Uses Crystal Control

I
N A TALK given recently at Co-
lumbia University before a well-
attended meeting of The Radio
Club of America, C. R. Runyon, Jr.,
gave a detailed description of his
short-wave radio station located at
544 North Broadway, Yonkers, N. Y.

Seven transmitting tubes are em-
ployed, as follows: one 7.5 watt UX-
210 as a crystal-controlled amplifier
tube; two more of the same type in
the first intermediate amplifier; still
greater amplification through the
medium of two 50-watt tubes (UV-
203-A) in a second intermediate stage
of push-pull amplification; and a final
stage of amplification employing two
250-watt tubes (UV-204-A) in a
push-pull amplifier circuit.

The output of this powerful ama-
teur short-wave transmitter is radi-
ated from an antenna system which
is suspended from the top of a 112-
foot mast which is erected in the rear
of Mr. Runyon's home. A counter-
poise is employed to increase the effi-
ciency of this station.

Radio's Greatest
Publication

The March issue of the CITIZENS RADIO CALL BOOK is just
off the press.

This issue contains a wealth of live radio information, including
a complete and up-to-date list of all broadcasting stations in the world,
showing schedules, wave-lengths, etc., a wonderful picture of
130 radio celebrities, a new department known as Ampere Andy's As-
sistors, giving the latest shop hints, showing illustrations how
to maintain and repair your receiver.

The following receivers are featured in this issue: The Camfield
Super-Selective Nine, the Ledge "N" Receiver, the Phasstrol Five
Receiver, the Citizens "Super" Eight, an Impedance Coupled Super-
Heterodyne, a Self-Modulated Oscillator, the Victoreen Universal
Super-Heterodyne Receiver, a Shielded Localized Control Receiver, the
Melot-Head Super-Heterodyne Receiver. Further Notes on the Com-
pletely Shielded Six Tube Neutralized Receiver, the World's Record
"Super" Nine, a Compact "B" Supply with Voltage Regulator Tube, a
30 K. C. Super-Heterodyne Receiver, the Improved Browning-Drake
Receiver, a 100 K. C. Super Using Air Core Transformers, a Complete
Plug-in Power Amplifier, and the Improved Nine-in-Line "Super." Also
circuit section with descriptions and reviews of season's popular circuits.

THE CITIZENS RADIO CALL BOOK is published four times yearly, January 1st, March 1st, September 1st,
and November 1st. You may now subscribe by using the coupon below for one, two or three years and save money.

By subscribing you will receive each issue by mail promptly upon date of issue.

Fill in the coupon at the bottom of this page and mail at once.

Please Mention Radio Age When Writing to Advertisers.
CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don’t overlook RADIO AGE’S classified advertisements.

The classified advertising rates are but four cents per word for a single insertion. Liberal discounts are allowed on six and twelve-time insertions, making rate of 3 and 2 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the July-August issue must be sent in by May 25.
Imagine the intense pleasure of bringing in your favorite distant station loud and crystal clear—right through summer's curtain of static and noise! But, you don't have to be content with merely imagining it. Real DX in summertime—real big volume—amazing clarity—much better selectivity—all these are now available to you—and, with your present set. Simply connect your set to SUBANTENNA—the marvelous new underground antenna system that uses filtered ground waves instead of noisy air waves.

Read PROOF that SUBANTENNA is the Greatest New Thing in Radio

Says Static Is No More
"I have received the Subantenna. My grandson installed it. STATIC IS NO MORE. Am well satisfied. I can tune in stations I never could coax out of the air even though I had a long aerial."—A. E. F., Kans.

Better Selectivity—No Static
"It has always been impossible for me to eliminate the Drake Hotel. I was told that Subantenna would enable me to do this. Although skeptical, in view of many similar claims made by other manufacturers of radio accessories, I had one of the Subantennas installed. The results have been most satisfactory, in that I have not only been able to get every station in Chicago of any consequence, when the Drake was on the air, but out-of-town stations as well. In addition I am able to report that static, which was a source of much annoyance before, has been entirely eliminated so far as I am able to observe."—R. L. F., Chicago.

Michigan Gets California
"I have had KFI, California, several time and go all over U. S. A. to Portland, Maine You have the goods. It is far better to volume and tone on loud speaker than out side aerial."—C. J. S., Mich.

Why SUBANTENNA Makes Ever Night a Good Radio Night
In summer etc., the ratio of static strength to signal strength favors static. The "noise" is so much great than the broadcast signal that it hides the music you wish to hear. That's why you don't get distance in the summertime. But, when you use SUBANTENNA, the situation is just reversed. For, in the ground, the ratio of static strength to signal strength favors the latter. In fact, there is so little static in the ground that the broadcast signal easily dominates it, with the result that you hardly hear the static, even on the most distant stations. Radio research men have long known this fact, but no device had ever been perfected by which ground waves could be used. Now, however, you have SUBANTENNA—a great new device which makes radio, for the first time, an all year 'round pleasure.

Eliminates Lightning Risk
Not only will SUBANTENNA give you loud, clear DX in summer—not only will this remarkable invention better the selectivity of your set—but it also completely eliminates the lightning hazard. With SUBANTENNA you can go right on listening-in during the most severe electrical storm without noise, fear of attracting lightning or damaging your set.

FREE TRIAL

Use STATIC-FREE Ground Waves
Get Distance Loud and Clear all Summer

SUBANTENNA—new underground Antenna System astounds listeners and laboratories with loud clear DX on hot summer nights when old style aerial gets nothing but unwanted noise.

Imagine the intense pleasure of bringing in your favorite distant station loud and crystal clear—right through summer's curtain of static and noise! But, you don't have to be content with merely imagining it. Real DX in summertime—real big volume—amazing clarity—much better selectivity—all these are now available to you—and, with your present set. Simply connect your set to SUBANTENNA—the marvelous new underground antenna system that uses filtered ground waves instead of noisy air waves.

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Get Distance Loud and Clear all Summer

SUBANTENNA—new underground Antenna System astounds listeners and laboratories with loud clear DX on hot summer nights when old style aerial gets nothing but unwanted noise.
No batteries—

Radio's most revolutionary development! Run this radio direct from house current outlet. Ordinary 110 volt 60 cycle domestic electricity transformed mechanically into smooth, quiet radio, A, B and C power as you use it. Radio power supply annoyances ended for all time. A snap of the switch is the only demand radio will make upon you from now on.

No more batteries to fuss with.
No more trickle chargers to watch.
No more keeping something filled with water.
No more trips to renew or recharge.
No more time to go to the home to have the radio serviced.

Radio Energy Unit weights only 13 lbs., is only half the size of an ordinary "A" storage battery—operates without interfering hum and with the certainty of an electric motor.

Radio Energy Unit

6-tube AC Receivers for use with Crosley Radio Energy Unit

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RADIO AGE

July-August 1927

25¢

See Page 34

Current Science
NEITHER can you obtain good musical performance from your receiver unless your audio amplifier can carry the full load of rich tones and overtones.

Wherever tone quality is paramount you will find Thordarson Amplifying Transformers. Over thirty manufacturers of leading quality receivers use them as standard equipment.

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Everyday Mechanics

Radio Age

Current Science

Established March, 1922

Volume 6
July-August, 1927
Number 6

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Chats

One outstanding achievement is recorded this month in the lead article describing the new method of frequency modulation which is expected to be a great boon to the transmission, reception and manufacturing interests of the radio industry.

Another achievement, though secondary in importance, is the announcement of the a.c. filament tubes, one suited for the r.f. and a.f. stages, and the other only for the detector stage. Full data on these is recorded in this issue.

Amateurs will find two articles covering their activities. The first is by Armstrong Perry and shows what you are missing if you don’t pound brass (telegraph). The other is a description of the short wave crystal controlled transmitter at 9BHX. In addition there is the Amateur Radio department.

Fiction lovers will revel in the Springy passages to be found in Joseph Balsamo’s present instalment of “The Froth Estate.”

K. B. Morcross has contributed an excellent article on the construction of the vacuum tube voltmeter for the serious-minded experimenter.

Both of our non-radio features, Current Science and Everyday Mechanics, are taking up a bit more space than usual due to the interest shown by our readers covering those two features. We shall be glad to hear from others on the subject.

Perhaps you’ve wondered why a bullet proof vest stops a veritable rain of bullets from a machine gun. Charles Lee Bryson gives an interesting account of the modus operandi.

We announce with regret the departure of our Associate Editor, F. A. Hill, who leaves us to join the Bremer-Tully Mfg. Co., of Chicago, as Assistant to the President.

Frederick Smith

Editor of RADIO AGE.

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New Modulation is Biggest Radio Discovery in Twelve Years

By F. A. HILL
(Associate Editor)

What is regarded as the most radical radio discovery since the appearance of the three element tube, is an announcement of the frequency modulation method of transmission, attributed to the fertile brain of Frank Conrad and associates.

For years the public has been kidded into believing that this and that development was revolutionary. But this discovery so far transcends in importance anything described in the last 12 years, it requires the use of superlatives which has heretofore been overworked.

This time we find a real revolutionary discovery. Here is what frequency modulation (as compared to power modulation means:

Return of the faithful regenerative sets.
Elimination of local station interference.
Greater signal at distant receiver.
Partial solution of the fading problem.
Extinction of the crystal set.
Sixty per cent power saving at transmitter.
More stations per channel.
Hastens crystal control of all stations.
Reduction of static-to-signal ratio.
New field for receiver design.

In the new modulation system instead of varying the amplitude of the signal component of the wave, this signal component is kept constant while the transmitting frequency is varied but not to exceed 500 cycles each side of the carrier straight line. Reference to the chart in this article will give an idea of the new scheme. The carrier frequency is shown as a beginning straight line.

The frequency of the voice or music component is determined by the distance between the humps. The closer these humps lie the higher the frequency of the voice or music. The greater the distance between the humps, the lower the frequency of sound impressed. Since the frequency variation is not more than 1,000 cycles overall, it is easy to see how sharpened this form of transmission is. With the station's emission occupying but a thousand cycle band it will permit the presence of more stations within a given band without interference.

Where in present modulation forms it is possible to receive broadcast music (although garbled) on zero beat with a regenerative receiver, under the new form of transmission music may not be received at zero beat. The only points at which music may be heard will be either side of zero beat. Zero beat will REALLY BE ZERO BEAT for nothing will be heard in that region.

Local station interference will be abolished on account of the sharpened transmission and the necessity for a receiver with a much sharper frequency response curve.

In the sketch with this article is also shown a graph of the signal intensity against distance. In the full line is the present modulation system where maximum signal is received at the point closest to the station, this energy dwindling off as the distance increases. In the new frequency modulation (dashed line) the signal intensity is at zero at the station and increases with the distance, up to a certain point, and then drops off as the distance increases beyond the range of the station. (Receivers set up in the station at KDKA will not pick up that station. The monitor set has to be located a mile or more away and the signal brought back over a telephone line so that station operators may listen to it). Experiments have shown that the signal under the new form is greater at a distance with the same, or less, power than under the old method of modulation.

Due to an increased sharpness of transmission and a sharper receiver it has been noted that fading is considerably reduced. Likewise in this connection the static-to-signal-ratio has been cut.

Crystal sets on account of their response curve will not pick up this form of transmission.

(Continued on page 35)
Do You Know What You Are Missing?

By ARMSTRONG PERRY

YOU may think that you are getting a lot out of radio, but sit in with a bunch of radio amateurs some time and you will discover that you have been getting only about one-half of one per cent of the kick there is in it.

Attend a meeting of the American Radio Relay League, a national organization of radio amateurs organized thirteen years ago when about the only broadcasts heard were weather reports and SOS calls in Morse code. I sat near the registration desk at one of its conventions, studying the types among the arriving delegates. They were all boys, from fifteen to seventy years old. One was a gangling youth of about seventeen. He put his hand around to his hip pocket for a handkerchief or some legitimate object and revealed patches on the seat of his trousers.

Now there is a good deal of significance in patches. If a farmer has patches on the seat of his overalls it is a pretty sure sign that the mortgage on his place will be foreclosed soon. A successful farmer never finds time to sit around and wear holes in that location. But on this fellow I was sure those patches meant nights of DX work. They meant too that he had the nerve to spend his money to attend the convention, where he would find fellowship, instruction and spiritual uplift, instead of buying a new suit.

I asked him how he was getting on. He said he was not doing anything worth mentioning, just working a few ham stations in England and now and then one in South America.

After all the fuss that has been made over the opening of radio telephone service between America and England, it seemed strange that he and other boys should talk so non-chalantly of sending message across the oceans, but then the amateurs have been doing it for years. The first was a fifteen-year-old boy named Harold Robinson, who bought a radiophone transmitter guaranteed to transmit twenty-five miles. He studied it, improved it, and increased his transmitting range until he received reports from persons who heard him 1,500 miles away.

The telephone service from America to England is a marvellous achievement. It is a far more difficult matter to establish reliable daily service than it is to make an occasional amateur record. But, when a boy who has to wear patches in order to attend a radio convention builds his own apparatus and exchanges messages across oceans, he is pointing the way for broadcast listeners to do something that is more fun than imitating a sponge and soaking up whatever happens to be in the air.

Amateurs who attend these gatherings wear tags on which their call letters are stamped. An eager youth comes hurrying through the door, glances at the letters on some other fellow’s tag and they join hands. Few of the members have ever seen each other before but one Gladys at those call letters and they are closer than brother Masons, for they have chatted many a time with their hands on their keys and phones on their heads. Those telegraph keys of theirs unlock doors and let them into more things than any latch key ever revealed.

Nobody cares what anyone’s name is. When IBIG was in the chair at one of the sessions, every delegate who addressed the chair began just as he would if he were calling a station: “IBIG!” If anyone said “Mr. Chairman” he classified himself as a novice.

One of the delegates was a China man. He looked just like any well-dressed celestial in American clothes until he started in the trouble-shooting contest, then he took on the atmosphere of a busy sector in the Chinese war. The trouble-shooting contest consisted of finding out what was wrong in a lot of radio diagrams. There were even more things wrong with them than can be found in the worst set that a broadcast listener ever threw together. What Whoop La did to those diagrams made the common or garden variety of amateur gasp with amazement. He won the prize.

There was one YL (young lady) present at the last gathering that I attended. Every girl “ham” is a YL, just as every man “ham” is “OM”, meaning “old man”. This one led a dog, but it seemed like an unnecessary precaution. She possessed plenty of charm, but the “hams” were too crazy over radio to be susceptible to girl-ness.

Once in a while a local ham organization goes to a convention in force. The Providence Radio Association distinguished itself recently by...
attending one arrayed in comedy straw hats about as big as a silver dollar. This claims to be the oldest active amateur radio organization, and was started about the time some of the present members were thinking of being born.

Relaying of radio messages was the reason for the existence of the American Radio Relay League, President Maxim says. Fifteen years ago an amateur was thrilled if his signals were heard across the street. A member of the Hartford Radio Club succeeded eventually in transmitting a message to Windsor Lock, twelve miles north.

About that time it was learned that there were radio amateurs in Springfield, 25 miles north. Mr. Maxim conceived the daring idea of relaying messages through Windsor Locks to Springfield. The plan succeeded and the League was born. That was only thirteen years ago, and the other day a member of the League, sixteen years old, told me of this incident:

"I work in a radio store. I put up a sign inviting customers to give me messages to send free of charge anywhere in the world. I advertised in the papers too. A lady came in and said she had a friend who had been a missionary in China and had just escaped and gone over to the Philippines. She wanted to know if I could send a message that far and find out if her friend was all right. I sent her message to a ham in California and he relayed it to one in the Philippines. It took ten days to get the answer back, but we found out the missionary was all right."

This youth showed no signs of boastfulness. The performance was unusual for him only because of the service rendered to the missionary and her anxious friend in America. He exchanges messages with Australian amateurs without the help of a relay station, covering a distance of over station, covering a distance of over 7,000 miles, with less power than flows through the lamp that illuminates this page as you read.

Amateurs cover these enormous distances by using short waves, around 20, 40 and 80 meters. For some reason that is not yet fully understood, these waves travel further with less power behind them than those commonly used in broadcasting and commercial and government services. They work as well or better in daylight and are not troubled seriously by static.

They may be inaudible anywhere within 500 miles of the transmitter but loud and clear 5,000 miles away. The theory is that they are propagated upward, strike ionized strata in the upper atmosphere, and are reflected back to earth. Like shells fired at a high angle, they strike nothing between the points from which they are fired and the point where they return to the ground. Experimentation with short waves is one of the most fascinating pastimes in radio.

Twenty watts input is all the average amateur uses, so short wave work does not run up the electric bill seriously.

OAJ3U may look to you like an unintelligible jumble of letters, but read it to a "ham" and he will say right off the bat: "Melbourne, Australia." This "Aussie" is celebrated throughout hamdom because his signals come through frequently, steadily and readily. When he landed in America a few months ago the radio amateurs were so glad to see him that they forgot to argue with him about who won the war.
“I have often read your articles,” he told me. So Radio Age is known even on the island continent.

There was a time when the radio amateur was more often an experimenter than a handler of traffic, but emphasis has been placed on traffic recently and the results are startling.

1BIG, of Augusta, Maine, won a prize offered by the League for the best traffic record for three months. He handled over 1,200 messages, including those originating at his station, those received and delivered by him and those received and relayed. 10C-1BFT of Concord, New Hampshire, a single operator with two transmitters tuned to different wavelengths, handled 1,150. He worked three stations in France, two in Belgium, one in Holland and one in England. In 1926 he took five messages from the McMillan Arctic Expedition, all of them important. This boy, who has reached the mature age of sixteen, started in radio when he was fourteen. In two years he has risen to the position of route manager and official observer of the A. R. R. L. for New Hampshire, and official operator in the Army-Amateur radio net.

1CPR, who was known as W. R. Pierce before he acquired call letters, is one of the few radio amateurs who look at broadcasting as something more than a popular amusement that gets in the way of useful radio activities. He bought a two-tube broadcast receiver and went after a logging record.

He reports that he has heard 625 stations in 38 countries, including the United States, and that he has cards or letters from all of them confirming his reception of their programs.

These amateurs are showing us how to get out of radio all there is in it. W. T. Grant, who received three cents a day as his wages on his first job and who is selling $40,000,000 worth of radio and other merchandise this year through a chain of more than one hundred stores, says that it is the law of life that anyone who renders a real service to humanity receives an adequate return.

This law operates in radio as in other affairs. Those who sit in easy chairs absorbing programs that cost someone else as much as $25,000 in an evening become so satisfied and fussy that the enjoyment of it all but vanishes. Also they develop “corporations” of a non-dividend-paying kind. The radio amateur, scrupling to buy the parts for his transmitter and receiver, putting them together with meticulous care, testing them out until they deliver satisfactory results and then using them for handling messages free of charge for anyone who needs the service, knows the joy of living.

When the world war broke, the American Radio Relay League furnished 2,500 trained amateur operators for the fighting forces within a few weeks. If the war in China draws us into its deadly grip there are at least five times that number who will enlist at the first call. Many of them are having experience right now in handling Army and Navy traffic, for the Army-Amateur net and the Navy-Amateur chain are maintained for the purpose of training radio amateurs for emergencies. Correspondence courses and training in camps are provided, in addition to daily practice throughout the year.

Time after time the amateurs have filled the gap when storms have disrupted wire service. Gifford Grunge of Jacksonville saved lives and property during the Miami disaster by keeping radio communication open. Railroads have called on the amateurs for train dispatching and other service when landslides carried away rails and telegraph poles. McMillan’s messages from the Arctic have been picked up by amateurs during each expedition and he had to depend on a fifteen-year-old amateur, Arthur Collins, for twenty-two days in 1925 when his expedition was near the Arctic circle and professional radio men were unable to reach him. Dyott, on his recent trip down Roosevelt’s River of Doubt in Brazil sent out reports through amateur stations.

Less than $100 will equip an amateur station with an efficient short-wave transmitter and receiver. The waves in the 20-, 40- and 80-meter bands carry half way around the world when propagated with a power input of from 20 to 100 watts. Amateur stations using 500 to 1,000 watts are exceptional and many amateurs testify that they do not reach out much if any better than those using 50 watts or less.

The short-wave receivers that amateurs use seldom have more than two tubes, which are enough to make low-

(Continued on page 39)
A vacuum tube voltmeter is an apparatus consisting of a vacuum tube and associated equipment so arranged and calibrated as to permit the measurement of a wide range of alternating and direct voltages. Alternating voltages may be measured with approximately the same accuracy regardless of their frequencies. A thorough understanding of this type of voltmeter, particularly when it is used in all its various applications, requires detailed study and theoretical considerations. However, one may obtain an excellent idea of its general mode of operation without the use of elaborate equipment and with very little theoretical knowledge.

Operation of a tube voltmeter (See Fig. 1) depends upon the fact that a small increase in voltage in the grid circuit requires a correspondingly larger increase in voltage in the plate circuit to "balance" the tube, that is, to bring the plate current back to its original value. Thus one may determine the value of voltage added to the battery in the plate circuit by employing a voltmeter of small range and measuring the increase in grid voltage required to restore the balance. The value of the unknown voltage is the product of the increased grid voltage and the "mu" or amplification constant of the tube. Mu is determined for the particular tube used. This rule for voltage measurements works both ways, that is, if a very small voltage is to be measured that voltage is added to the battery in the grid circuit and the increased B battery voltage which is required to restore the balance of the tube is read with a voltmeter. The unknown voltage is then computed by dividing the increased B voltage by mu. The tube voltmeter may also be used to determine the operating condition of tubes and their characteristic curves.

A schematic diagram is shown in Fig. 1. Fig. 2 shows the actual arrangement of parts and Fig 3 shows the completed instrument. A 201-A type of tube is employed. The instrument MA is primarily for the purpose of indicating constancy of plate current rather than its actual value in milliamperes. A cheap voltmeter is therefore satisfactory. It should have a range of from five to ten volts. The value of R may be from 400 to 800 ohms which is sufficiently great to prevent an unduly heavy drain upon the C battery. In addition to MA, a direct current voltmeter having a range of about 100 volts is needed. (The exact range depends upon the character of the measurements.) The voltmeter should have a double scale so that small voltages may be read with fair accuracy. The instrument should be provided with connecting leads terminating in clips so that it may be readily connected to different parts of the circuit.

The parts are mounted on a board provided with binding posts assuring convenient connections and changes in B and C. The A battery may consist of dry cells (four connected in series) provided the tube is not burned for long intervals of time. Posts 7 and 8 permit easy addition of C battery as required in the measurement process; additional C battery can be added at 5 and 6 instead, but if too much voltage be applied here the drain on the battery becomes excessive.

In the usual methods of operation of the tube voltmeter the value of mu (amplification constant) for the tube is first determined by a single series of measurements. In lieu of
This voltage = suggested in voltmeter needle that of current. Tube be 3 the until filament method 4 it is 2.5). Mu is now computed to be

\[
\frac{130 - 88}{9.2 - 2.5} = 6.3.
\]

It is important to obtain the voltage readings while the voltmeter is actually connected in circuit and to readjust R in each case to maintain exactly the same deflection of MA.

A somewhat simpler method of determining mu which is theoretically correct is to so adjust the plate and grid voltages that zero plate current is obtained and then divide the plate voltage by the grid voltage. In practice, it is difficult to secure good results by the use of this method.

Let us now turn our attention to the graph shown in Fig. 4. This is obtained by plotting values of plate volts along the vertical axis and values of grid volts horizontally, meantime keeping the filament terminal voltage (that is, the filament current) and the plate current constant. For the graph shown the filament voltage is 5 volts and the plate current is 3 milliamperes. As previously stated, the value of plate current need not be known and might in this case (for example) be a reading of 3.6 on a voltmeter inserted in the plate circuit.

To determine the graph, the voltmeter was clipped across F and F (Fig. 2) and the filament rheostat adjusted for 5 volts. The voltmeter was now connected to 8 and 9 (this caused a shift in the needle of MA) and the milliammeter brought to exactly 3. This gave a grid voltage of 2.25. The voltmeter was then clipped across 3 and 4 and the reading taken after the plate current was brought back to 3 milliamperes by adjusting R. This gave a voltage of 66.5 which together with the grid voltage of 2.25 determined point A on the graph. Other points were obtained in the same manner. A "mean" curve which is essentially a straight line, was drawn through the several points. Mu may be determined from this curve. Take any range in grid volts, say 4 to 10, and note the corresponding range in plate volts, 78.5 to 117. Mu is therefore

\[
\frac{117 - 78.5}{10 - 4} = 6.4
\]

In using the graph in conjunction with the tube voltmeter to measure voltages the value of Mu need not actually be known. To make such a measurement connect a source of unknown direct voltage at 3 and 4 (Fig. 2) in place of the B battery and vary the voltage across 8 and 9 by adding more battery at 7 and 8 and by adjusting R until the same plate current is obtained as was used in the calibration. Also make sure that the filament terminal voltage is the same. Suppose the grid voltage is found to be 12.6. Locate this point on the graph and read the corresponding plate volts. This shows the unknown voltage to be 133.

To measure a small direct voltage, disconnect the C battery, connect terminals 9 and 6 with a wire and connect the source of the unknown voltage to 7 and 8. Adjust B until the proper late current results, then read its voltage from the voltmeter. The unknown voltage is then determined from the curve as before.

Old dry cells are useful as "C" or "B" batteries and by connecting some in "opposition" the voltage of the B battery may be varied as accurately as desired.

The measurement of alternating voltages involves a procedure which is similar to the measurements just described. However, increase the value of the voltage obtained from the graph by one half.

(Continued on page 26)
The FROTH ESTATE

by Joseph Balsamo

“No trouble at all,” said Amy Templeton Graves.
“It is customary to make an appointment before expecting—”
“I’m leaving for the East on a night train,” said Miss Graves.
“If you would tell me the nature of your business—”

“Sorry, but it’s personal.”
Daly, listening, was becoming interested and as he pictured the haughty shoulder that Miss Sims undoubtedly was shrugging at the moment he smiled broadly, shoving aside the circulation chart. The musical voice was heard again, in a sort of contralto chant. Daly suspected that it was raised to just the proper pitch and power to make sure of carrying through the open door.

“Remember when the Prince of Wales came to Fortunatus? I called at his hotel in the afternoon and told his major domo or valet or secretary, or whatever he was, that I wanted just a word from His Highness about what he thought of Fortunatus and American girls, et cetera. They must have thought I was going to try to sell the Prince some oil stock or a parcel of life insurance, the fuss they made over it. It seems they were having a bit of tea in the Wisteria Room. There was an orchestra and dancing. I was getting an eye full and thinking what a hard life that royal cake eater was having in our midst when a gentleman with flat feet and a rented cutaway stepped up and touched me on the shoulder. Usually I get along without taking advantage but when that house detective started to ease me off to the corral I used my sex. I waited until a busboy came alongside and fainted right into his tray of empty Bronx glasses. There was quite a commotion. They sat me in an occasional chair and someone started for a glass of water. I opened my eyes to tell them not to trouble about it, that a plain Bronx would do just as well, and I looked right up into the blue eyes of the eldest son of the current King of England. There’s a boy for you! He had asked a few questions and came right out to see what could be done. Royalty and the elite of Fortunatus stood around looking at me as if to say, ‘She may, after all, be somebody’s sister.’ I sat up straight and reached for my turban and then I smiled at the Prince. He smiled too, and said something about me being a bit of all right.”

The story thus far

Col. Maximilian Minimil sets $10,000,000 aside out of his personally acquired colonial fortune, for the purpose of financing the Fortunatus Gazette for his son Daly. The younger Minimil, while the great project is being organized, has some difficulty in making other people believe he intends to publish a newspaper that is to be free from the smut and hysteria of certain other dailies. He believes a clean journal will win out. Bill Rossum, publisher of the Clarion, is a former movie actor. A horse stepped on his face and, although putting him out of the picture game, so transformed his countenance that he has the appearance of a super-man. People do what Rossum wants because of the compelling power of the Rossum face. Rossum tries to prevent the sale of the first issue of the Gazette. The Minimil’s win their circulation battle by a ruse and the Gazette is successfully launched.

Daly, who doesn’t know much about the grinding of the news mill which produces daily newspapers, visits his own local room to watch the city editor and his staff of reporters and subeditors. The young publisher is surprised at the processes of converting facts into stories. He orders the city editor to discharge one of the girl reporters, giving the reason that she is so good-looking she might distract the attention of the young men from journalistic labors.

XII

DALY had returned to his private office and was studying a circulation chart when Miss Sims, his secretary, entered and presented a card. It was a neat little card, bearing only a name:

Amy Templeton Graves.

Daly looked at it, frowning. “Who is she and what does she want?”

“She merely says it is important and personal.”

“Meaning nothing at all,” said Daly. “Tell her I’m in—”

“Conference,” assented the young lady secretary and withdrew.

The door between the ante room and the private office was ajar. Daly heard Miss Sims convey his threadbare little lie to the waiting visitor.

“Perfectly all right,” said a well modulated voice, “I have a good book with me and I’ll wait if you don’t mind.”

“But—”
"It, of course, would be impossible for us to talk to reporter for publication," said His Highness, "but after you are bucked up a bit we would regard it as a favor if you would have a one-step."

"Oh, Oo! And a few minutes before those debs and sub debs and old ladies in young clothes had been regarding Miss Amy Graves as about as important as a sparrow's birthday! I stood up and the Prince and I walked over to an open window and it wasn't long before I said I was a hundred per cent and off we glided. The Prince said I danced extremely well and I said he wasn't so bad himself and he laughed and after the dance he ordered an ice and we sat at a little table and chatted and finally I excused myself for I had got my interview, a Bronx, a parfait and I enjoyed the unanimous hatred of all the sisters in the Fortunatus blue book and I was so happy!"

Silence in the ante room and Daly wondered if Miss Sims had walked out on Miss Graves.

"No," said a sonorous voice, suggestive of Ethel Barrymore's, "No, we never met again."

Daly managed to throttle a laugh down to a gurgle, but Miss Graves had heard and she cried joyfully:

"The conference is breaking up."

Daly appeared at the door. "Come in, please," he said, and then he blushed very much like Mr. Asbury Lunt might have blushed, and exclaimed weakly, "Oh, it's you."

"In person," she said, and throwing a triumphant glance at the thoroughly bewildered Miss Sims, the young lady bowed gracefully as Daly stepped aside and motioned her to precede him into the private office.

XIII

Seated on opposite sides of the big flat desk they looked at one another without speaking. The girl who had been chattering so briskly a moment ago now seemed at a loss for a word. Daly, with indifferent success, tried to suppress a smile.

"You ordered me fired," she said at last. "Is that so amusing?"

"Pardon," he said, very soberly, "I was thinking of your affair with the Prince of Wales."

"I'm serious," she protested. "Stub Graham told me you ordered me off the staff and I have gone to a lot of trouble getting in here to thank you."

"I hope you're not going to be sarcastic."

"Not a syllable," she exclaimed. "I want to thank you for paying me the finest compliment I ever had... too good looking to be turned loose on a helpless newspaper staff!"

Daly glanced at Miss Graves and although his appraisal of her was properly swift she was modestly aware of it and the color rose in her cheeks. Daly wondered if she knew that her oval face, framed by the chic green turban and softened by vacant curls of auburn hair and illuminated by eyes that were pools of flickering blue light, was a face among thousands, millions. He wondered if she realized how exquisitely her tailored suit and open collared silk blouse caressed the lines of her lithe, slender body. Lips, lashes and eyebrows that glowed in freedom from rouge and pencil. A Da Vinci nose, chiselled in warm Italian marble. A throat—suddenly he looked up from the letter opener with which he had been toying. It was his turn to speak.

"Are you going to take a train East tonight?"

She looked at him in astonishment. "What has that to do with it?" she asked.

Daly pulled himself together. It occurred to him that the publisher of the Fortunatus Gazette was too rapidly becoming pop-eyed over a little girl reporter. What a laugh that situation would get in the Gazette plant, from the press room in the sub basement to radio station on the roof.

"Merely this," he said, bringing his eyes around boldly to meet hers. "I hadn't considered that my instructions to Graham might mean really serious consequences to you and I wouldn't want to be the one to drive you out of town looking for work. Perhaps we're making too much of a small matter. I'll tell Graham I've changed my mind."

A shadow deepened the blue in her eyes. She hadn't come to hear him say that. Considering the matter, she did not know that she had wished him to say it. But of course she couldn't tell him that. Couldn't permit him to guess it, even. She arose and made a move toward the outer room. He followed and stood with his hand on the edge of the door. He was a tall figure and there was nothing lacking now in poise or dignity. She looked up.

"I suppose," she said, "that I should thank you now for giving me back the job, although, if you will remember, I didn't ask you to do so. And I suppose, too, I should withdraw my thanks for the compliment you seem to have withdrawn." Daly closed the door softly and stood facing her.

"I have withdrawn nothing."

"It's a little bewildering but in that case I'm going to thank you for everything, many, many times, and I'm sure that ought to cover it."

"We haven't been honest about anything," he said. "Not since you came in. Suppose we stop fencing and begin all over again and tell the truth."

"It would be interesting," she replied. "Let's start with the conference; as a matter of fact were you in conference?"

"No, I was not. But how about the Prince of Wales? Did he tell you you were a bit of all right and buy you an ice?"

"No."

"We are two terrible, terrible liars, Miss Graves. Now the next question: Why did you come here to see me?"

"Let me get this straight. Are we both pledged to tell the truth and nothing but the truth?"

"Absolutely."

"Then, being the man, you should plunge first. As a matter of fact why did you fire me?"

She was looking up at him, her face flushed, but
determined courage in her eyes, and perhaps a little something more.

"Because when I saw you in that local room I thought you were the most adorable girl I ever looked at. Thinking that, I couldn't make it seem right for you to be there. It didn’t seem to be your background, your atmosphere. Foolish, maybe, but the truth. But you didn’t go. Why didn’t you?"

"Because when Stub Graham told me what you said I concluded that you liked me an awful lot and I was very happy over it because I had been looking at you and—and I thought you seemed so regular, somehow, such a man."

Daly stood gazing at her. "Is that the whole truth; did you come to my office to thank me?"

"No," said the girl. "I really was a little worried about losing the job. I wanted to tell you that I could take care of myself and I was sure of it because I’m taking care of my mother and a kid brother. But the main thing was to come to you and see whether you would tell me—what you told Stub Graham."

Daly took her two hands within his own and held them close. Her face was lowered now.

"You are the most beautiful girl in the world."

Some time later she rescued her turban from the crazy angle it had taken and pushed back a wayward curl from her forehead. She straightened the folds of the sheer silk collar, which had been sadly disarranged.

"Ain’t truth wonderful?" she said, dabbing her eyes with a tiny handkerchief.

"Devastating," he agreed. "But you must go now. Miss Sims will—. I want to meet your mother and talk this thing out. Tonight? Tomorrow? When?"

"My, what a fast worker you are. I’m sure we’d better have a few hours to think about it. I’ll telephone you tonight."

He opened the door and Amy Templeton Graves very bravely and successfully passed out into the ante room and nodded a bright farewell to Miss Sims who gave her the cool scrutiny that only one woman can give another—and get away with it.

At 10 o’clock that night Amy took the train East after telephoning that she was compelled to go and that she would write.

XIV

July 22, 1926.

Dear Daly Minimil,

When I left Fortunatus day before yesterday I was running away. I wanted time to think. For some years I had been sure that if and when I met the right man I would know just what to do if and when he began to make signs that he thought I was the right girl. Well, I was hardly prepared for such a ride on the speedway of romance as it eventually turned out to be. Hired, fired, kissed and proposed to, all in one afternoon and the same man playing the heavy lead in each sketch!

I am going to confess that I don’t regret a minute of that afternoon. I guess I am as modern as most girls of my age, weight and class and I believe in quick decisions. But there’s a speed limit to everything. You don’t know a thing about me except that I am as fresh as a channel breeze and that I am the most beautiful girl in the world. You are right about the first count but all wrong on the second. You ought to see my sister. She can give me all four aces and make game in no trumps, and I don’t say it hesitatingly.

On the other hand I know some things about you and yours and in that way I have an advantage. Your father, for instance. I have an idea he would take it more kindly if you give him his chance to hit the ceiling before you buy the ring instead of afterward. Tell him you are in love with the world’s most adorable and then go on with the story in easy installments until you come to the part where you admit that you can’t remember my first name and that I was one of your girl reporters for a few uneasy minutes and that you never saw me but once in your life. That will be a basis for further parley.

Maybe you haven’t thought of it but Bill Rossum over there on the Clarion would walk a mile to read a society notice in his own newspaper and in half a dozen others to the general effect that Mr. Daly Minimil publisher of the Fortunatus Gazette, was engaged to marry Miss Amy Templeton Graves, a red-headed girl reporter who worked on his new newspaper for an hour or so.

No, Daly it would hurt you a little. And that would hurt me a lot. They would say that you were the heir to the biggest wad in the state of Coma and that I was living in the second flat back around the corner from the tannery. If you do go to the jeweler’s (and I hope and pray that you will) postpone it until you have read all the latest advertisements about skid chains and brake lining. You won’t need a traffic horn.

I’ve been a little girl reporter quite a long time now and, old dear, I know why orange blossoms wilt faster than geraniums. Do as I say about this and I’ll promise to bring you the slippers and pipe ever after. I love you and I want you to love me permanently.

Yours,

A. T. G.

P. S. This is Thursday. You will receive this letter on Saturday at the latest. There’s a radio in the place and I’m going to be listening in on Sunday night. If, during the half hour of old favorite songs Sunday night, I should tune in the Voice of Fortunatus, on the roof of the Gazette building, Fortunatus, Coma, and hear your baritone Soloist sing “Beautiful Garden of Roses,” I would know you had arranged it. How’s that for a transcontinental secret? I’ll also take it as a promise that you are looking over the brake lining and the skid chains. Love. A. T. G.

(To Be Continued.)
The Spectrum of Radiation
By ELMORE B. LYFORD

A large part of our daily life depends upon vibration, in one medium or another. Sound, and our powers of hearing, depend upon vibration of the air around us. Light, and our powers of vision, depend upon vibrations in the ether. The radio we listen to in the evening is actuated by waves which are transmitted by this same ether. Radiant heat, X-rays, and the electric current in most of our homes—all depend upon vibrations, or waves, of one frequency or another.

What the average person does not realize, perhaps, is that all of these waves, or vibrations, are identical in their form, and differ from each other only in frequency, or wavelength. The relation of these different vibrations, one to another, and the order in which they fall when arranged according to frequency, may therefore be interesting.

When comparing vibrations of greatly differing frequencies, the most convenient measure is the octave, that is, the frequency scale of acoustics. An increase of one octave means a doubling of the frequency, regardless of the absolute frequency, or starting point. To set up such a scale, let us choose as our starting point 16 cycles, or vibrations, a second, this being about the lowest frequency that can be recognized as a sound by the human ear. One octave above this would be 32 cycles a second, two above would be 64, and so forth. The third octave above our starting point is 128 cycles per second—middle C on the piano. Sixty-five octaves will be necessary to include all the vibrations known to man.

A graphical representation of these sixty-five octaves is shown, and the position of various types of vibrations on this “scale” are marked. A little study of this chart will bring out several interesting facts. One of the most striking is that the range of visible light is less than one octave out of the entire sixty-five. The ear is much more versatile than the eye, for it can hear vibrations over a band of frequencies nine octaves wide. At the bottom of our frequency scale—the slowest vibrations with which man deals—come the 25, 60 and 133 cycle alternating electric currents which are almost universally used for power and lighting purposes. The frequency band to which the ear is sensitive also starts around 16 cycles per second, and extends nearly nine octaves, up to frequencies in the neighborhood of 8000 cycles per second. These vibrations which affect our ear are carried by air as a medium, but all other vibrations are transmitted by waves in that intangible stuff which permeates all space, and which scientists call ether.

Next higher in our frequency scale come vibrations caused by electric waves. These are caused by lightning flashes, certain forms of arcs, and “surges” such as are sometimes encountered on electric transmission lines.

Just above and overlapping this band come the ether vibrations known to us as radio waves. Varying from 15,000 to 300 million cycles a second—from one to 20,000,000, in wavelength—they cover a frequency band of fourteen octaves. This is the largest band of frequencies covered by any one class of vibration, and it is being gradually extended even more, particularly on the high frequency end.

On higher frequencies than the waves classed as radio, but yet closely allied, are the Herzian vibrations. These vibrations were produced and measured before those at “radio” frequencies, and in a certain sense the work of Herz was the forerunner of the great development of the radio frequencies which has occurred in the last forty years.

Between the Herzian waves and the very longest infra-red rays, next above, there is a gap in our scale which covers a range of about nine octaves. Vibrations in this range of frequencies, from about a thousand million to a million a second, have not yet been discovered, though there is no reason to suppose that they may not exist. Modern science knows no way of producing frequencies of this order, nor no way of detecting their presence if they could be produced. The characteristics which vibrations in this band of frequencies might have cannot even be deduced. If apparatus is ever devised which will produce and detect them, they may be found to be very valuable for the transmission of signals, or voice, or power—or they may be worthless for any practical use.

The infra-red rays or vibrations above this unexplored region cover a band of about eight octaves. They blend then into the frequencies which constitute visible light, and which, as has been said before, cover a band less than an octave wide. “Light” waves of frequencies too high to be detected by the eye are called ultraviolet, and these have been detected by other means over a band of frequencies about two octaves wide.

Vibrations in the infra-red range are sometimes called radiant heat, and are detected in the radiation from certain stars, and from the moon. Ultra-violet radiations are given off by an arc light, the brighter stars, and by other very hot bodies, including the sun. These ultra-violet rays are of importance in medicine as germ-killers, but in excess they are also more or less destructive to human life.

Above the range of frequencies covered by the ultra-violet radiations there is another band which is so far unexplored and unknown, and above this comes the range of frequencies attributed to X-rays. These cover a very narrow band at about the 57th octave. These X-rays are very important in medicine, because of their property of penetrating otherwise opaque bodies, allowing us to take photographs of things inside.

At the extreme end of our frequency scale we find the frequencies of the different radiations given off by radio-active substances such as

(Continued on page 16)
LEAVE it to an amateur (and an old time brass pounder at that) to solve the problem of properly tuning a voltage feed Hertz.

Hearing that C. W. Kern, 9KB, had done the work easily we called on him for an explanation which he advanced as follows:

"The difficulties of properly tuning a voltage feed Hertz antenna, usually encountered at amateur stations situated in crowded city locations are well known. One of the greatest obstacles is lack of communication between the man at the set and the man on the roof changing the feeder.

"At 9-KB this was overcome in a very simple manner. Two ordinary head-phone sets were connected with a piece of lamp-cord (any double conductor wire will do) long enough to reach from the set to the roof, but laid in such a way as to be entirely out of the field of the antenna itself. One side of each head-set was taken out of the holder and used as a 'transmitter,' leaving the remaining single phone on the frame to be worn over the head in the usual way. A 4½ volt 'C' battery was placed in the circuit to boost the audibility, but this was not absolutely necessary as it will work without battery.

"With such an arrangement it was easy to follow operations at both ends of the line and to tell at what point on the antenna the feeder gave the best readings.

"With a semi-vertical single wire antenna 58 feet long best results were obtained with the feeder slightly under 6 feet off center. The position of the feeder in this particular case was found to be more critical than the ordinary methods of locating it seemed to indicate. While the antenna would work at almost any point with the feeder within 3 to 7 feet off center, by the use of the telephone one point was reached where the wave was sharper and general results most satisfactory."

In a supplemental note to us Kern says:

"Since its installation I worked OA-7DX who said my signals were R-7. Also worked OA-4BD. Worked eight out of eleven stations called, in every district, at one sitting with the present antenna layout. But while we are thinking we are getting out pretty well what about our friend OA-7DX whom I have worked several times, who uses an ordinary 201-A? He said to me 'I am still using that 201-A tube' (and it was several months ago he first told me about it). Either we have good receivers here or he has much efficiency."

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A PORTABLE JACK
By Charles F. Felstead (6 CU)

A PORTABLE jack can be made very easily from a single-circuit jack and a short length of Fibroc tubing. The tubing should have an inside diameter of ⅜ inch, and be about 3½ inches in length. A disc of ¼-inch thick cord, wood, or bakelite, ⅜ inch in diameter, is glued in one end of the bakelite tube. A hole large enough for the head of the jack is drilled in the center of the disc. A piece of the turned up end of the jack frame that is supposed to rest against the panel may have to be cut away to permit the jack to be put inside of the bakelite tube. The other end of the bakelite tube can be plugged up by means of another disc. A small hole should be made in this second disc for the wires that connect with the jack. These wires can be a length of ordinary double phone cord, if the jack is to be used close to the receiving set; but, if it is to be used with an extension cord for connecting to a loud speaker at some distance from the receiving set, a twenty-foot long, or longer, piece of double lamp cord, or a length of any insulated, flexible double wire, may be used for the extension cord. In either case, a plug should be fastened to the other end of the connecting wires to plug into the jacks in the receiving set. If binding posts are used on the set, spare terminals soldered to the ends of the wires may be substituted for the plug. If wood or cork are used for the discs in the ends of the tube, they will look nicer if they are painted black. The bakelite tube will not have to be so long if the type of jack known as a "short" jack is used.

IN A recent card received by 9BHX from 2XAI at Newark, N. J., data is given regarding that transmitter which is engaged in amateur test work as well as photoradio work, the latter under the call of WAQ, both calls operating on 42.95 meters, crystal control, with 20 kw. input. The station is on the ground floor of a high, white building, and as such is not a large signal. E. Gundrum is manager of 2XAI-WAQ. Signals from that station received at 9BHX were considerably better than our standard, WIZ.
PROPAGATION of Short Waves Around the Earth is the title of an article by E. Quack, reviewed in the April number of the Proceedings of the Institute of Radio Engineers by Stuart Ballantine. It is quite interesting to short wave enthusiasts in that comparison of signals from 2XT on 18,550 kc at the transatlantic receiving station in Getlow were photographed with an oscillograph and the presence of a doubled signal found, the double occurring a short time after the principal signal. Later tests were made on the signals of AGA at Buenos Aires on 20,000 kc. Records show a time lag of .135 second. Assuming a wave velocity of 299,800 kilometers per second the corresponding path-length turns out to be 41,499 kilometers (25,750 miles). This of course exceeds the circumference of the earth. If it be assumed this path corresponds to the circumference of a circle parallel to the great circle of the earth it appears from computation that the short wave has been propagated along a super-atmospheric stratum 182 kilometers high (113 miles) above the surface. No proof that the wave actually takes this path is submitted. It is also interesting to note this double-signal effect is observed only on the very short wave lengths, from 15 to 22 meters.

Radio Stunt in “Less Than No Time”

WHILE operating an amateur receiver and transmitter one night, E. Granbacks, an operator of Station 6CTX of Richmond, Calif., got in touch with an amateur station in Belgium having the call eb4WW. The Belgian gave Granbacks a message going to Hawaii, the time in Belgium being 4:45 a. m. Very shortly after this Granbacks succeeded in hooking up with the desired amateur station in Hawaii, whose call was ob6AXW, and gave him the message. This occurred at 9:30 p. m., of the day before, in Hawaiian time. Thus a message actually traveled 7,500 miles and yet arrived at its destination seven and a half hours before it was filed in Belgium!

A SIDE from the a. c. tubes described on page 15, two new rectifier tubes have been announced by the R. C. A. which have a greater current capacity than any of the previous models and which it is believed were developed to take care of the increased current required for operation of the new a. c. tubes.

The full wave rectifier, UX 280, gives a d. c. output of 125 milliamperes. It may be employed interchangeably with any devices in which the 213 was previously used.

The half wave rectifier is called the UX 281 and takes the place of the 216-B. In circuits designed for its use the d. c. output current available is 110 milliamperes. Two of these tubes used in the full-wave scheme shown in the blueprint section of this issue will give 220 milliamperes instead of 130 as at present with the two 216-B tubes.

Both of the rectifiers are of the hot cathode type, with a new ribbon, oxide coated filament insuring great ruggedness and long life (Allah be praised!)

It is understood that greater plate current is required on the a. c. tubes, so it is imagined these two new rectifier releases are to insure ample plate current which the previous rectifiers might not have been able to afford.

JOHN E. HODGE, 4BY down in Savannah, Ga., having seen advance proofs of the blueprint article in this issue, believes we should tell those who are intending using a large tube as a power amplifier and a smaller one as a doubler, that the grid input connection of the big tube should be made variable so that it may be clipped down from the plate tap. In the drawing we have shown the grid input wire as permanently connected to the plate of the preceding tube. In the case of a 210 feeding another 210 this practice seems to work all right. But Hodge suggests that for a 210 feeding a 203-A it would be better to make the lead variable since some instability may be found when running the grid input right off the previous plate. He also finds that amplifying the fundamental and then picking up twice its frequency seems to work better than the form we show. As most of the short wave stuff is a matter of opinion and will be for a number of years, readers should try out both methods for their own information. It is quite probable that results obtained with 210 tubes will not always match results secured with fifty watters and vice-versa. For a limited plate voltage and to ease the strain on the pocketbook the 210 proposition looks good.

Use SW Oscillator to Pick Up Programs

UNTIL recently reception of short wave broadcasting programs was confined to amateurs and experimenters who could build their own equipment for the purpose.

Now, through the invention of W. M. Bruce, Jr., consulting engineer and expert on submarine cables, the field has been widened so all radio fans who can afford the cost may enjoy the new form of entertainment. The theory of Bruce’s new device, known as the Crosley Wave, is like many other inventions, so simple that it is amazing it hasn’t been thought of before.

The unit consists essentially of a small short-wave receiving set with detector and one stage of audio frequency amplification and an oscillator tube adjusted to operate within the broadcasting range.

Signals are received by the short wave set and are detected and amplified by the two tubes provided for this purpose. The amplified signals are then impressed on the oscillator tube, which is modulated by them and which rebroadcasts the signals on a longer wave length, for example, 300 meters.

It is merely necessary, then, to connect the output of this oscillator tube to a radio set, tune the set to 300 meters (or whatever wavelength the oscillator tube is adjusted to) and listen to the short-wave signals. In brief, the signals are picked up on the short wave, used to modulate an oscillator tube, and retransmitted into the radio set at ordinary broadcasting wave-lengths.
ONE of our foreign Dial Twisters (in fact he is the first and original one) wishes to correspond with radio fans on general lines, and asks that we accord him a bit of space for this announcement: "Reginald A. Garratt wishes to correspond with radio fans on general lines and also with the idea of forming an Anglo-American Radio Correspondence Club. If interested, drop him a line. His address is 70 Victoria Road, London, North Four, England."

We think the idea is a good one and wish Mr. Garratt all kinds of luck in starting such a club. Perhaps many of our Dial Twisters will be of the same opinion and will so advise our genial British member.

C. B. STAMM, D. D. S., of Lancaster, Pa., writes asking that we devote some of our energy to uncovering a super-regenerative set that will work. Remembering some of the fiascos that were perpetrated in the name of the super-regenerative class we have refrained from going into that subject. However all we need now is a good tube for r.f. amplification and when that is perfected there will be no need for the super-regenerative set. In the meantime the best bet we have found is the combination shown in the blueprint section of the May-June issue where the 9 tube World’s Record super was described. By changing the plug-in oscillator coil and cutting the loop circuit the set may be adapted to short waves. It may also be enlarged without much trouble to take in long wave phone and code work. Frankly it is an all-round set.

GEORGE A. CLARK of Represa, Calif., tells us he wouldn’t sell any of his RADIO AGE issues for any price. He has bound the 1925 and the 1926 (with the Annual) into a volume and finds it quite handy for his work in conducting a radio class. He thinks the magazine is getting better every month and impatiently waits for each succeeding issue.

New A. C. Tubes Are Announced by R. C. A.

AS WE go to press announcement is made by the Radio Corporation of the UX226 a. c. filament tube useful as an r. f. amplifier and a. f. amplifier (but not as a detector) and the UY227 a. c. filament tube as a detector (but not r. f. and a. f. amplifier). The UX226 has a 1½ volt filament drawing 1.05 amperes; the UY227 takes 1.75 amperes as 2½ volts. Both are a. c. operated. Their characteristics are otherwise very similar to the conventional 201-A. While the UX226 employs the standard UX base, the UY227 however uses a special five prong base.

This seems to be the opening up of the a. c. set operated era. Tubes will be available July 1, according to the announcement.

In addition two new types of rectifier tubes have been announced. Details concerning these tubes will be found on page 14.

This announcement follows a period of announcement and denial, counter announcement and counter denial, that has had the radio industry whipped into a frenzy of expectation. Use of these new a. c. tubes (which still require plate current from batteries or eliminators) is expected to give an added impetus to the set manufacturing industry in that receivers may now be made that are truly electrically operated.

An Idyll of the Fleet

A beautiful and striking picture from the deck of the U. S. S. Pennsylvania as she sends forth one of her winged messengers from her ‘plane catapult during manoeuvres, as the great U. S. battle fleet proceeds from Southern waters to a resting place in New York Harbor.

"Say Bill! What’s a radio engineer?" "I guess it’s a fellow like you who makes his set whistle at every station."

THERE is apparently such a paradox as cold heat—at least there is the fact that in the research laboratory of the General Electric Company there are men who nonchalantly thrust their bare hands into an electric furnace which melts metals with ease. Still another astonishing fact about this furnace is that white mice will stay in it, even though the current is on and even though it is a simple matter for the mice to run out of it if they desire to do so. Again, it is possible to heat to incandescence the interior of a
radio tube without heating the glass bulb itself, simply by inserting the tube in the furnace. Another interesting experiment can be performed with an incandescent lamp, to the base of which there has been attached a single loop of wire; by bringing the lamp near the furnace, the filament can be made to glow.

It will be noted, however, that before a person thrusts his hand into the furnace he is careful to remove any rings from his fingers. Similarly, the metal drinking cup for the mice is not placed in the furnace itself but in an extension of it, although the mice spend most of their time in the furnace proper.

The secret is that the furnace heats electrical conductors only, and the reason is that the equipment is a high frequency induction furnace.

THAT the number of persons listening at radio receivers materially affects the intensity of a radio wave at greater distances is indicated by a recent experiment carried out in London by R. H. Barfield, of the English Radio Research Board. London possesses the same forest of radio antennas which can be seen nowadays on the house tops of any American city. Unlike American cities, London has only one broadcasting station, the famous 2L0. Presumably all of the local antennas are tuned to this one station and are receiving its waves. By testing the strength of the waves received from 2L0 in different directions outside the city, Mr. Barfield found that the wave energy is noticeably less after it has passed over thickly-populated residential districts, with many receiving antennas, than after it has passed outward in some other direction where residences are few and antennas sparse. This is interpreted as indicating that the energy absorbed by the antennas actually does decrease materially the energy of the radio wave, which must be used in its further progress. Radio engineers have long wished for some means of determining, inside the broadcasting station, just how many persons are tuned in at any instant. Thus they would know, by the sudden decrease of "customers," whenever an unpopular number is put on the air.

THAT the mysterious cosmic rays which reach the earth continuously from somewhere in outer space, as proved recently by Professor R. A. Millikan, may have important effects on long-distance radio is the suggestion made by Professor Werner Kolhörster, of Berlin, a German physicist who studied these remarkable rays even before the investigations of Professor Millikan. The effect operates, Dr. Kolhörster believes, through the famous Heaviside layer, well known to radio fans as the stratum of air, fifty or a hundred miles up in the atmosphere, along which long-distance radio waves are believed to move. Radio waves traversing long paths around the earth are believed to follow this Heaviside layer, as otherwise they would go off into the empty space outside the earth and be lost. The passage of radio waves along the Heaviside layer varies from time to time, being more perfect at night than in the daytime and better in winter than in summer. Sometimes the Heaviside layer seems to be disturbed, so that radio waves will not pass along it at all. Some of these variations may be due, Dr. Kolhörster suggests, to the effect of the rays from space in disintegrating the atoms of the air in the Heaviside layer and thus altering the electrification of the layer. The cosmic rays which reach the earth's surface are very feeble but they are stronger, Dr. Kolhörster believes, in the upper levels of the atmosphere.

NOW that the alternating-current-operated vacuum tube is so much in the public eye, it is opportune to say a few words about the very heart of this ingenious device—the cathode or electronic emitter which takes the place of the usual filament.

The cathode or electronic emitter of virtually all present-day A. C. tubes consists of a piece of insulating tubing of about the size of ordinary lead-pencil lead, with two minute holes passing through it from end to end. About this tiny insulating tubing is placed a metal shield which in turn is coated with the electron-emitting paste. Inside the insulating tubing is a pair of resistance wires, joined together at one end to form a loop. When current is passed through this loop, the heat generated causes the electron-emitting coating to pour out its profuse flow of electrons.

Certain A. C. tubes have been made experimentally with a kind of fused quartz for the heater tube, but in several instances the material has been incapable of withstanding the severe service conditions. Of late, the A. C. tube manufacturers and experimenters have turned to Isolantite—which has proved fully capable of meeting the extraordinary requirements here involved. Isolantite tubing no thicker than lead-pencil lead is extruded in continuous lengths, together with the minute parallel holes, in perfectly round section. The insulating characteristics and very low dielectric absorption properties of this material make it ideal for the purpose. Furthermore, the heat conductivity is so exceptionally high that maximum conduction of heat is assured from heater wire to electron-emitting coating for highest efficiency.

The Spectrum of Radiation

(Continued from page 12)
Low Power Crystal Control Transmitter

Part of Radio Age “Quad Unit”

By F. A. HILL

(Associate Editor)

BETWEEN the rugged power tubes now available, use of the 40 and 20 meter bands, and the fact power sources for a low power transmitter may be the same type as a broadcast listener uses for high quality output, the prospective amateur is no longer burdened with details that previously prevented him from getting into the transmitting game. Assuming he has learned the code, the balance of the work is relatively simple. With the advent of crystal control and the fact these bits of quartz are no longer so expensive, many an amateur with a wobbly note and a wave that skids from Calcutta to Gary, Ind., may make over his favorite set into a crystal control outfit and still give rein to all his DX propensities. The description of the crystal control outfit at 9BHX may serve as a guide for those just entering the game and who do not wish to invest very heavily in equipment. The experienced amateur will find in the story just another way of making up a transmitter without a great deal of apparatus.

The layout was named the “Quad unit” because of the four constituent parts, the transmitter, the BCL receiver, the power supply and the traffic receiver.

At the top of this page will be seen a photograph of the layout which is arranged for continuity of circuits. It could also be built on a stand with the crystal at the bottom, doubler on the middle and the power amplifier on the top shelf. However since this was to be a temporary scheme pending moving into other quarters the stunt shown was adopted. On the left is the 201-A tube and Frost socket; the crystal and its mounting, the grid biasing resistance, the bypass condenser, and the Aero 40-80 meter transmitting coil and a Bremer-Tully .0005 mfd variable condenser. Power for the quarter ampere receiving tube is derived from a Thordarson type T-2180 transformer with a 110 volt primary and a 5 volt secondary. Plate power for the crystal which oscillates at a fundamental frequency of 3800 kilocycles, is secured through the 90 volt tap on the Carter resistance strips placed across the output of the Thordarson 216-B full wave power compact. Current readings on this tube may be secured through the Jewell milliammeter shown on the test board panel on page 21. This milliammeter may be plugged into any of the various circuits in case it is not desired to use more than one meter. The connection on the test board is by means of Frost closed circuit jacks in each of the power leads, this stunt serving as well for the broadcast receiver as the transmitter. If a single meter is to be used it is suggested that one of a reading not to exceed 150 ma be used. The total output of the full wave 216-B will be 130 mills, so the meter should be large enough to take in that value. Other meters on the transmitter are shown in the schematic Figure 1, one being a O-8 ac voltmeter and the other a O-1 rf ammeter.

The center tube is the doubler which takes twice the frequency of the crystal fundamental (3800) and amplifies it at 7600 kc before passing onto the power amplifier where it is again amplified at 7600 kc and passed into the antenna circuit. In both the doubler and the power amplifier the filament current is secured from a Thordarson type T-120 transformer, with an Allen-Bradley Radiostat in the primary for voltage control of the secondary. Plate supply for the doubler tube is from the 300 volt tap on the Carter resistance strip, while plate supply for the power amplifier is taken from the high voltage end which will be between 450 and 500 volts.

Instead of making up our own inductances we utilized the new Aero transmitting coils. In the crystal circuit an Aero 40-80 meter coil spanned by a .0005 mfd Bremer-Tully condenser served to tune that circuit to
FIG. 2 SCHEMATIC OF DUAL PURPOSE RECTIFIER SYSTEM
USED AT 9 BHX
The print in tube.

The cartridge may nicely.

3800 kc. The same type coil, but with a .00025 mfd condenser served to tune the doubler circuit to 7600 kc, while the same scheme was used in tuning the power amplifier circuit. The antenna coil has the rf ammeter in one lead and the .00025 mfd condenser in the other, the former going to the antenna and the latter to the counterpoise. Keying is accomplished in the plate circuit of the doubler tube.

Referring to Figure 1 in the blueprint section, bias for the grid of the crystal oscillator tube is derived from an Allen-Bradley 100,000 ohm cartridge resistance in series with an rf choke coil (those furnished by Aero with their transmitting coils do nicely). This value may be cut to 50,000 ohms if desired for greater power in the crystal circuit. Bypassing is by means of the .006 mfd Sango. The rf choke shown in the plate lead is another Aero choke. In the doubler grid circuit self-biasing may be adopted with a 50,000 ohm cartridge resistance of the type mentioned previously. If you cannot use self-biasing at first, try it with C battery values of about 90 volts, and then when the set is tuned to resonance, remove the C bias and try the resistance. Probably you will succeed in getting rid of the C battery in this circuit. However in the power amplifier a little more difficulty will be encountered and here you may have to depend upon the biasing battery instead of the resistance, especially if you use the set un-neutralized as is the case at 9BHX. Other parts of the schematic are self-explanatory. (Of course if you use the C battery scheme remove the resistances otherwise the battery will be shorted). The resistance method is shown in all cases in full lines, while the battery method is shown in dashed lines.

In operation of the transmitter from the same rectifier and power supply as is used for the receiver, refer to figure 2 of the blueprints for the schematic and the values of resistances. The high voltage source is a Thordrason T-2098 transformer with a T-2099 choke, connected as shown in the schematic diagram, which is the same kind of a connection as is used for a power amplifier. The only point of difference lies in the use of a double pole double throw switch which changes the power output from the receiver to the transmitter resistances. Condensers for the rectifier are made by Potter and are called their heavy duty type. Carter resistances are used on both the sending and receiving sides. In the former there are three resistances of 3500, 2500 and 20,000 ohms respectively. These will pass 25 ma at 90 volts, and 25 ma at 300 volts, while the high voltage tap (450) will give about 100 ma if crowded. These resistances draw a total of 20 ma across the line. In the receiver side the resistances are 2900, 7400 and 3800 ohms respectively, but in this case sliders are provided on the resistances so that voltages may be varied to suit individual conditions.

Having hooked up the transmitter and the power service as shown the next step would be to tune the crystal circuit. Temporarily leave the 300 volt and 450 volt connections off the doubler and power amplifier, and apply 90 volts to the plate circuit of the crystal oscillator. The crystal should be in place in its holder (See October, 1926, blueprint section). It should be cleaned with carbon tetrachloride (Carbona) before being placed in the holder. If you are using a single milliammeter for all work, plug this meter in the 90 volt line. With the variable condenser set at zero start increasing capacity, watching the meter at the time. If you are within the range of the crystal’s fundamental frequency the needle will start slowly dropping as you increase capacity. Keep on increasing capacity slowly until the needle takes a pronounced dip. If further capacity is added the needle will either jump back to its original setting, or else take a second dip which will indicate the presence of another fundamental on the crystal—sometimes called the parasitic frequency. Assuming you have a crystal which shows only a single frequency and whose frequency lies within the range of the 40-80 meter coil spanned by the .0005 mfd condenser, tune the crystal plate circuit until you get the deepest portion of the crystal dip shown on the meter without instability. You are then tuned to the fundamental of your crystal. You can tune your amateur receiver in the 80 meter band and you will find the crystal’s fundamental, also its second and third harmonics, or even further if you wish.

With the crystal oscillating, put back the 300 volt tap on the doubler plate circuit, put in temporarily about a 90 volt negative bias on the doubler grid, and press the key. Tune the doubler plate capacity until you find resonance in this circuit which will be indicated by lowest plate current. The simplest method we found of tuning the set was to use the resonance type indicating wavemeter described on page 23, December, 1926, issue. This meter when placed near the crystal circuit inductance will give a meter indication at the fundamental of the crystal and on several of its harmonics. Pick the second harmonic of the crystal and find the point where the resonance meter reads the highest. Then set this meter near the antenna circuit. As you tune the doubler circuit you will probably cause the resonance meter near the antenna circuit to show a reading. Tune the doubler until you get a maximum reading on...
the resonance meter. Then go to the power amplifier circuit and tune it so as to get maximum reading on the resonance meter. Then tune the antenna condenser likewise, although by this time you will have enough radiation to determine your tuning by. In our work we found the resonance indicator indispensable in tuning a set easily before there would be enough radiation apparent on a 0-1 rf ammeter. Of course after sufficient radiation shows it is simple, but when minute values of rf current are being measured, the resonance indicator meter showed them up before the antenna ammeter. Incidentally this same meter gives you a much better chance to tune the various circuits right on the head. After all circuits have been tuned and you no longer care for the meter, set it near your receiving antenna (if you are using a separate one) and let it indicate the fact your emitted wave is always right on the dot. We use our meter to determine the amount of contact necessary on the bug to give perfect dots at high speed. For example if the dash will run the meter to .4 we adjust the bug until it will cause a train of dots to reach .2 on the meter. At this setting the bug will be making perfect dots that match in intensity the dash signals. It is not possible to run the dots higher than about one half the value of the dashes on the meter on account of the inability of the meter to respond any quicker. This same meter is especially fine for remote control work. When you press the key the meter reads if the crystal is oscillating and the set tuned to resonance. If such is not the case you know by the failure of the meter its up to you to run back to the place where the transmitter is located and retune it. On one occasion we wore out a pair of shoes galloping back and forth between the key in one room and the transmitter in another. Finally the matter was so adjusted that the crystal stayed put for weeks and weeks at a time. (Business of knocking on wood).

The antenna circuit for the 40 meter transmitter was a semi-vertical single wire, 32 feet long. The counterpoise was a single wire, horizontal, the same length. The receiving antenna was a single piece of wire 20 feet long tacked to the joists under the roof. This permitted breakin communication, but was not entirely satisfactory in all respects because the energy picked up by the single wire was generally enough to ruin the disposition of a 199 used for the detector in the receiver, especially if the chap you are working on is on your wave.

The schematic circuit of the receiver is shown in figure 3, which is the old Weagant now grown decrepit with age. In it were used the Aero coils for the band from 15 to 200 meters. Two of their broadcast coils were also used to cover the entire band. Condensers were Remler double rotor, which are illustrated in the pictures on page 20. The grid condenser, grid leak, transformers, etc., are placed beneath the subpanel so they will be out of the way. Tea may be served on top of the subpanel if desired since it carries nothing but the tubes and the plug-in inductances. A Jones base mounting plug is used to hook the receiver up to the A and B circuits.

While the coils referred to made the range of frequencies desired without any trouble, we wanted a traffic receiver so went over to the design shown in the schematic on page 21. Amateur gentlemen who can remember beyond 1917 will doubtless recognize an old friend. It is the receiver with two separate B batteries and it formed the basis of all schematics many years ago before radio scientists discovered that a common A and B battery might be utilized. A little concentration on the part of those who pore over circuits will develop the fact that with two B batteries (and batteries are cheap after all) it is possible to have your resistance regeneration control at ground potential, and also your headphones at ground (or shield) potential so that every time you move your head to look out of the window the signal coming in will not alter its course and land in Lima, O. So with the variable resistance at ground potential and the phones at the same potential you can crane your neck at will or scratch your head without a 20 meter signal going A. W. O. L. on you. (Derisive laughs from the gallery will be stifled if the stunt is tried.)

Next we went to a completely shielded box into which the whole kit and kaboodle was placed, batteries and all. Two dry cells furnished the filament current for the detector and one stage. Two sets of two 22½ volt B batteries were also placed inside. We used the smallest B blocks that could be found to conserve room.

In this picture is shown the test board (left) and the full wave 216-B combination which gives power for both the broadcast receiver and the low power crystal transmitter. The meter in the test board is a milliammeter which may be plugged into any of the voltages supplied either the broadcast receiver or the transmitter.

Schematic of the traffic receiver described in this article. The text explains reasons for some of the connections.
FIG. 3 SCHEMATIC OF SHORT WAVE RECEIVER
FIG. 4 GRID DIP DRIVER, SCHEMATIC AND PICTORIAL LAYOUT.
The plate current is not excessive on either tube so the batteries should last a long time. The receiver is thus portable and pretty well removed from high power line interference. Signals are amply strong on one stage using 199 tubes for even the most fastidious traffic hound, unless of course it is the tin ear gentry that requires an R-17 signal to copy a message.

In this boxed receiver we used a Cardwell tapered 3 plate condenser with one of the rotor plates removed, so that as it stands now there is one rotor and one stator. Taking some Silver-Marshall blank coil forms, illustrated as 4-E in figure 4, we wound our own coils to cover the bands we wished. We used No. 18 tinmed copper wire, placed one end in a vise and wound the coil under a good tension. The threaded grooves on the six ribs on the coil forms prevent slipping of the winding. The S-M people should be congratulated on the ingenious method of winding the tickler in the slot at the bottom of the coil where its position always remains the same. The size of the wire used is determined by the number of turns required, and this seems to cut no figure regarding the operation of the set. Six coils were made up in this fashion covering a band of about 2,000 kilocycles apiece. The principal one was for the band from 7000 to 8000 kc. On this coil WIZ at 6970 kc tunes in at 95 degrees and NAA on 8030 kc tunes in at 38 degrees, giving about 57 degrees tuning to cover the amateur band. The other coils take in a little larger frequency range, the smallest one going down to 20,000 kc.

The antenna condenser was a type N X-L variocorder with the capacity practically all out. Once set for our particular antenna it was left alone. In the receiver L 1 is the large winding and L 2 is the tickler. These are wound in the S-M blank coils. The resistance that governs the regeneration and oscillation is a Frost 0.5-0.000 ohm variable resistance spanned by a one mfd condenser. It is the smoothest regeneration control we have seen for this particular work.

To aid in finding stations of a known frequency readily we built up an alleged calibrated oscillator which, considering the demands made upon it, served quite well. It is illustrated in figure 4A, 4B and 4C. A Silver-Marshall blank form carries a secondary and a tickler winding of equal number of turns, arranged for a Hartley oscillator. This stunts resolves itself into a grid dip meter as well as an oscillator. As an oscillator it covered a range from 6,000 kc to 20,000 kc, using a 199 tube. Both A and B batteries are placed inside the wooden box shown in 4B. The condenser is a Cardwell taper plate .00025 mfd. This is a Marco illuminated control (with illumination eliminated) and a bake-lite coupling joint between the dial and the condenser shaft to keep all oscillator parts from the panel. The meter, a O-1 ma Jewell, was placed in the front Fibroc panel although we believe it would be a bit better if placed further away from the operator. It should be bypassed with a .002 or large condenser. This oscillator was checked against a calibrated crystal and settings noted on the oscillator for all of the harmonics of the crystal. Curves were then drawn for the entire range of frequencies so that a received signal could be transferred to the oscillator, the reading taken and a reference to the chart would show the approximate frequency. While this calibration held for a month we do not guarantee how much longer it would hold. However, if one has a crystal it may be used as a frequent check against the settings of the oscillator. Use of broadcast harmonics, even the crystal control ones, we found to introduce too much error, especially when running their harmonics into the 15,000 and 20,000 kilocycle bands.

The schematic shown in 4D is that of the resonance type indicator described in the December, 1926, issue and should be easy to build.

Before closing we might gather up a few loose ends. As to the distance which the set can cover, we do not know. Using the layout shown here the station gets RS-6 reports from this country on both coasts. It has two or three reports from Australia but no communication made. The communication angle depends mostly on the operator and how desirous he is of burning the midnight Rockefeller product.

In tuning the doubler circuit if you should happen to hit the fundamental of the crystal instead of its second harmonic you will know it by the violent oscillation of the doubler and the fact the crystal will kick off its setting. The same applies to the power amplifier circuit.

If you get the set all tuned with the use of the C batteries, try eliminating the C bias on the doubler and insert a resistance. If that is successful try the same trick on the power amplifier. Maybe you will get away with it; and maybe you will not—it all depends.

Plate current for the 201-A on the crystal in 9BX runs 20 ma when not oscillating and about 10 ma when oscillating. Plate current for the doubler does not exceed 10 ma, and current for the power amplifier plate does not exceed 100 ma. Under these conditions all of the circuits are working at a safe value. If you are skeptical of the 201-A in the crystal, use a 112, although you do not really need a great deal of crystal energy to swing the 210 tubes.

About radiation we cannot tell you much. Our best value for the current specified has been 7 amphere. It seems enough to carry on intelligent conversation, so why worry about the elusive extra tenth of an amphere.

Description of the construction and operation of the traffic receiver has been reserved until the last so as to give as much data on it as possible.

Schematically the receiver is depicted on page 21. On the opposite page will be found a photograph of the receiver itself enclosed in an aluminum box. The parts used in the set are as follows: Sockets and 50,000 ohm variable resistance by Frost; grid condenser and bypass condenser by Sangamo; audio transformer by Thorardson; 1 mfd bypass condenser by Potter; Electrad grid leak; coil socket and blank forms by Silver-Marshall; tuning condenser (a cut down 3 plat-er) by Cardwell antenna coupling.
condenser (type N) by X-L, A and B batteries by Everready, and the final choice on dials is the latest Remler release which is a dandy drum dial, taking any and all kinds of condensers. The geared vernier does not make any noise either at 40, 20 or 15 meters; also does not worry the operator with backlash. Signals on any of the bands mentioned may be followed with ease, which contributes a great deal to the peace of mind of the operator.

As elsewhere stated, several items are at ground potential. The variable condenser is grounded to shield, so is the positive A line, likewise the variable resistance which governs regeneration, and the headphones are at ground potential, being between ground and negative of the second B battery. The Frost variable resistor in the picture is hidden beneath the Potter bypass condenser, which is located midway between the drum dial and the B batteries. That is about all that is necessary to tell the traffic hound or the seasoned experimenter. The coil socket, transformer, tube sockets and the antenna coupling condenser are mounted on a flat board on the bottom of the box.

Now for the operation of the set. First of all you will want to wind your own coils to cover the different bands. The values shown in this article apply for this particular receiver used at 9BHX. However, they can be duplicated easily enough. The grid dip driver previously described is a dandy means of showing the high and low frequency limits of your recoils. If you chart your oscillator you can set it to work on any desired frequency and tune your receiver to meet it. In winding the tickler turns which go into the slots on the Silver-Marshall blank forms, it is well to wind on an extra one or two and then if regeneration is too strong (or uncontrollable) over the entire tuning range of the coil, one turn may be lopped off at a time until you get the proper regenerative value.

Coil 1 has 20 turns of No. 18 tinned copper wire spaced about an eighth of an inch. The tickler coil is 5 turns of No. 22 DCC wound in the slot. It covers (with the cut down Cardwell) the range from 6950 kc to 8500 kc, sufficient to take in all of the 7000-8000 kc amateur band which is a thousand kilocycles wide.

Coil 2 has 15 turns on the secondary spaced the same as the previous coil. The tickler has 3 turns. This coil tunes from 8300 kc to 10,150 kc.

Coil 3 has an 11 turn secondary and a 3 turn tickler. It ranges from 10,000 to 12,400 kc.

Coil 4 has 9 turns for the secondary and 3 for the tickler. Its range is from 11,450 to 14,000 kc.

Coil 5 which takes in the lower amateur band, has a 7 turn secondary and a 3 turn tickler. It ranges from 14,000 to 17,000 kc. That particular amateur band is from 14,000 to 16,000 kc.

Coil 6 has a 5 turn secondary and a 3 turn tickler. Its range is from 17,000 to 20,000 kc.

It will be observed that there is quite a recurrence of a 3 turn tickler in these coils. However, this value proved to be most effective for the 199 tube with 45 volts; other tubes and voltages may change the turn number.

In the following table may be found some of the stations that will serve as a landmark for the amateurs in finding the frequency range their receiver covers. Most of the stations are crystal controlled and permanent although in the case of the Navy these frequencies may be altered from time to time:

<table>
<thead>
<tr>
<th>Station</th>
<th>Frequency</th>
<th>Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIZ</td>
<td>6970</td>
<td>1</td>
</tr>
<tr>
<td>2XAI</td>
<td>6960</td>
<td>1</td>
</tr>
<tr>
<td>FW</td>
<td>7590</td>
<td>1</td>
</tr>
<tr>
<td>9BHFX</td>
<td>7600</td>
<td>1</td>
</tr>
<tr>
<td>9EK</td>
<td>7800</td>
<td>1</td>
</tr>
<tr>
<td>9MO</td>
<td>7890</td>
<td>1</td>
</tr>
<tr>
<td>WUA</td>
<td>8010</td>
<td>2</td>
</tr>
<tr>
<td>NAA</td>
<td>8030</td>
<td>2</td>
</tr>
<tr>
<td>WVZ</td>
<td>8050</td>
<td>2</td>
</tr>
<tr>
<td>KDQA</td>
<td>8260</td>
<td>2</td>
</tr>
<tr>
<td>WVV</td>
<td>8370</td>
<td>2</td>
</tr>
<tr>
<td>WTO</td>
<td>8450</td>
<td>2</td>
</tr>
<tr>
<td>WVA</td>
<td>8510</td>
<td>2</td>
</tr>
<tr>
<td>WVC</td>
<td>8530</td>
<td>2</td>
</tr>
<tr>
<td>WVT</td>
<td>8670</td>
<td>2</td>
</tr>
<tr>
<td>WVA</td>
<td>8730</td>
<td>2</td>
</tr>
<tr>
<td>WVB</td>
<td>8850</td>
<td>2</td>
</tr>
<tr>
<td>WXX</td>
<td>8890</td>
<td>2</td>
</tr>
<tr>
<td>WNB</td>
<td>1985</td>
<td>2</td>
</tr>
<tr>
<td>AOE</td>
<td>9665</td>
<td>2</td>
</tr>
<tr>
<td>WVR</td>
<td>9010</td>
<td>2</td>
</tr>
<tr>
<td>WVC</td>
<td>9150</td>
<td>2</td>
</tr>
<tr>
<td>KEL</td>
<td>10,230</td>
<td>3</td>
</tr>
<tr>
<td>AGB</td>
<td>11,270</td>
<td>3</td>
</tr>
<tr>
<td>GL-Q</td>
<td>12,100</td>
<td>3</td>
</tr>
<tr>
<td>2XAD</td>
<td>11,370</td>
<td>4</td>
</tr>
<tr>
<td>KET</td>
<td>13,100</td>
<td>4</td>
</tr>
<tr>
<td>WIK</td>
<td>13,600</td>
<td>4</td>
</tr>
<tr>
<td>NAA</td>
<td>13,950</td>
<td>5</td>
</tr>
<tr>
<td>NAA</td>
<td>16,000</td>
<td>5</td>
</tr>
<tr>
<td>WLL</td>
<td>16,660</td>
<td>5</td>
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<tr>
<td>NPG</td>
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<td>5</td>
</tr>
<tr>
<td>2XT</td>
<td>18,550</td>
<td>6</td>
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<tr>
<td>WSS</td>
<td>18,740</td>
<td>6</td>
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<tr>
<td>SPFU</td>
<td>19,330</td>
<td>6</td>
</tr>
<tr>
<td>AGA</td>
<td>20,000</td>
<td>6</td>
</tr>
<tr>
<td>2XAW</td>
<td>20,000</td>
<td>6</td>
</tr>
</tbody>
</table>

It would be well not to place too great reliance on the permanence of the frequencies shown in this list, since there is a general shifting of...
frequencies at the various stations as conditions demand. For the present these figures will be correct, however, as far as we could ascertain at press time.

Reception on the traffic receiver was all that could be desired. Freedom from noise and a dandy signal was the result. Inside of an hour the following foreigners were heard: OZ3AI, OZ2GA, EG5XY, OA2YI, NNINIC, NM1N, NM1J, OA2RC, OZ4AE, O4ACG, OZ1AP and OA2BP.

We cannot resist the temptation to suggest that the world is getting mighty tired of rotten ac notes and the more either pure dc or nearly so stations are, the less interference there will be on the 40 meter band. The 20 meter band may be all right for somebody with an ac note but the chap with pure dc will be passed over every time unless he has a wallop about like WIZ on the 40 meter band. Also we would like to venture the opinion that the world needs a good receiver and if there were more of them in existence there would be less alibis on the part of the fellow who cannot get his traffic through. With a decent tuning set it is not hard to work on the 40 meter band. With a poor receiver no wonder so many complain about punk conditions on 40 meters.

To derive kilocycles from meters divide 299,820 by meters; to secure meters divide 299,820 by kilocycles. Or better still, get a copy of the government kilocycle conversion table, Miscellaneous Publications of the Bureau of Standards No. 67, which may be secured for a nominal fee.

Beginners may find interesting data on securing licenses, etc., from a story printed on page 17, May, 1926, Radio Age.

Oscillation Control

In many types of receivers, especially the home built type, the tendency of the r. f. stages to oscillate has been the greatest drawback. To counteract this condition Electrad of New York, has recently marketed a device known as the Phasatrol, which consists of a variable resistance and a fixed capacity made up into a special unit for either one hole mounting or baseboard work.

Installation of the device is very simple. The line between the plate of any r.f. stage and the P post of an r.f. coil or transformer is broken and the Phasatrol inserted. The terminal B plus goes to the B battery, while P of the Phasatrol goes to plate. PC on the unit goes to the old P connection on the transformer. In this manner the resistance is placed in series with the B battery, and r.f. current for the transformer is secured through the capacitative coupling of the condenser. Instead of the primary winding of the transformer carrying any direct current it carries only the a.c. component of the signal.

The device is shown above. It may be adapted to almost any kind of receiver, including superheterodynes in which intermediate stages have a tendency to oscillate. Well designed super intermediates will not require its use, but many of the old type supers could be improved by the insertion of a Phasatrol in each of the intermediate plate circuits.

Ghosts Prove to be Radio Mirages

The process of television recently developed by the engineers of the Bell Telephone Laboratories has supplied a new proof that the upper levels of the air are highly electrified. The process works by radio as well as by telephone wire. As the experiments continue radio images are being transmitted continually between the experimental radio station at Whippany, New Jersey, and the laboratory in New York City. It is found that many of these radio images are double, a second ghostly picture of the person whose face is seen being visible beside the main image. If the engineers in charge believed in the occult they might have been frightened by this apparent evidence of psychic influence. Much slighter appearances have led to ideas of spirits and auras and other mysteries. But the engineers have found a simpler explanation. It is that the radio waves traverse two paths between the transmitter and the receiver. One path is a direct one, like the beam of a searchlight. The other path is upward to the highly electrified layer in the air, fifty or sixty miles above the ground, and thence downward again to the receiver. The electrified layer acts like a mirror and reflects the radio waves back to the earth. The ghostly images on the television screen are really mirages, like those which travelers sometimes see in the desert or on the ocean.

Making a V. T. Voltmeter (Continued from page 8)

The graph of Fig. 4 suggests the possibility of obtaining calibration curves with points over the entire range of the tube voltmeter by actual measurements with both alternating and direct voltimeters. Such instruments, of the high resistance type may be borrowed for the purpose and will give a calibration of good accuracy. Since the calibration described in this article depends upon the accuracy of a low priced voltmeter, the accuracy of subsequent voltage measurements outside the range of the calibrating voltmeter is limited. Nevertheless the construction of the tube voltmeter will be found to be well worth while in the interest and instruction derived from its use.
POISONS of serpents have attracted the attention of many noted scientists. There is a lure and fascination in such studies. Attending their progress is the realization of contact with a high degree of specialization perfected through the ages, until the snake acquired a pair of hypodermic needles to take the place of teeth in the upper jaw, and glands secreting lethal fluids that have killed a million and more humans.

It is well to check up that latter statement. A million humans bitten and killed by poisonous snakes! "In how long a time?" asks the reader. And the answer is that in fifty years in India alone, statistics point to this appalling number of deaths from snakebite, as the annual average is slightly over twenty thousand each year. Add to this the fatalities from deadly serpents in Africa, where there is a large number of dangerous species; in Australia, where the greater number of the serpents are poisonous; and the vast tropics of Central and South America infested with poisonous snakes. There has been an estimate made (without actual statistics) that from three to five thousand deaths occur from snakebite each year in the American tropics. Statistics gathered by the writer, over a period of several years, and relating entirely to the United States, indicate an annual average of over one hundred deaths.

Like the history of a number of sinister human maladies, the death rate from snakebite is soon to change, with the application of scientific discoveries to practical methods of understanding and widespread use. The actual start was at the Pasteur Institute, in France, some twenty years ago. Dr. Albert Calmette immunized horses against the action of cobra venom and obtained a serum for use in India. Unfortunately, the venom of the cobra is particularly rapid in action and the population of India rather slow to appeal for help when bitten. Calmette's discoveries have, however, started research work in many countries and there are now specific serums prepared in various parts of the world.

While Calmette must be credited as being the pioneer in the production of a curative serum, following the researches of venom composition by Wier-Mitchell, Noguchi, Langmann and others, the eyes of the scientific world were turned, a little over ten years ago, to Brazil, where was founded for the first time an extensive institution for the production of serum for snakebites. The name of the chief of this novel and modern establishment in the city of Sao Paulo, was soon to become internationally known. Dr. Vital Brazil has set a world-wide pace in producing a remedy, astonishing in results, not only of vast economic importance to the American tropics, but already the means of saving many lives in the United States.

When the serum is injected into a human victim, even though grave symptoms have developed and there is great pain and swelling, an immediate immunity takes place. We cannot say that the serpent's poison is neutralized—in fact, we cannot accurately define the working of the serum. There is a change within an hour. Mental hallucinations give
way to clear thought, reflex vomiting ceases, the great swelling of arm or leg quickly subsides, and the area of discoloration fades to normal hue. At the seat of the fang wounds is an area infiltrated and broken down with the poison. Without the serum—if the victim lived—there would be a steady and dangerous necrosis, probably going to the bones and invading their surface, but this area quickly clears up, in firm and healthy tissue, leaving nothing but an indented scar to tell the story.

Serum for the United States will be ready in considerable quantities early this summer. It will be produced at the Antivenin Institute of America, at Glenolden, Pennsylvania, an establishment which came into being under the sponsorship of several scientific institutions, among them being Harvard University. The work of serum production is in charge of Dr. Afirnado do Amaral, who was associated with Dr. Brazil in the work at Sao Paulo. He is a comparatively young man, of brilliant attainments, has already spent several years in the United States becoming accustomed to American methods, is a well-known authority on reptiles, and promises to produce the duplicate in this country of the Brazilian institution.

The establishment of the Institute is broader than the mere opening of the laboratory at Glenolden. Branches for the distribution of information will be located over the entire United States. The headquarters for information will be at the New York Zoological Park, in charge of the writer. An important branch in New England will be in charge of Dr. Thomas Barbour, of the Museum of Comparative Zoology, at Harvard University. The Zoological Society of St. Louis will be one of the midwestern branches, with Curator Perkins, of the Reptile Department, in charge. Another branch will be established in Texas, under the direction of Colonel M. L. Crimmins; another in California, under the direction of L. M. Klauber, Curator of Reptiles of the Zoological Society of San Diego.

**Belated Justice for Aluminum Discoverer**

THAT the wrong man has been credited for a century with the discovery of one of the most useful modern metals, aluminum, is the report made to the American Electrochemical Society by Junius D. Edwards and Martin Tosterud, research chemists of the Aluminum Company of America. In 1825 Dr. Hans Christian Oersted, Professor of Physics at the University of Copenhagen, in Denmark, and well-known all over Europe as the discoverer of electromagnetism and possibly better still as a delightful lecturer and writer on popular scientific subjects, announced that he had produced the silvery metal now called aluminum. The experiment was repeated in Germany, where chemists were unable to make it work. The German chemist, Friedrich Wöhler, quite as eminent as Oersted, then modified the reported method, made his new method work successfully and has been honored ever since as the discoverer of the metal. Oersted was already well-supplied with scientific honors and he was a busy man. Apparently he did not regard his discovery of aluminum as of any importance, for he never contested Wöhler's claims or attempted to establish his own rights as the discoverer. Recently Messrs. Tosterud and Edwards extracted from the dusty annals of the Royal Danish Academy of Sciences the record of Oersted's first experiment. They have duplicated this experiment, exactly as the long-dead scientist described it. It proves to work perfectly.
Bed of Pacific Believed Twisting Like Turntable

That the entire bed of the Pacific Ocean is slowly rotating, like a gigantic soup plate laid on a table and turned around in the direction opposite to the movement of the hands of a watch, is the startling idea suggested by the Japanese earthquake expert, Dr. Sakuhéi Fujiwhara. Evidence supporting this remarkable conclusion has been found both in Japan and in California. Study of the earth movements associated with recent earthquakes in the Island Empire indicate a very slow drift of the sea bottom off the Japanese coast to the south, while the islands themselves are moving relatively to the north. Similarly, in California, investigation of the San Francisco earthquake as well as of subsequent earth movements, has disclosed a slow northward drift of the sea bottom and a relative southward movement of the land. Facts supporting the same conclusion are marshalled by Dr. Fujiwhara from other margins of the great Pacific basin. No reason is apparent for such a gigantic twist of the enormous depression in the earth’s crust which the Pacific represents and Dr. Fujiwhara suggests none. While other scientists will undoubtedly remain critical of the theory until further proof is available, it is already attracting much interest in geological circles.

Test Brick By Radio

APPLICATIONS of radio to almost every purpose have been made in the past few years so it is hardly surprising to hear of a new and novel use to which a condenser microphone and a two stage amplifier has been put.

Building bricks are now being tested for quality by means of the condenser microphone and amplifier mentioned above. One of the first uses of its kind comes to our notice in a communication appearing in the May, 1927, issue of the Journal of the Franklin Institute, presented by Juichi Ohata, of the physics division of the Aeronautical Research Institute of the Tokyo Imperial University.

We quote from the Journal:

“In discriminating the quality of material the sound produced by striking it is very often utilized in practice. In the case of brick it is generally believed that one which gives a metallic sound when struck by a hammer has superior quality as the architectural material and this opinion is undoubtedly correct.”

About thirty specimens were tested, the majority being overburnt. The final method of test was the use of a condenser microphone and a two stage amplifier connected to an oscillograph.

“Records of sound were obtained with about 30 specimens. A wave of 50 cycle a.c. was recorded simultaneously as the timing wave. In the beginning of the work it was noticed that there existed remarkable differences in the degree of damping of the sound in various specimens and it was hoped that by the oscillographic record of the sound produced, the pitch of as well as the degree of damping of the sound might be accurately determined, both being believed to have an intimate relation to the quality of the material. As a matter of fact it was found, however, that in some specimens the intensity of sound was greatest in the beginning and then gradually died out, while in others the sound attained its maximum after an elapsed some time. Moreover a beautiful beat note was observed with some specimens.

“To produce sound the specimen was simply supported with the left hand and then struck at the middle part with a small steel hammer held in the right hand. The force of the blow as well as the speed of separation of the hammer after striking may not be constant in each case, so that the complex nature of the sound may be partly due to the difference in the mode of striking. Anyhow, owing to such complex nature of the sound the comparison of the degree of damping was made somewhat difficult, and hence only the pitch was determined from the record.”

Condenser Aids Long Lines

Frank G. Baum, noted engineer, whose device, known as the "synchronizing condenser and regulator," purchased by the Westinghouse Electric recently, solves the problem of transmitting economically large amounts of electric power over distances of thousands of miles. The advantages claimed for the new device are,—eliminates distance as a barrier in power and light transmission, increases the efficiency of the lines in that just as much power reaches the destination as starts from the generating plant. Herefore so-called "line loss" has been a serious obstacle to long distance transmission. It also increases the amounts of power and light that may be transmitted over the wires. Baum’s invention in appearance and in action is similar to a gyroscope used on ships. The "condenser" constantly revolves about an axis and is so designed that it automatically keeps the power in the lines at the highest peak.

Giant Incandescent Lamp

A tremendous but practical 10,000 watt, 25,000 candlepower incandescent lamp has just been perfected by the Westinghouse Lamp Company for the lighting of airplane landing fields. Henry Ford will make use of the new lamp for his aviation field and the Army Air Service is expected to install several in their landing fields. These new lights are intended to supplement the high intensity searchlights and a single bulb enclosed in a device similar to a light-house lens is sufficient to illuminate an average landing runway 2,000 feet long. The heat developed inside the lamp is so tremendous that a special type of hardened glass is used.
Silk Worms Are Improved by Getting Drunk

THAT silk worms do their best work when fed on alcohol is the conclusion of the Japanese silk-worm expert, Mr. Nakai, as reported to the Journal of the American Medical Association by that periodical's Japanese correspondent. Working at the silk-culture laboratory of the Prefecture of Okayama, Mr. Nakai has developed a food for silk worms consisting in part of sake, the Japanese national drink which is an alcoholic wine made by the fermentation of rice. Silk worms are fed usually on the leaves of the mulberry tree, which grows in profusion in Japan. By the use of the sake, mixed with wheat flour, the worms can be kept alive and active, Mr. Nakai finds, on much smaller amounts of the mulberry leaves. Even more important practically than this saving of the quantity of the leaves necessary for the worms is the fact, which Mr. Nakai also reports, that the dose of alcohol in the sake improves the physical condition of the worms.

Sky Salts England

THAT the whole island of Great Britain is being sprinkled with salt, as if from a gigantic salt-shaker, is the conclusion recently announced to the Literary and Philosophical Society of the city of Manchester, England, by Wilfred Irwin. The salt comes from the sea and most of it falls on the land surface, not as dry salt, but as salt dissolved in the British rain-water. Mr. Irwin has analyzed rain-water collected at twelve different points in England and Wales, both at times of calm weather and during violent storms blowing from the sea. Averaging the data, with proper calculations of the amount of rainfall and so on, he finds that about one million tons of salt falls each year on England and Wales alone. This enormous amount of salt would soon render the land a barren desert, like the salt flats of the Sahara, were it not for the fact that the salt is carried back to the sea again in the water of the brooks and rivers. The amount of salt sprinkled on the land is much greater, as was expected, during or just after violent storms from the sea than at times of calm. The source of the salt is believed to be almost entirely sea spray blown up from the surface of the ocean during storms and dried in the air to tiny particles of salt dust. These then blow inland and are dissolved and carried down by the rain.

Daily Tide Discovered in Blood Corpuscles

THAT there is a daily tide in the human blood, not unlike the ebb and flow of the tides in the sea, is the remarkable conclusion recently announced by Dr. A. F. Bernard Shaw, of Newcastle, England, as the result of a long series of researches on the white corpuscles of the blood. These white corpuscles exist in the blood in much smaller numbers than the familiar red corpuscles but they are equally necessary to life. They are believed to have the duty, among other things, of dealing with disease germs that enter the blood. Physicians have long known that the number of these white corpuscles in the blood varies from time to time, as well as in different conditions of health. Dr. Shaw has discovered that these variations in the number of the white corpuscles correspond to two daily waves of rise and fall, like the changes of the tide. One of these white-corpuscle tides reaches its maximum in the afternoon; the other in the early morning, after midnight. The causes of this curious fact are quite unknown. Dr. Shaw has not been able to detect any relation to the hours of eating or sleeping or of other periodic bodily actions. It is not inconceivable that some real tidal effect may be at work; either an inherited habit from the days when our remote animal ancestors were really tidal creatures living along the seashores, or some effect of the changing positions of the sun and the earth.

Test Tube Traps Drinkers

For Tipplers' wives—no more sniffing; this simple device, will tell whether friend husband has been drinking and how much. One breath through the tube and chemicals betray the secret

Scientist Travels Around Earth In Submarine

A YOUNG Dutch scientist has completed a voyage around the world under water in order to measure the gravitational attraction of different parts of the earth's crust. His name is Dr. Vening Meinesz and his voyage was made in a submarine loaned by the Government of Holland. By measurements of the force of gravity on land scientists have learned this force is not quite the same everywhere. At some points on the earth's surface a pound weight weighs a trifle more than a pound; at other points it weighs a trifle less. The differences are too small to be detected by ordinary scales but are important to science because they are believed to indicate differences in the density of the rocks of the earth's crust. This idea, known scientifically as the theory of isostasy, is important to theories of the structure of the earth, of earthquakes and of many other matters. The intensity of gravity cannot be measured on shipboard because the motion of the ship disturbs the apparatus. Dr. Meinesz devised a method of using apparatus carried by a submarine, submerged in the ocean. The motion due to the waves is thus avoided. When detailed measurements made on the recent under-water voyage have been computed they are expected to prove of great value to science.
Everyday Mechanics

Automatic Photo Device
During the past few months over 280,000 people have stopped in at a Broadway store and had eight tiny photographs of themselves made for 25 cents, the entire operation being performed in eight minutes by a remarkable device. The machine has now been sold for $9,000,000 by its inventor, Anatol Josepho, a young Russian photographer. The syndicate buying the patent's rights is headed by Henry Morgenthau, New York financier and former United States Ambassador to Turkey. Photo shows Josepho demonstrating how his machine is operated.

Picks Lottery Winners
A view of the apparatus used in deciding the winning numbers in the States Highway Lottery of Lower California, Mexico, which was recently inaugurated. The proceeds of the lottery go towards the developing of new roads throughout Mexico. The machine used to decide the winning numbers cost $10,000 to build. Three poor road laborers drew the winning numbers in the first lottery and won $10,000.

Left-Handed Girl Wins
Mary Weiser, of Newark, N. J., who is left-handed, has found that her peculiarity is an advantage for it enables her to do easily a job that right-handed girls cannot succeed at. The engineers of the Westinghouse Lamp Company recently built a machine for testing radio tubes at the rate of 30,000 a day and designed it to be fed by girls seated on either side. It was soon found that one of the girls did her part well enough but her partner could not keep pace with her. It was soon discovered that the second girl was forced to work left-handed and, therefore, was handicapped. A hurried search for a left-handed operator was instituted and Mary Weiser was selected for the job.

Distress Pistols for Aviators
Lloyd Bertaud (left), navigator, and Clarence Chamberlain, pilot, examining a Coston Chamberlain, pilot, examining a Coston aerial distress pistol which the latter carried on his flight across the Atlantic to fire cartridge flares in the event he was forced to land on the sea.

 Builds Tin Can Locomotives
Henry Comstock, 18-year-old high school student at Leonia, N. J., with his miniature Mikado type of locomotive which he constructed out of tin cans in eight days. The boiler of the engine is made of syrup cans, the wheels of can tops (the spokes punched out), and the cylinder is a tea can. The coupler on the front is the top of a shaving cream tube, the compressor is an adhesive tape box. The roof of the locomotive is made from part of a ginger snap can. The tank of the tender is made from a coffee can. The marker lights are binding posts from a radio battery and the headlight is made out of the top of a ketchup bottle.

One-Man Orchestra
S. L. Norris, of Dalton, Ga., had cravings to be an orchestra leader but the prospect seemed far distant. However, he has invented a machine which satisfies that craving somewhat. He can be his own orchestra and orchestra leader at one and the same time. The device by which he can play six different instruments was exhibited at the Fiddlers' convention in Atlanta, Ga., recently. The instruments which the contrivance operates includes one fiddle, three banjos, a whistle and a set of bells.

When Rail Monsters Crash
This photograph shows the tangled mass of steel and iron that resulted when two locomotives of the Colorado & Southern Railway met in a head-on collision at Wheatland, Wyo., recently.
How Bullet-Proof Vests Stop Steel

BY CHARLES LEE BRYSON

FROM that day when the caveman first made for himself a clumsy contrivance of dinosaur hide stretched over a flat piece of wood with which to ward off the blows of his adversary's stone axe, the imagination of man has been stirred by every advance in the art of protecting himself from the missiles of his foes. These advances have come slowly down to us through the prehistoric shield, the wool-wadded skin armor of the wild Afghans, the bronze helmets of the Assyrians and Babylonians, the cuirass and greaves of the Middle Ages and the light shirts of steel chain of later days, until the twentieth century has brought us to the bullet-proof vest. It looks like the ordinary woolen garment, but it stops bullets from the heavy U. S. .45 calibre automatic service pistol, the powerful German Mauser, and even the deadly Thompson machine gun.

Of what is this vest made? One might expect to find it fabricated of steel, tempered more finely than the old masters of Damascus could do it. Not so. It is made of a metal which is an improvement over steel in its resistant aspect—a metal lighter, more tough, more elastic. It has been named bovite, after its inventor, Mr. John J. de Boves.

Is the principle on which it operates, then, mere toughness? Mere resisting power? Not at all. Its lightness, its toughness, its elasticity are made use of, but the great principle which holds safe the life of the man behind the vest is the distribution of, rather than the resistance to, the force of the bullet. In making this distribution of the energy of the bullet, Mr. de Boves says he merely supplies the necessary "vibratory leak" which gradually absorbs the force of the bullet's blow instead of meeting and forcibly resisting its power.

For the bullet-proof vest is not merely a cloth-covered metal plate which by its strength and thickness is impenetrable. The metal part consists of three layers of bovite, each more thin and more light than the blade of a safety razor. And instead of each layer being one broad sheet, it is made up of many strips running perpendicularly, each about an inch and a half wide, held in place by the cloth and the stitching, much after the manner of the corsets which, within the memory of men still living, women used to wear. These strips overlap, after the style of the weatherboarding on a house, so that there is no crevice through which a bullet may slip. The whole is covered with handsome black cloth, so that no one suspects that the wearer is encased in armor more resistant than ever Ivanhoe or Richard Coeur de Leon wore.

The vest fits snugly under the arms, reaches well up to the neck, and of course covers the back as well as the front of the body. There is also a little flap, or apron, which hangs down to protect the groin. Thus all the vulnerable parts of the torso are held safe. Alexander H. Dunlap, publisher of The Detective, the official journal of the police and sheriffs' forces all over the country, estimates that of all the men killed by gunshot wounds, ninety-eight per cent are shot in the body, and ninety per cent in the front part of the body. That leaves only two per cent of all fatalities for those portions of the body not covered by the vest, and of course all but a negligible percentage of these are head wounds.
What, then, happens when a man wearing one of these bullet-proof vests is shot? If the vest is put on a tailor's dummy, presenting a hard, unyielding resistance, the bullet goes through it as if it were a piece of tin nailed on a board. The principle of the "vibratory leak" has no opportunity to work. But on the soft, yielding human body, this principle saves the victim. The outer of the three plates of bovite receives the shock of the bullet, and instantly it springs, stretches, yields, and permits part of the force to be transmitted. One such thin plate alone would be perforated. But instantly the second plate takes up such of the strain as has passed the first, and it in turn springs, stretches, yields. It sustains perhaps one-tenth of the force of the blow which was delivered to the outer plate, yet if there were but two plates they might, conceivably, be penetrated by a high-powered bullet. But inside the second lies the third plate, waiting its turn to take up and distribute the blow. It receives perhaps one per cent of the force of the blow, and it springs, yields slightly, and the bullet is stopped there dead in its course, deformed, flattened, utterly harmless.

Mr. de Boves says that he hit upon this principle by observing a large bell set in vibration by the blows of a heavy hammer. He considered that if he interposed his hand between the hammer and the bell he might, by suffering a crushed hand, diminish though he could not wholly prevent, the ringing of the bell; but after the blow had fallen he could easily, and without harm to himself, grasp the rim of the bell and by providing the "vibratory leak" instantly stop the vibration and the sound. Then he set about providing a "vibratory leak" to take up the force of a bullet's blow before it had penetrated the human body. The tough, elastic, yielding metal bovite, arranged in three very thin overlaying plates, furnished him the medium.

What happens to the bullet fired against this impenetrable barrier? It is unbelievably deformed and flattened. The heavy steel missiles are mushroomed out like lead bullets fired against seasoned oak with a steel backing. Here again the value of the "vibratory leak" is seen. If a steel bullet were instantly stopped by a thick, unyielding steel plate, the bullet might be shattered, and each fragment would become a dangerous miniature bit of shrapnel. But, merely held back by the yielding but impenetrable series of bovite plates, the bullet is flattened and distorted, but not splintered.

One of the most interesting features of the development of this vest is the series of demonstrations on human beings. James Letts, of Mr. Dunlap's office, known by his fellows as the "human target," has been shot more than 5,000 times, and has yet to feel a wound. He has de-

(Continued on page 45)
ABROAD where radio is still in the novelty class, a good deal of interest has been attached to the recent experiments of broadcasting from a ship to a plane, broadcasting from the ocean depths to a plane and broadcasting from a plane to the under sea diver.

This stunt was performed off the coast of Sylt, Germany. In the large photograph shown above is the makeshift studio in one of the German vessels from where the program was sent. It was picked up by Otto Kemmerick, a German long distance swimmer who wore a specially built rubber suit which carried headphones so the swimmer could listen in. An especially constructed antenna was used inside the suit for reception.

In the lower photograph are shown: Otto Kemmerick, right, the famous German long distance swimmer, bidding good-by to Alnwik Harmstorf, a diver, just before the broadcasting tests were tried off the coast of Germany. The diver broadcast to an airplane pilot who in turn replied. The swimmer passing through the water picked up both sides of the conversation through an especially constructed suit and headphones.

**Plays For Hour At Time**

A new phonograph, has been perfected which will play for an hour at a time. The machine automatically feeds twelve records to the revolving disk from a magazine, with stops between records of less than half a minute. It makes it possible to put into the magazine the records of an entire symphony, or an assorted program of dance music, or the more important selections of an opera, and listen to them all without the necessity of changing records. The several operations which take a record from the turntable, deposit in it the magazine and replace it with a new record are performed by a system of cams, which are so simple that there is said to be no more chance of anything getting out of order than there was in the old-fashioned machine.

**Auto Happy Hunting Ground**

Thousands of new automobiles are manufactured yearly in America, but have you ever wondered where all the old autos go to? There is a firm in Los Angeles which buys any make or model auto in existence, including wrecks. These cars are stripped of all the parts which are still in good working order, and sold to the public. All other parts which are not useful are cut up with a torch and sold to steel and junk companies.

**Buys Station WENR**

Station WENR formerly owned by the All-American Radio Co., has been purchased by the Commonwealth Edison Co., of Chicago, effective June 1.

Studios are located on the 23rd floor of the Straus building in Chicago. According to the new schedule of broadcasting the programs will be divided into noon hour, matinee, dinner music, classical hour and the popular hour.
New Modulation Biggest Discovery
(Continued from page 3)

While it is not indicated that this modulation system may be applied to other than crystal control outfits, it appears at the time to hasten the universal adoption of crystal control for all stations.

This recent discovery will open up a new field for receiver design in which the manufacturers will find the greatest necessity for sharp-tuning receivers. This will be greatly welcomed by the listening public.

So much for the achievements that must follow the lead of Conrad's research. Those who have been following closely crystal control work will see the basis for the new frequency modulation system. For some time past the Westinghouse interests, of which Conrad is assistant chief engineer, have been using crystal control not only on their broadcast transmitters but on their private telegraphic stations. Normally it takes sixty percent of a station's power to modulate its carrier. Under the stunt originated by Conrad, there is an immediate saving of 60 per cent in power costs.

Like other important basic discoveries there appears to be no limit to their applications and the frequency modulation seems to be no exception to the rule. The longer the matter is considered the more its importance grows on one.

How Strong Are the Signals?

How strong are the signals from your favorite broadcasting station? How many miles do the average broadcasting station cover day and night, winter and summer? These and many other questions may be answered by the portable radio receiving outfit shown in this photograph and designed by the radio laboratory of the Bureau of Standards for use by radio supervisors of the Department of Commerce. S. S. Kirby of the Bureau's radio laboratory is shown in the picture.

Glider Establishes New Mark

Ferdinand Schulz, a teacher in East Prussia and one of the foremost German gliding flyers, recently established a new world's record for remaining in the air in a motorless plane at Rositten, Germany. Schulz kept his glider in the air for fourteen hours and seven minutes during which time he covered a distance of at least 450 kilometers and at times rising to a height of 380 meters.
England Hears Rome Storm

How a thunderstorm in Rome ruined radio reception for listeners in Spain, in England, in France and even in Norway was described recently to the Royal Meteorological Society, in London, by the well-known physicist and radio investigator, R. A. Watson Watt.

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DeForest and Crosley
This is the first picture of Dr. Lee DeForest, left, and E. F. Crosley, Jr., right, taken together. Mr. Crosley became president of the DeForest Radio Corporation a few weeks ago and he will retain complete control of the company for five years under an agreement.

Plane Tows Glider
Experiments are being conducted by the Rash-Katzenstein Airplane Works, near Berlin, to prove that airplanes may do what railroad trains are doing nowadays, that is to have a "Locomotive" pull a number of motorless airships, releasing each one of them over various cities. A glider was fastened to an airplane by means of a wire and an automatic release enables the pilot of the glider to disconnect his ship at will.

Remember
on your present set, or the one you're building, you can't sacrifice the added convenience, lightness and mechanical superiority of the Jones MULTI-PLUG.

Type RM, with 4 ft. cable, price $1.50
Ask Your Dealer
HOWARD B. JONES
2226 Waushara Ave.
Chicago, Ill.

Townsend
"B" Socket Power
Best in World!
Says A. W. Gale
of Gloversville, N. Y.

DeForest, Crosley, and others have had it. One of the first was Dr. DeForest. The Eliminator works fine. Showed it to a friend and he wants one also. I'll say it sure beats batteries. I get stations I never got before on a 6 tube set.

Charles Ellis, 88 Jones Ave., Columbus, Ohio, says, "Your Eliminator works fine. Have had station WJAX and others over 1,000 miles distant. Picked up all different stations one evening and around 30 another time. My neighbor has a $75.00 Eliminator and I don't see that it works any better than yours. Delivers up to 100 volts on any set, on D. C. or A. C.—any circuit, full tone, clarity and volume.

Tested and approved by America's leading Radio authorities—Radio News and Popular Radio Laboratories

ORDER TODAY!

Simply fill out the coupon and slip it into an envelope with only $1.00 and mail it once. Your Townsend "B" Socket Power Unit will be sent promptly. Deposit only $1.00 plus postage with the postman. Try out for 10 days then if not delighted with improvement in reception, return it to us and purchase price will be refunded.

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10 Days FREE TRIAL

You are the judge.

TOWNSEND LABORATORIES
713 Townsend St., Dept. 13, Chicago, Ill.

Gentlemen: Attached find $1.00. Kindly send at once Townsend "B" Socket Power Unit, C. O. D., for $5.85, plus postage, on guaranteed 10-day free trial.

Name
Address
City, State
Build a VICTOREEN for real radio pleasure

A Victoreen Super has range, selectivity, volume and clarity. There are thousands of fans who build Victoreen sets every year. The results come up to full expectations.

VICTOREEN TRANSFORMERS are the heart of the circuits—air-core construction—tuned to 3-4 of 1 1/2 precision—use No. 170 for storage battery tubes—No. 171 for dry cell tubes. Each $7.00.

Other VICTOREEN Parts—
Rheostat. Large number of turns of wire—three terminal type. 2, 6, 10, 20, 30 ohms. Each $1.20.
Potentiometers. 200, 400, 600 ohms. $1.50. Master Control Unit. A compensating single control unit for sets using two or three pentodes, and equals capacity. Price $19.50. Extra condensers $0.50 each.
Audio Control Unit. Three rheostats of proper ohmage controlling detector and audio tubes. Each $4.50.

Ask your dealer or write direct for literature giving complete information.

The George W. Walker Co. 6228 Carnegie Ave., Dept. P, Cleveland, Ohio

Know What You’re Missing (Continued from page 5)

power Australian amateur stations plainly audible in any part of the United States.

The short waves interfere with no one. It is not unusual to find a short-wave station operating in a section filled with broadcast receivers without causing complaints. Often the neighbors do not know that the station is there.

There are many purposes that amateur radio might serve which are now overlooked; opportunities that challenge men of vision.

Men who have common commercial interests might easily maintain communication over long distance with low-power, short-wave sets installed in their homes. They could exchange confidential messages with small chance of their being intercepted and could code them if greater safety were required.

Radio amateurs could serve philanthropies such as the Young Men’s Christian Association by sending their messages across the continent in less time than it takes the mail to go from New York to Chicago.

The Boy Scouts of America requires its members to learn the International Morse code in order to reach the rank of first-class Scout, and a merit badge in radio is offered, but for lack of technical leadership it seldom gives the Scouts an opportunity to put their knowledge of radio to practical use. Here and there are radio patrols that do interesting stunts in the field and at home stations. A very little effort would be required to increase interest in radio and build up a communication system that would handle much of the organization’s correspondence and be of invaluable service in emergencies.

Which idea appeals most strongly to a red-blooded man: to sit in the old arm chair after night merely listening to programs, or to be communicating with folks all over the country and exerting an influence felt around the world. You can start something today, by securing the parts for an amateur transmitter. Directions come with them and amateur short-wave apparatus is far simpler to assemble than any other kind. (See the blueprint section in this issue.—Editor).

There is one thing that never yet has been accomplished and any man who achieved it would become famous. There never has been a complete tie-up between local radio amateurs and the chamber of commerce, the police and fire departments, the Red Cross, the Y. M. C. A., the Boy Scouts and other civic organizations.

---

CARTER PARTS as usual specified in

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Ask your dealer to show you why
In Canada: Carter Radio Co., Ltd., Toronto

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X, P, Q, R, M, Z, T!

An announcement on the average loud speaker, may sound like this; but with the "ENSCO" 3 foot cone or roll speaker you hear every word and every note through the heaviest static.

Kit $10 GENUINE $10

Why has "ENSCO" been endorsed by all leading magazines and the foremost newspapers? Because—it is the most highly developed big cone assembly now offered to the public, it reproduces all frequencies and greatly reduces static. The "ENSCO" unit is the only direct-drive unit for large cone speakers.

Manufactured under U. S. Patent No. 1030199; "ENSCO" Cushion Drive Patent No. 1463584; Cone Diaphragm Patent No. 1090655 and other patents pending. Assemble the "ENSCO" speaker in less than an hour. It works on any set with any power. No filters or choices necessary, 90 to 250 volts without protection or 500 volts with transformer. Six different types to choose from. Comes beautifully decorated and marked for assembly. Wall, pedestal or console; all fully described in illustrated instruction book.

Sold under absolute (money back) guarantee.

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28 E. Jackson Blvd., Chicago

Ask your dealer or mail order to nearest office.

Send money order, check or cash, or we will ship C. O. D. We pay shipping charges.

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Graphs Show Resistor Resistance Values

Few radio enthusiasts recognize or even realize the relationship between milliamperes, ohms and watts. Consequently, resistors are often incorrectly applied, resulting in serious overload and early breakdown, with the cause remaining an unsolved mystery to the layman although it may be perfectly plain to the electrical and radio engineers with their knowledge of the mathematics of the thing and the ability to figure it out for themselves with the hard-working slide-rule.

It will be noted that the first curve sheet or graph covers a resistance range of from 0 to 10,000 ohms, and also from 0 to 100,000 ohms, while the second covers a range of from 0 to 100,000 ohms, and also from 0 to 10 megohms. Otherwise, both graphs cover the same ground. Furthermore, it will be noted that if the resistance be considered in ohms, instead of megohms, then the reading for milliamperes is taken from the left-hand margin, while if the resistance is considered in megohms, then the reading for milliamperes is taken from the right-hand margin.

It is interesting to note the correspondence between current, resistance and wattage. Thus the 5-watt curve starts off with a current of 70 milliamperes at 1,000 ohms resistance, and drops down in a broad swing to 22½ milliamperes at 10,000 ohms.

TRANSMITTING APPARATUS

A Complete Stock at "Chi-Rad"

In addition to our regular broadcast apparatus we carry a very good stock of transformers, chokes, grid leaks, high test condensers, etc., for transmitting purposes.

NEW SHORT-WAVE COILS

Specially built by "Chi-Rad". Write for descriptive bulletin and catalog. Dealers and set-builders please use business letterhead when writing for discounts.

CHICAGO RADIO APPARATUS CO.

415 So. Dearborn St., Dept. RA, Chicago

Please Mention Radio Age When Writing to Advertisers.
12,000,000 FORD OWNERS
Need This
NEW Timer!

Earn $100. Weekly
Selling Them!

You will never again find such an opportunity to make big money as the DYNAMO TIMER offers you right now—the Timer is the weak spot of the Ford car. Expert automotive engineers claim that the average Ford wears out from 8 to 10 ordinary Timers. Think of the tremendous sales possibilities when you offer the Dynamo Timer with a guarantee for the life of the car. You don't have to be a salesman—this amazing Dynamo Timer sells itself on sight—millions of Ford owners need it. 200 per cent profit for you on every sale.

Make Old Fords Run Like New

Once a Ford car is equipped with the "DYNAMO," the Timer can be forgotten—the only thing that will prevent forgetting it will be the noticeable improvement in the running of the car. More power, more mileage, instant starting, amazing pick-up, are only a few of the features that will make any Ford owner a "DYNAMO" booster after he once uses this new Timer.

Guaranteed for Life of Ford Car

Remember, every Ford owner in your territory, sooner or later, is going to have to buy a new Timer. Why not be the one to sell him a Dynamo Timer backed with our actual guarantee for the life of the car?

Get Territory Quick

 Territory is going fast. Our agents can easily make $5,000, $6,000 and even $10,000 a year. Spare time workers make $20 to $30 a day.

If you want to get in on this big money, investigate now.

NOW Is THE TIME To ACT!

Don't let some friend or neighbor in your territory beat you to it. Send in the coupon Today for Free Sample offer and particulars of our big money-making proposition.

FREE SAMPLE

To aid our agents we have arranged a plan that provides them with a Free Sample so they can equip their own car or carry it for demonstration purposes. The unique principles of this wonderful Timer will make themselves apparent to any Ford owner after a minute's examination.

Big Money for You!

The money-making possibilities of a DYNAMO TIMER agent are absolutely unlimited, especially with the sales helps and backing we give our men. JOHN KABLE made $200 in less than 10 days. Many others are making big profits also. There is no reason why you, too, cannot get into the big-money class the same as John Kable and these others.

Ryan from Washington says: "I wouldn't take $25 for my Timer if I couldn't get another. I sold three in ten minutes."

"I am having good success in selling Timers," writes Berton, of Iowa. "I sold 10 Timers in three hours and am sending you an order for more, but they won't last long."

There is no sales resistance for the Dynamo Timer agent. Our agents everywhere are meeting with the same ease in selling as Ryan and Berton. You, too, will find it easy to sell the Dynamo Timer. Send the coupon now.

DYNAMO TIMER CO. 426-1164 Eleventh St., Milwaukee, Wis.

RUSH COUPON TODAY

DYNAMO TIMER CO., 426-1164 Eleventh St., Milwaukee, Wis.

Gentlemen: I want to get in on the big money to be made with your new DYNAMO TIMER. Without obligation, rush me particulars of your territory plan and FREE SAMPLE offer.

Name ..........................................................

Local Address ...........................................

City ................................................................

State ..........................................................

Please Mention Radio Age When Writing to Advertisers.
Bullet Proof Vest Stops Steel
(Continued from page 32)

ied death from Colt automatics, Thompson machine guns and German Mausers. And it is a fact that recently he was shot by accident, fairly over the heart, and if he had not happened to be wearing his bullet-proof vest at the moment he would have been killed instantly.

What is the effect on the man shot when he wears a bullet-proof vest? There is none. Mr. Letts says that he feels a very slight impact, as if one tapped him with a finger tip. There is not the slightest inconvenience, and the ashes are not even jarred off his cigarette. And this by a blow which, but for the vest, would mean instant death.

Policemen, sheriffs and their deputies, state and highway police, are rapidly being equipped with this safety device, and already the lives of many officers have been saved. It is on record that a motorcycle policeman of East St. Louis, Ill., pursued and, single-handed, captured an auto load of gunmen though they fired at him repeatedly. When they were safely in custody he examined his vest and found that it had stopped four bullets, any one of which would have killed him.

Another instance is cited from Martin's Junction, Ky., where the town marshall, John Hall, arrested two desperadoes as they stepped off a train, and his vest stopped ten bullets, any one of which would have given him a fatal wound.

More recently, in a Chicago suburb, several policemen arrested a number of escaped convicts from the state penitentiary. There was a hot revolver battle, and a number of the officers were saved by their bullet-proof vests. The only policeman killed had been furnished with the vest, but had scorned to wear it.

Such is the use to which the principle of the "vibratory leak" is being put—an idea so novel that Hiram Maxim said that Mr. de Boves "seemed to have discovered a new law of physics."

Radio Principles Help
Make Rubber Tires

E
ev
day a new use of radio is announced to the world. The latest is the practical application of radio principles to the manufacture of rubber for tires, bathing caps and many other products.

This inventor, Albert Allen, of Boston, happened to put a piece of tissue paper in a condenser of his radio receiving set one night, thinking that the station he was listening to would come in better. Much to his surprise, he heard an entirely different station. This interested him and he put in a thicker piece of paper and strangely enough, got a third broadcasting station.

Inventor Allen had not discovered a new radio principle. But there came to his mind's eye a practical use of this fact. If, he thought, changing the size of the paper, changes the wave length of the radio set, why cannot we measure the size of paper placed in a condenser by noting the actual change in wave-length.

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Make Rubber Tires

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WAR IS DECLARED
RADIO DECLARES WAR
On "B" Batteries

A sudden revolt from set owners
A fight against the costly upkeep of "B" Batteries startling tests revealed that the average life of "B" Batteries is 10 weeks. Think of it. Not alone money wasted, but the grief that goes with it. This amazing "B" eliminator is now in use by thousands of set owners on every make set. Just plug into your light socket and turn on your set. This unit will operate on A.C. or D.C. current. Has 4 taps and from 10 to 135 volts. 120 volts at 45 mills.

Will work any set from 1 to 15 Tubes

LASALLE MERCHANDISING
309 So. LASALLE, CHICAGO, ILL.

This coupon and money order for $2.95 or C. O. D will bring you a Eddyson "B" Eliminator.

Name:

Street:

Town: State:  

LaSalle Merchandising Co.
309 So. LaSalle St.
CHICAGO, ILL.

Please Mention Radio Age When Writing to Advertisers.
Dominion of Canada

CFAC Calgary Herald, Calgary, Alta. 434
CFGA Calgary Star Publ. & Prtg. Co., Toronto, Ont. 356
CFCH Marconi Wireless Tel. Co. Ltd., Ca. Mont., Que. 400
CFCK Radio Supply Co., Edmonton, Alta. 417
CFGN W. W. Grant (Ltd.), Calgary, Alta. 434
CFGR Laurentide Air Service, Sudbury, Ont. 410
CFCT Victoria City Temple, Victoria, B. C. 329
CFCL The Jack Elwell (Ltd.), Hamilton, Ont. 327
CFHC Henry Birks & Sons, Calgary, Alta. 434
CFKH Thordal Radio Supply, Thorold, Ont. 424
CFKQ The Electric Shop (Ltd.), Saskatoon, Sask. 329
CFRC Queens University, Kingston, Ont. 450
CFXJ Westminster Trust Co., Westminster, B. C. 291
CFXK Radio Corp. (Am. Ltd.), Vancouver, B. C. 389
CHBC The Calgary Albertan, Calgary, Alta. 434
CHCM Riley & McCormack (Ltd.), Calgary, Alta. 434
CHGS The Hamilton Spectator, Hamilton, Ont. 341
CHIC Northern Electric Co., Toronto, Ont. 357
CHINC Toronto Radio Research Society, Hamilton, Ont. 357
CHJA National Bible Assn., Saskatoon, Sask. 329
CHIXC R. Booth, Jr., Ottawa, Ont. 434
CHYX Northern Electric Co., Montreal, Que. 411
CJCA Edmonton Journal, Edmonton, Alta. 511
Sun Spots Responsible

RENED evidence that the sunspot maximum which is due this year will be one of the most severe for many years is supplied by the summary of sunspots visible during 1926 contained in the annual review of Royal Astronomical Society of England. The number of spots on the sun varies according to a regular cycle, with maxima every eleven years. It is known, however, that not all of the sunspot maxima are of equal intensity. At some of the eleven-year peaks of the sunspot curve the sun is much more active than at others. The average spottedness of the sun during 1926 was already high, although the real peak of the curve is not expected until this year. This fact, together with certain characters of the spots and of their locations on the sun, suggest to the experts of the Society the maximum of sunspots in 1927 will be a high one, perhaps one of the highest since careful scientific observations of the sun were begun. The activity of the sun, as indicated by the spots, is believed to be responsible for many terrestrial disturbances, including stormy weather, bad radio and sunburn. We may expect that 1927 will be an altogether exceptional year in these respects.

Radium Kills Hair

THAT in addition to its other uses in medicine radium may be employed to remove superfluous hair, is reported by Hayward Pinch, Director of the Radium Institute, in London. The rays shot out from radium when its atoms explode are powerfully destructive to living matter. That is why radium can be used to kill germs. It is used similarly to kill cancer cells. Its rays can be used equally well, Mr. Pinch reports, to destroy the living hair cells from which superfluous hair grows. Merely to shave such hair or to remove it with chemicals is not permanent. These cells can be killed by electrolysis, by introducing a tiny electric needle into each cell.
CLASIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook RADIO AGE's classified advertisements.

The classified advertising rates are but four cents per word for a single insertion. Liberal discounts are allowed on six and twelve-time insertions, making rate of 3 and 2 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the September issue must be sent in by July 25.

AGENTS
Sell Radio Sets on time $10.00 down buys 5 tube set. Agents get my special prices. Bargain Speakers; order now. T. King, 650 Osceola St., Syracuse, N. Y.

APPLIANCES
SEND FOR free illustrations and plans of our wonderful two-place, companion type, small, high lift wing machine, and information on how to build and be sure it will fly; also propeller literature. Crawford Craftsmen, 2225 American Avenue, Long Beach, California.

BOOKS AND MAGAZINES

FREE—Two big New Magazines and Information worth hundreds of dollars to you. Ensell 2x stamps. Salesmanager, Box P, Beaver Dam, Wisconsin.


Twentieth Century Book of Receipts, Formulas and Prices, only 85c cloth bound containing 1,600 proven formulas for the manufacturer, laboratory, office and home. Sent prepaid upon receipt of $1.00. Send checks for 40c 44a for 32a 46a 49a 55a 57a 62a 63a 65a 67a 69a 72a 73a 76a 77a 78a 82a 83a 85a 87a 89a 90a 91a 92a 93a 95a 96a 97a 98a 99a 100a. Material and samples of all grades. Scientific and practical, scientific and mechanical. Books. Midland Products Co., Dept. RA, 524 Courtland Ave., Park Ridge, Ill.

BOYS
Boys get a three feet model airplane free. No selling. Write for particulars. Aero Ship, 3503 Hubert Ave., Detroit, Mich.


BUSINESS OPPORTUNITIES


LAND FREE if planted to bananas. Banana bear a full crop the second year. $5.00 monthly will plant five acres, which should pay $1,000 profits annually. Reliable Companies will cultivate and market your bananas for 1/3 the net proceeds. Write today and let us get your plans and orders of 10 ducks weekly sent to 500 pounds each. For particulars address Jethis Plantation Co., Empire Building, Block 766, Pittsburgh, Pa.

DOGS
BEAUTIFUL REGISTERED BULL PUPPIES $15. Bull, 501 Ankwell, Dallas, Texas.

ELECTRICAL

FORMULAS
Furnace, Drakemen, Baggageemen, (White or colored) showing advertisements. 75c; $2.47—monoplane. Free 125c. Exploitee unexpecyed, 228 Railway Bureau, East St. Louis, Illinois.

HELP WANTED

MISCELLANEOUS
"MUSIC Compassed" to words, Bauer Bros., (formerly of Sousa's Band). Oshkosh, Wis.

GILLETTE STYLE Razer with 10 Blades 60c Prestal. Land Sowker, 158, Speaker Unit $1.40 prestige. Transformer 25a, Mce Station A, New Haven, Conn.

PANEL ENGRAVING
WE SPECIALIZE in high grade single panel engraving. Also quantity panel work and special machine engraving on small parts. The only panel engraver in Chicago devoted exclusively to engraving. A. L. Woody, 18 South Weil St., Chicago, Ill.

PERSONAL

RADIO
EXTRA HEAVY Antenna wire 7 No. 18 $1.30 100 feet. 17 No. 22 priced 3/3 4 feet $2.70 all prices. George Schulte, Calumet, Michigan.

MR. H. BADZECK, 1855 Addison St., Chicago, Ill., received a call late last night from a club of Radio Operators who are in need of Radio Operators. TroubleShooters. Just the thing I have been looking for. I am ready and willing to go on this unless you have a claim. It will pay you to investigate at Universal Test Equipment Co., 2939 N. Oakley Ave., Chicago, III.

Radio Books — Construction of a modern Super Heterodyne Type Receiver: Invaluable Testing and Operating $1.00; Henley's 227 Radio Circuit Design. 267 pages. $1.00; The ABO of Vacuum Tubes used in Radio Receivers 183 pages, 75 cents; Henley's Workday Radio Receivers 156 pages and also Wireless Station Testing 392 pages $2.98. Wireless Transmitters and Telephone Explained. 500 pages. We are putting out a new book on Trouble-Shooting on our books every day. We have at least 50 new books and catalogs of all the latest and best practical, scientific, mechanical and industrial books. C. G. & C. D. Geo. Schultz, Calumet, Michigan.

SILICON Transformer Steel is for order. .014", 10 lbs. 28 cents, 5 lbs. 30 cents, less than 5 lbs. 35 cents per lb. Northern California deals. Circles elements half price. Sheet aluminum 1.10", $4.00 6" and 9" 20 feet each all prices. Geo. Schultz, Calumet, Michigan.

PURE ALUMINUM and lead rectifier elements, holes drilled, with brass screws and nuts per pair 1-1/2", 3/4" 15c, 1/2", 1/4", 1/8", 1/32", 1/36" circle elements half price. Sheet aluminum 1.10", $4.00 6" and 9" 20 feet each all prices. Geo. Schultz, Calumet, Michigan.

CONDENSERS, 600 VOLT FILTER, 1 mgf 485, 25 485, 624 576 25, 724 25, 1 576, 1 576, 0 576, 5 $15.25, 2 $27.50, 2, 6 $62.00. Write LIMINATOR BLOCKS. 2, 5 and 8 $6.75, 2, 2 and 1 8 50c 2, 2 $15.25, 6 and $5.25, 2, 2 $10.75. Many other capacities. Ane transformers and chokes. THE RADIO CLUB, Inc., La Perle, Ind.

IVORY RADIO PANEL parts them all. Write for FREE Sample. Involuta Radio Panel Co., 3320 Ave. G, Fort Worth, Texas.


AMAZING RADIO OFFER. 3 new S-7 Tube Super includes everything.喪供 all parts complete in small box. Classifying binding loose. The choice of experts—Built to last a lifetime. The Radio Hospital, 641 N. Preston, Philadelphia, Pa.

Iron core chokes 20H-25 MA $1.00. 30H-GMA $2.50. 30H-85 MA $2.75. 50H-105 MA $2.50. 50H-85 MA $2.75. 75H-85 MA $5.75. Will help draw your circuits and plans on your requirements. Radio Parts Sales Co., Orange, N. J.


GUARANTEED RADIO PARTS—TUBES 198b and $2.62 3% for 2 or Transmitters 1441; 16, 17, 12, 33 rata Variables Condensers $1.45, Transformers $4.75, RiMettor Regulators $1.35, and Potentiometers $1.10 to $1.00; C. M. K. Condensers 10, 12. Write for complete list. Collector Radio Parts $1.32. Usual Domestic Kesamei 10c. Collector books. Catalog and prices $1.50. Postpaid—Cash With Order. GORDON G. ATWELL, Shreveport, La.

110-190-5 volt transformer for making a Trilode Charger for 50c. Battery using 2.114a tube 2.62. 30H 3a 26. 30H 0. Ohm, Chokes $2.75. 110-420 volt Transformer $6.00. All postpaid. Write for list of specials. We estimate on kits to your specifications. Radio Parts Sales Co., Orange, New York.

WESTERN Electric power amplifier $16.00. Magnavox Three-stage power amplifier $14.00. Signal 1-plate som- enators of all kinds. Get my bargain list for the ham. KNY Story City, Iowa.

RUBBER STAMPS
RUBBER STAMPS and supplies. 25c per line. Cushion Mounted, Catalog for stamp. Newman & Son, Auburn, Nebraska.

SALESMen WANTED
I AUTO GAS SAVER FREE. To Introduce. Amazing our performances. Drudges millions. IRCHILDM- Owner, C-90, Wheeling, Illinois

STAMMERING
STAMMERING quickly and easily cured. In your own home. Free 50 cents refund. Send my bargain list for the ham. SMV Story City, Iowa.

TYPEWRITERS
TYPEWRITERS, all standard makes, $10.00. Fully Guaranteed. Free Trial. Write for COMPLETE information. Typewriter Exchange, 121 N. Francisco Ave., Chicago.

WANTED TO BUY
Full value paid for old GOLD jewelry, silver or platinum. Packages returned if our offer not satisfactory. Jewelry Specialty Company, 3320 Ave. G, Fort Worth, Texas.

Radio Age Classified Ads Result

Please Mention Radio Age When Writing to Advertisers.
The Walker Bread Co., of Fort Worth—one of the best known baking concerns in Texas—run their Blankeke Control Equipped Ford Delivery Trucks and Salesman's Cars TWO EXTRA DAYS EVERY WEEK without gas—giving them 104 days of FREE gasoline per year.

Agents—150%
Walker Bread Co. Delivery Truck No. 6 used 28 gallons of gas in four days (7 gals. a day). This same truck equipped with the Blancke Control ran SIX days on an equal amount of gas—gaining two days a week over its former record—or 104 Free Gasoline days a year.

Original Letter from the Walker Bread Co., on file in our office, lists other similar average results on their numerous cars and says further: "These cars cover the same territory daily; gas is put into the cars each day, so that we have an accurate account of the amount of gas used by each car. The saving of gas by the use of your Automatic Carburetor Control will pay for its installation every thirty days." Backed by scores of endorsements from well known Companies such as this,—by a big National Advertising campaign and by guaranteed results—the Blancke Control is bringing undreamed of success to our representatives. R. K. Waite ordered 2000 controls in 2 months, making a profit of $6,000! Every mail brings additional astounding reports.

Profit Guaranteed
Strongest Guarantee in automotive history backs side of Blancke Control. Guaranteed to give 150 miles on 5 gals. of gas on Fords—to practically eliminate carbon—save half oil—relieve battery strain—make motor run smoother—give better acceleration—allow slower speeds in high gear. Saves half repair bills. No holes to drill, no bolts to remove—Anyone can attach it in 3 minutes. Ford owners everywhere are delighted with the Blancke Control and their boosting promotes sales. You don't need experience. Guaranteed results speak for themselves and sensational "Sure-Fire" Demonstration sells for you.

Get One Free to introduce, also Blancke plan that guarantees 150% profit, starts you without capital in a real business that pays you from $500.00 to $2,500.00 and up each month and gives user agent new Ford Car free by time his present one is worn out. Get started NOW. Use the coupon!

BLANCKE AUTO DEVICES Co.
154 E. Erie St., Dept. 820 K Chicago, Ill.

BLANCKE THERMOSTATIC CARBURETOR CONTROL

$15 a Day Guaranteed to Distributors

RUSH THIS IMPORTANT COUPON

BLANCKE AUTO DEVICES Co., Dept. 820 K, 154 E. Erie Street, Chicago, Illinois.

Gentlemen: I should like to get a Blancke Control FREE. Also send details of amazing new Guarantee Plan by which I can make from $300.00 to $2,500.00 a month profit—no obligation for me.

Name
Address
City State

SALES Guaranteed
Drum notes not only heard — but identified

Thousands of radio listeners will now realize for the first time that radio orchestras have drums when they hook up this new, improved Crosley Musicone.

As originally produced the Musicone startled the radio world, eclipsing the old type horn and squeaky speaker.

Today, the new Musicone with its latest refinements and improvements correspondingly leads its host of imitators.

Prepare for a real surprise when you hear this amazing device with its beauty and fidelity of treble reproduction — clarity and breathless reality in middle tones — richness and resonance of bass. Today — infinitely bettered and superlatively developed, the Musicone is the world's finest loud speaker — and, at such extremely low prices, it's the world's greatest radio value.

The Crosley patented actuating unit (and not the cone) is the secret. There's nothing else like it.

Write Dept. 63 for descriptive literature

The improved
GROSLEY
MUSICONE

SUPER-MUSICONE
16 inch Cone
$14.75

THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., Pres.
Cincinnati, Ohio

Prices slightly higher west of the Rocky Mts.

ULTRA-MUSICONE
12 inch Cone
$9.75
Everyday Mechanics

Radio Age

September 1927

25¢

Using the new AC tubes—two illustrated articles

Current Science
Can You Sell Gas at 5¢ a Gallon?

If so Mail me the above coupon

Great new invention brings gasoline cost down for 8,000,000 Ford Owners. Hundreds of our men are earning more than they ever made before or thought possible introducing the famous Blancke Thermostatic Control. A proved success, backed by over 351,272 public and private tests, which show beyond a doubt that it is possible for Ford Owners to reduce gasoline cost to 5c a gallon. (Affidavits and hundreds of testimonials on file.)

We Pay Our Distributors $15.00 a Day

Can you imagine anything easier to sell than gas at 5c a gallon? No wonder our men are coming money! No wonder we can afford to offer you the most liberal, most worth while proposition you could ever dream of. The coupon will bring you full details. Get it into the mail at once!

FROM AGENTS

Frank Andrews, Pres.
Blancke Auto Devices Co.
154 E. Erie St., Dept. 820-M,
Chicago, Ill.

Dear Sir: I am interested in selling gas at 5¢ per gal. Send full details and free trial. No obligation to me.

Name

Address

City State

FROM USERS

The Thermostatic Control you sent me is the only claim. I have sold 44 devices by explaining the device and merits of

Paul Less, Colo.

We had a test run Saturday and Sunday through great and hilly country from Washington, D. C., to Martinsburg, W. Va., and back about 209 miles. Made it in on 3 gallons of gas. The attachment is a wonder.

Charles F. Haugene, D. C.
Mr. T. R. Wright told me that he went 20 miles on half gallon of gasoline.

John H. Odgers, Ontario.

Get Free Trial

Act at once if you want to get started with a sure thing. Make real money with the backing of a big, well-known responsible firm. Don't delay. We want to assign men right now to the profitable territories we have left open. Get in with a live proposition that is different. Be successful! Be independent! Make $10,000 a day and large commissions. Mail coupon quick for free trial proof, and find details of a big proposition that will surprise you.

Frank Andrews, President
Blancke Auto Devices Co.
154 E. Erie Street
Dept. 820-M
Chicago, Ill.

Nothing Like It

Do not confuse the great Blancke Invention with anything else you've ever heard of. Its principle is entirely scientific—absolutely different. You can easily prove this to your advantage at no risk.

All you need to do is mail the coupon at the top of this page. It will cost you nothing and will positively bring you by return mail the biggest surprise and greatest opportunity you've ever known.

Cadillac, La Salle and Delco Light
Now use as standard equipment Thermostatic Carburetor Control under Blanke License

Frank Andrews
President
Blancke Auto Devices Co.
154 E. Erie Street
Dept. 820-M
Chicago, Ill.
“Best Receiver I Ever Built; That World’s Record Superhet”

THOUSANDS have made and proved the sets described by Fred Hill and illustrated by photographs and blueprints in former issues of Radio Age.

Not Too Late For You

Radio Age has a limited supply of past issues containing articles fully describing construction of these receivers, all built and tested in our own laboratory. These articles are accompanied by the famous Radio Age blueprints, or full page diagrams, bound into the magazines. If you plan to build a super this fall look over this list of available back issues:

January, 1927
Full Data on the Super 8

April, 1927
One Spot Super and Power Compact

March, 1927
Building Ideal Model Super 8

May-June, 1927
Using 9 Tubes on World’s Record Super

We will mail any one or all of these back issues at only 30 cents each on receipt of stamps, currency or money order. Write now while they last to

Radio Age
500 North Dearborn Street
Chicago
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Final Advertising forms close on the 20th of the 2nd month preceding date of issue

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Chats

The Radio Corporation of America now has friendly representation on the National Radio Commission which regulates broadcasting and allocates wave lengths. R. C. A. has finally assumed control of the chief group of patents under which the bulk of present-day radio sets are manufactured. R. C. A. has even acquired the chairmanships of one of the important committees of the Radio Manufacturers' Association.

None of these things bother us in the least. We had not only anticipated the ascent to the heights but years ago we told our readers what the corporation was determined to do. There is no surprise in the sequel. We expressed doubt as to whether Federal Trade Commission charges of conspiracy against the big five would ever get anywhere. Does any reader know what became of that virtuous glare of trumpets?

It is to be regretted, however, that the R. C. A. should again have thrown the radio trade out of step by announcing the prospective production of a new tube and then proceeding to withhold actual delivery of the tubes far beyond the date originally announced. Result—thousands of radio buyers refusing to buy anything or to build anything until they could be assured that what they intended to buy or to build would not be "obsolete" as soon as installed.

Same old story. You will remember the situation several years ago when we all waited throughout a long summer for the arrival of revolutionary equipment, dealers grumbling, buyers disgusted and trade taking the count. One ray of sunshine pierces the gloom. This tube delay has given the independent makers of tubes a chance to step in. We understand the independents are making hay while the sun shines.

Frederick Smith
Editor of RADIO AGE.
Time to Build
By ARMSTRONG PERRY

THERE was an old fellow, who had started life with nothing and made an honest fortune in real estate, who used to whisper to his intimate friends now and then: "It's time to build!"

He meant that land and building materials were as low as they were likely to go, that increase of population soon would crowd the present housing facilities, and that those who built would profit from their foresight.

If he were alive today, he would be interested in radio and he would advise: "It's time to build."

It is time to build. Radio programs now are superlative. Once they were made up of phonograph selections because the fact that voice and music could be transmitted and received through the ether was new and interesting and any sound at all could be used in a demonstration. When the novelty wore off, uncanned music was substituted. Most of it was worse than the phonograph music but it was interesting because we were hearing music made by real people while they were making it. Some good programs had to be broadcast to hold the interest of listeners who could appreciate it, and the number of those who could tell classics from clutter increased. Today the broadcasters are giving us the best there is; cheap stuff is used only to fill in.

Everybody likes a fight, except those who take the beatings; every championship bout, game and race is broadcast. Everyone likes good music; the air is full of it daily. We are all hero worshippers; every aviator, athlete and politician who makes the front page is given his chance at the microphone. No one can afford to miss today's broadcasts, when a few dollars and a few hours' work enable him to crash the gate at more big events than he could reach without radio even if he owned a flock of automobiles and a fleet of airplanes.

Old and New Styles Good

It is time to build. Apparatus has been developed to the point of high efficiency. The seemingly impossible has been attained—receivers can be attached directly to any electric lamp socket. Older types of receivers, with wet batteries, dry batteries or battery eliminators can be remodelled or merely rejuvenated by overhauling. Every one of them, right down to the crystal detector, gives better results today than it ever did, because of the increased power and quality of the broadcasting stations. There is no limitation of time or money that needs to keep a man from building a new receiver if he wants something better than the old one.

Interference has been reduced, conditions are improving. Broadcasting is under control at last.

Prices Low

Prices of parts never were so low nor the parts so good. Radio business has developed to a point where manufacturers and dealers are making liberal price reductions. Quite different from the hectic days of 1922 and 1923 when customers formed lines reaching out into the street and waited for new shipments of phones and coils to arrive.

The other day a man walked into a chain store. He forgot whatever it was that his wife sent him for and, as usual, found himself hanging over the radio counter. The store advertised: "Nothing over one dollar" and there on the counter was a five-tube radio set whose name was a household word.

He was about to ask for a dozen of those sets and had his twelve dollars in his hand when he overheard
a salesman explaining matters to another customer. The set was composed of parts that sold for five cents to one dollar apiece. Altogether they came to forty-five dollars. For the convenience of a customer who wanted to buy them all at once, the store would put them into a cabinet, each in its correct position, and fasten them there with wire and solder. They charged a little more than for wrapping them with paper, twine and gummed strips; the customer could save the difference by assembling the set himself.

He hesitated. Then a bright idea came. He bought the parts, took them home, assembled them. After he tested out the receiver and adjusted it for extra good results, he gave it some touches of individuality that he knew would please a neighbor. He invited the neighbor in to hear it. It caught his fancy and he wanted to buy it. The builder sold it and cleared $20.

The next day he was back at the store for another kit. His first customer sent him his second. The next week he was back after his third outfit. In a month he figured out that if he could keep the neighbors away long enough he could build a set for himself with the money he had made and have enough left to pay him for the time he had spent on all of them.

There is something about a hand-made set with the monogram of the owner on it that gets 'em. The factory-made product may be as good, or better, but it is not exclusive.

**Relieves Nerve Strain**

It is time to build. Hand work relieves mental strain. Driven all day by executive pressure in the ceaseless grind of business or industry, a man develops a longing to do something in his own way and take his own time about it. He may be a putterer who butchers bakelite and lumber into irregular shapes whose dimensions even geometry could not discover, or he may be a careful artisan whose finished product breathes the spirit of the artist. It makes no difference which he is. Building a radio set in the quiet of the evening in his own home relaxes the nerves, breaks up the monotony of the struggle for existence. It is an unselfish pastime, too, for a radio outfit can provide pleasure for the whole family and friends.

Our eyes have been used too much; the ears should be used more. Radio develops hearing. We learn to distinguish the different instruments in the orchestra and to know the announcers by their voices. It gives us an enlarged channel through which pleasurable sensations reach us from the outside world. We can lay down the fine print that makes us screw up our faces until the wrinkles become permanent. For a few hours at least we can relax, put aside the glasses that wear creases in the bridges of our noses, rest our eyes and let our ears work. It doubles the joy of life.

**Radio A Time-Saver**

It is time to build. Radio saves time. A man who takes a half hour of our time when he puts his message into print gives it to us in ten minutes, and more interestingly, by radio. When he talks into the microphone he has to condense. It costs one hundred dollars an hour to operate an average broadcasting station and the management counts the seconds. So does the audience. If a speaker wants to hold a radio audience more than ten minutes he has to begin by making a transatlantic flight or knocking out a world's champion.

Time is life. A man must be informed about current events or he is laid on the shelf—modern business has no use for a fellow who does not know what is going on—and if he spends an hour a day gathering information when he could get it by radio in fifty minutes, he is wasting one business week a year. It would be better to use radio and take an extra week's vacation. News, book reviews, talks on the leading plays, technical information, all are on the air regularly. Listening to them directs attention to articles and books.

(Continued on page 39)
Some Interesting Characteristics of the A. C. Tubes

The new A. C. tubes seem to be the long sought solution for complete and economical A. C. operation of radio receivers. The new tubes replace the comparatively bulky equipment of the "A" eliminator type only recently developed. Until the cartridge type rectifier was invented an eliminator was a bulky affair, almost as large as a good sized storage battery, and usually just as wet. Even the latest types of "A" eliminators have a chemical filter condenser in them, with a few exceptions. The only accessory to the new tubes is a small filament-heating transformer, which is very much smaller than the smallest of "A" eliminators.

The announcement of the appearance on the market of the two tubes was made in the July-August issue of this magazine. There are two Cunningham types of A. C. tubes, as already made clear, in that issue; the type CX326, an all purpose amplifier, and the C327, which was designed purposely as a detector, but is also an efficient radio frequency and audio frequency amplifier when used as such.

The CX326 is similar in electrical characteristics to the 301A type. The plate impedance, however, is lower, giving the tube a higher mutual conductance. The filament construction is of the inverted V type, like that of the 301A tube, but is in form of a ribbon and oxide coated. The filament is heavy and takes considerably more current than the 201A tube. The temperature of the filament does not follow with changes in current flowing through it nearly as rapidly as with a light filament and therefore the filament emission to the plate is practically uniform.

In the lighter filament the temperature changes modulate the plate current, as the tube resistance rises and falls with the amount of filament emission, and the A. C. component in the plate circuit is the result. Fig. 1 is a graph showing the amount of A. C. in the plate circuit of various tubes as the center tap to the potentiometer is moved from the exact nodal point. It is very apparent that greater deviations are allowable without inducing noticeable hum in the circuit.
new tube than in the tubes designed for D. C. filament operation.

There is a balance point between the electromagnetic and electrostatic fields set up by the alternating current and the CX326 is designed so that this point is effective when the tube is used as an amplifier. Fig. 2 illustrates the effect of the plate current on the percentage of hum. It is readily seen that the hum is at a minimum when the plate current is about three milliamperes. This also shows why the tube is not adaptable as a detector, since the plate current would be very much reduced with the grid bias method of detection and the amount of hum correspondingly increased.

When the tube is used as a radio frequency amplifier the results are about the same as those obtained with a 301A tube, since the internal construction of the elements, and therefore the inter-electrode capacity, is the same. The grid plate capacity is about 10 m. m. f. As an audio frequency amplifier the tube is also the same, possibly a little better on the low notes for some transformers.

The use of a bias on the radio stages as well as the audio stages is absolutely essential. The bias is necessary to keep the plate current at a value where the A. C. component is minimized (as has already been observed from the graph of Fig. 2.), and to prevent grid current from flowing. Among other things, this means that the use of a potentiometer for controlling oscillations is impossible. The radio frequency stages may have the grid returns connected to the same potentiometer as the audio stage since the potentiometer adjustment for the r. f. tubes is not as critical as for the audio tube.

With the rather high grid bias required for these tubes (see data list on these pages) the input impedance of the tubes is quite high and the selectivity of tuned circuits across the input is not impaired.

As has already been brought out, the filament voltage must be constant, as well as the plate current, and have a definite value for operation without hum. The plate current should be three milliamperes and the filament 1.05 amperes. This prevents the general practice of controlling oscillations which might occur in the r. f. by means of a rheostat in the filament circuit, or a variable high resistance in the plate current supply.

The internal construction and base of the type C327 tube is quite different from the standard 201A tube. The tube, instead of having a regular filament, has a heater filament which requires a current of 1.75 amperes, and an electron emitting cylinder around it. The cylinder is electically insulated from the filament and connected to the center tap of a potentiometer for the plate current return. The cylinder is oxide coated and when heated by the filament inside, emits electrons to the plate. The potential distribution over the whole surface is uniform and therefore the A. C. fluctuations in the filament have no effect on the plate current. The grid and plate are also in cylindrical form, grid plate capacity is almost half that of the CX326 or 201A tube and should make an excellent r. f. amplifier. The mutual conductance is also slightly higher; the amplifica-

Fig. 3. Time in seconds.

Fig. 4. Plate current grid voltage curve for type C327 tube

(Continued on page 32)
Locating Mineral Beds by Radio

**EVEN** the well known and much honored prospector must now accept the very latest fashion in mineral exploration, for the radio has come into the field with eyes more powerful than all the prospectors combined. New fields will be opened in the mining world, abandoned mines promise to again start operations, while mining property throughout the world will be waiting for the radio to help in locating its underground fortunes. The radiore process, as it is named by the inventors utilizes the well known electrical principle of inducing an electric current through a conductive body and thus creating an electro-magnetic field which extends out at varying lengths. A high frequency sending set with another apparatus designed for receiving and direction finding comprises the complete outfit for the radio prospector of today.

From the broadcasting, set which is set up at any desired location in the field, an alternating electric current of a very high frequency is sent out into the air, and creates what is called the primary field. If there are any conductive ore bodies within this radius of the broadcasting set some of the electric current will naturally flow through them. As a result of the induced current flowing through the conductive ore deposit an electro-magnetic field will be created called the secondary field. The next problem for the radiore engineer is to locate the axis and depth of the mineral body.

To find the axis of the secondary field a receiving set is used with direction-finding loops mounted on the well known surveyor’s transit. After the territory has been divided into smaller plots, for convenience in surveying, the radiore receiving set is set up at some point within the primary electro-magnetic field. The operator uses the usual wireless receivers to listen in as he revolves the direction—finding loops in various directions in order to determine the direction to the axis of the secondary field. If there is a conductive ore deposit anywhere under the surface to a depth of 500 feet it can be definitely located by continued observations and plotting of the area. Only ores of the sulphide group such as lead, iron, and copper, and a few ores in their natural state, can be determined with the radiore process so far. However continued experimenting is now being carried on in the mining fields of Arizona and other states of the southwest to further perfect the instruments.

The entire radiore outfit is designed for convenience in carrying about in the field work, while the total weight of every part is nearly 500 pounds. The receiving and sending sets are mounted on tripods which enable quick set-ups and moving in the field. Under normal conditions a crew of four or five men can operate one outfit. In case the terrane is hilly and rocky or covered with dense vegetation additional helpers are added.

Where the ground has been almost inaccessible for the ordinary type of prospecting the radiore process may be used to quickly determine the underground mineral conditions, the radio prospectors may even set up their apparatus hundreds of feet underground, in active mining tunnels and shafts. As an accompanying help to mining the radiore process proves to be the greatest development of the present day. Expensive and futile mining operations will be unnecessary when the ground may be explored without costly drilling.

As yet the character of the ore deposit which may be located cannot be determined with the radiore ap-

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Current Radio Wisdom in Tabloids

Wildest Radio Dreams Not Nonsense
From an interview with Merlin H. Aylesworth, President of the National Broadcasting Company, which appears in the American Magazine for August.

RECENT successful experiments in television, in which persons were seen in the act of telephoning by the ones spoken to, are by no means the end of wonders that may be accomplished by the radio. To the contrary, the wildest dreams for its development are not nonsense, said Merlin H. Aylesworth, president of the National Broadcasting Company in an exclusive interview given to the American Magazine for August.

Radio has shaken off the handicap of taking limitations for granted. In radio and in pretty much everything else, the men who dare to think most boldly, even most absurdly, have been more nearly right than those who have believed that only the little things were possible, said Mr. Aylesworth.

We know for a certainty that big things are just around the corner. We expect that we shall live to see motion pictures flashed onto the walls of our homes. Science may even find a way to break down food into electrons and transmit them to our kitchens by radio and then reassemble them for nourishment. This sounds like the wildest nonsense at the moment but the radio itself seemed like nonsense only a couple of decades ago.

Our hope for radio is that it will make the people of the United States feel that they have “been some place”; that their lives will be richer, their experience wider, their appreciation of life more satisfying because they have been in touch, through this magic, with the wisest, the most talented and the most high-thinking folks of their time.

We are just beginning to find out about it ourselves. But we already know some things that have human interest. We know that there were 5,200,000 radio receiving sets in the country last June, which means, if you assume five listeners to every set, a total radio audience of twenty-six million people. New York State, with 654,000 sets, has the most listeners, and Nevada, with 7,200 sets, and New Mexico, with 7,800, the fewest. The four cities that have the largest number of listeners in proportion to their population are Los Angeles, San Francisco, Chicago, and New York, in the order named.

So far as we can discover, the male and the female audience is about evenly divided. For instance, a recent mail canvass conducted through station WEF A brought 1,943 letters signed by men, 2,190 letters signed by women, and 929 signed by “Mister” and “Misses.” Naturally, the daytime audiences will consist almost entirely of women, though it might surprise you to know how many offices of busy executives now have radio sets—a few minutes of orchestra music with the after-luncheon cigar before the afternoon grind begins.

* * *

Against Radio Advertising
From address by United States Senator Arthur Capper of Kansas, broadcast over Station WIBW, Topeka.

IT SEEMS to me that the radio’s greatest value is in the direction of furnishing entertainment and practical information to the listeners. For that reason I have regretted to see what appears to be a growing tendency on the part of some of the broadcasters to commercialize their programs—to utilize the air for the sale of merchandise or to make commercial appeals to comparatively small circles of people.

I do not believe this phase of broadcasting should be encouraged. I believe it was this commercial feature that was to a large extent to blame for the tangle in the wave lengths which the Radio Commission is now engaged in untangling. Commercialism is always followed by a certain selfishness that is rather inclined to brook no interference with its plans. Radio is bigger than that and its future should not be hampered by such small, selfish interests.

Broadcasters should always remember that the interest of the public come first. I am sure that this was what Congress had in mind when the radio law was passed. The Radio Commission named to administer that law must also bear in mind that it’s the listener who comes first.

* * *

Favors Advertising
Martin P. Rice, Director of Broadcasting for the General Electric Company, in an address on “Radio Advertising.”

BY CONTRIBUTING to the cost of broadcasting, it (advertising) has made possible the rapid development and maintenance of a great public service which makes weather, market and stock reports, music, entertainment, education, religion, and the addresses of statesmen available to everybody, everywhere, without tax, cost or expense.

All of these objects may be termed advertising in the broad sense and if you look over the long list of broadcasting stations on the air today you will find very few of them which are not advertising something. The almost universal desire to broadcast today springs from the desire to advertise. It is an age of publicity and advertising.

There is nothing incongruous about it and nothing shocking. Probably everyone who reads a national magazine or buys a newspaper replete with the latest telegraphic reports from all over the world does not stop to consider that his purchase price is only a fraction of the publisher’s cost and he may not know that the advertisers make up the difference. There can be no misunderstanding about a commercial broadcast program because the announcer always states frankly the name of the advertiser who sponsors it.

(Continued on page 45)
The story thus far

Col. Maximilian Minimil sets $10,000,000 aside out of his personally acquired colossal fortune, for the purpose of financing the Fortunatae Gazette for his son Daly. The younger Minimil, while the great project is being organized, has some difficulty in making other people believe he intends to publish a newspaper that is to be free from the smut and hysteria of certain other dailies. He believes a clean journal will win out. Bill Rosom, publisher of the Clarion, is a former movie actor. A hero stepped on his face, and although putting him out of the picture game, so transformed his countenance that he has the appearance of a super-man. People do what Rosom wants because of the compelling power of the Rosom face. Rosom tries to prevent the sale of the first issue of the Gazette. The Minimil win their circulation battle by a rush and the Gazette is successfully launched.

Daly orders the city editor to discharge one of the girl reporters, giving the reason that she is so good-looking she might distract the attention of the young men from journalistic labors. The girl visits Daly in his office to protest against being dismissed and Daly falls in love with her and tells her so. She leaves Fortunatae that night, expressing in a letter to Daly that she fears he is too hasty in his wooing and she wishes to give him time to consider the future.

XV

Mr. EMORY LATHROP, eminent member of the law firm of Lathrop, Lathrop and Moore, shaved himself hastily and laved his face, which extensive adventures on tee and green and fairway had given a hue not dissimilar to the calf binding on his law reports. A robust and yet a distinguished figure of a man, Mr. Lathrop.

"This knocks me out of the club handicap play," sighed Mr. Lathrop, looking out over the green hills of Long Island. "That man Minimil never takes a day off and he apparently doesn’t want his legal counsel to swing a driver, either."

Mr. Lathrop’s valet laid out linen and a carefully pressed suit. This done he completed packing a Gladstone bag. It was Sunday morning and the Lathrop household was not yet astir. The head of the menage made his way to the breakfast room where Fawcett had eggs and toast and coffee waiting. As Mr. Lathrop sat down to his solitary meal he glanced again through the East windows which revealed hills bathed in hazy sunshine. A perfect day for golf. Mr. Lathrop decided he would look at the telegram again, hoping against hope that there would develop some means of escape from this job of legal work. No, the message was annoyingly clear and explicit:

Emory Lathrop
Boulder Beach
Long Island.

Meet me Keystone hotel, Philadelphia,
Sunday morning eleven o’clock important.

Minimil.

Mr. Lathrop gazed at the hateful yellow sheet as if to assure himself that it really meant this particular Sunday, this Sunday of perfect golf weather, this Sunday of the handicap match in which he was to have teed off with Judge Kershaw in the semi-finals of the club’s midsummer tournament.

Eminent lawyers are gifted with resourceful minds and Mr. Lathrop was no exception. He found no way of evading this unwelcome Philadelphia journey, but as he studied the telegram he discovered therein an inspiration that made his countenance beam suddenly and glow as radiantly as the golden yolks of the poached eggs that smiled merrily up at him from their twin couches of golden toast.

"Eleven o’clock. Why, that may be early enough to give me a chance to go out to the Philadelphia Country Club for eighteen holes in the afternoon! Meet Traynor and Calkins there, like as not."

Mr. Lathrop was talking to himself but Fawcett, capable old sort, was listening. There was instant action. Fawcett called the country club to say that Mr. Lathrop’s car would stop there in about fifteen minutes and Mr. Lathrop wished to pick up golf clubs and clothes on his way to the train.

Col. Maximilian Minimil of Fortunatus was watching alertly for the arrival of Mr. Lathrop and when that quietly attired barrister entered the lobby of the Keystone hotel, followed by two bellboys, bearing hand bags and golf bags, the Colonel stepped forward eagerly to seize his hand. Col. Minimil was clad in a suit of violent plaid, fully as noisy as his greeting. He rushed Mr. Lathrop off to his apartment in a lofty corner of the Keystone and almost pushed the eminent lawyer into a capacious chair by a window.

"It’s about Daly," the Colonel said, facing Mr. Lathrop. "Boy’s completely goofy over a red-headed
girl reporter. Never saw her but once but just as sure he’s going to marry her as if the two families had planned it when he and she were born. She’s a smart one. Ran off from Fortunatus to Philadelphia to put up a bluff of making him wait. Gold digger. You know the kind. Daly will either get her back to Fortunatus or follow her here. Up to us to nip the affair in the bud. I’ll pay her off and you can take care of the legal end.”

“I didn’t suspect Daly to be so—so susceptible,” ventured Mr. Lathrop.

“Hit him all in a heap,” rapped out the Colonel.

“Saw her in the reporter’s room and fell like a log.”

“Um,” mused Mr. Lathrop. “How about her? Are you sure she isn’t genuinely interested in Daly?”

“Interested your eye,” boomed Col. Minimil.

“Interested in his bank roll!”

“And yet she ran away from it?” asked the lawyer.

“Just a poker trick, passing for a raise,” snorted the Colonel.

“You give her credit for great shrewdness. Either she is full of crafty ways, Colonel, or she instinctively did the right thing about getting away and giving him time to think things over. She’s either a dangerous adventuress or—-.” Mr. Lathrop’s voice trailed off into silence and he sat considering the matter.

“Or what?” demanded the Colonel.

“Or she’s in love with Daly,” calmly reflected Mr. Lathrop, aloud. “In that case, Colonel, we might better go a bit carefully.”

“Bunk!” shouted the Colonel, “did you ever know two young folks to fall in love like that anywhere except in one of them confession stories.”

“Once,” said Mr. Lathrop, a smile flickering at the corners of his mouth. “That was when Mrs. Lathrop and I met. We were married a week later.”

“Say Lathrop, are you one of these sentimental lollypops or are you a lawyer?”

“I sometimes think I’m both,” laughed Mr. Lathrop.

“Well you are off on the wrong foot in this case. Only one thing to do. Make an appointment with this lady and you’ll see how she will play her cards. I know ’em. Look at Adam and Eve or Cleopatra and Napoleon Bonaparte. They’re all alike when they want something and they always want something.”

“I’ll call the young lady up for an appointment,” said Mr. Lathrop. “What particular part of the Garden of Eden is she gracing with her presence and what is her name and telephone number?”

Colonel Minimil held up a forefinger as if to impress upon his attorney his client’s cleverness. “Had the best detective in the country locate her,” he said. “She writes stuff under the name of Amy Templeton Graves but her real name is Amy Templeton and here’s the address and telephone number.”

Mr. Lathrop looked at the memorandum which the Colonel handed him and almost imperceptibly raised his eyebrows as he read the street address. He got up and walked to a little table on which the telephone stood.

“Miss Templeton? Ah, Mrs. Templeton, may I speak with your daughter please? Will she return soon? Not until dinner. I see. This is Mr. Lathrop. I have just arrived from New York and would like very much to reach Miss Templeton as soon as possible. Could I call her by telephone elsewhere? Too bad, but thank you, Mrs. Templeton, I will call up again at 6. Thank you. Good bye.”

“Not home!” asked the Colonel.

“Out for the entire afternoon,” replied Mr. Lathrop happily, at the same time seizing a handbag and proceeding to pull forth shirts, golf socks, shirts and shoes. “Come to luncheon with me at the Country Club and we’ll talk the thing over while I’m fixing up a game with a couple of near-golfers who gave me a trimming a month ago. Can’t turn a wheel until 6 anyhow.”

XVI

If Col. Minimil had not elected to dress himself up like an excursion boat before going to the country club this chapter in the tale of the strange adventures of Minimil and son could not have been written. But the Colonel did so attire himself. He selected a suit of plaid material which was not merely loud. It was cataclysmic. A devastating storm of cobalt blue, burnt orange, and scarlet swept across the background of gray cloth. His hat was a wide-rimmed covering of pearl gray, to match his spats. He carried a stick that had been nothing more than a dried Malacca reed in its native jungle, but which now was a polished rod surmounted by a silver knob, the size of a tennis ball. The stick looked much more like the baton of a circus bandleader than it resembled the cane of a gentleman.

Mr. Lathrop, the conservative New York lawyer, quailed at the sight of the Colonel in his Sunday outfit. But it was not the duty of a lawyer to question the sartorial taste of a client and Mr. Lathrop said nothing and appeared to observe nothing. The elevator boy breathed deeply as the upholstered Colonel entered the lift. Passing through the lobby Mr. Lathrop heard a bell boy ask the cigar counter girl: “Where is the faro game?” Out under the porte cochere a taxi driver called out to a crony across the street, “Whatsay about a little game of checkers?” A young gentleman, lolling in the tonneau of a special-bodied touring car, whistled the tune, “Horses, Horses, Horses.” Beyond these trifling incidents and several scores of smiles and nods and whispered comments the Colonel’s outfit attracted no attention whatever.

At the country club Mr. Lathrop had the good fortune to find Mr. Ned Traynor, an ancient golfing foe, and a match was arranged with gusto and dispatch. Mr. Traynor explained that a young lady was to play with him but that she was a cocking good golfer and it would make a tip-top threesome. Mr. Traynor waited while Mr. Lathrop and the Colonel partook of a light luncheon in the grill and then the three walked out on the terrace which overlooked the first tee and the eighteenth green. They stood there a moment chatting
before saying goodbye to the Colonel and trying not to be aware that every eye in or on that part of the golf course was directed at the landscaped elder Minimil. A girl, idly swinging a driving iron, as she waited near the first tee, looked up casually and saw the Colonel. Her prettily flushed face went white for a moment. Her eyes narrowed and she puckered her fair brow into a scowl of amazement and indignation.

Need we say that the young maiden in such evident stress of spirit was Amy Templeton? It was indeed she and indeed she had been knocked for a row. The Colonel little thought as he went forth to the golf course that he was to so dramatically betray his presence in Philadelphia to the very lady whom, in the presence of legal counsel, he had come to see. Unconscious of the tumult he was causing in the breast of the little red-headed girl reporter from Fortunatus the Colonel shook hands with Mr. Traynor, waved au revoir to Mr. Lathrop and retired from the terrace.

Miss Amy stillled the beating of her heart and took her errant emotions firmly in hand. Followed, was she? The old Colonel was here to nip her romance in the bud, was he? Miss Amy smiled. It is a well known phenomenon of biology that a red-headed girl will fight for her heart's desire as savagely as a Yunnan tiger battles for his breakfast. No need to try to explain or analyze. An eagle in the air; a serpent on a rock, or near a rock; the way of a maiden with a man. The man of shallow thought assumes that when a lovely woman stoops she is stooping to folly. He does not guess that she may be reaching for a sash weight.

When Mr. Traynor advanced and introduced Mr. Lathrop to Miss Amy, adding that Mr. Lathrop had left the New York bar flat to come to Philadelphia to get a good beating at golf, the girl put two and two together and added them up to a dozen sage conclusions. This lawyer had come to the club with Col. Minimil. He and the Colonel were here to rescue Daly from a titian-haired girl reporter, who was plotting to lure Daly Minimil to the altar and thereby attach herself to the Minimil bankroll, popularly supposed to have a circumference exceeding that of a full-grown water main. Miss Amy was beautiful and yet not dumb.

She greeted Mr. Lathrop with the sweetness that comes to womankind when they are most dangerous. She welcomed him with a warm shake of the hand and a straight look out of eyes that literally swam in loveliness. If Mr. Lathrop, the level-headed legal bearcat, was a trifle groggy under the barrage of feminine charm he was crowded right up against the ropes when he heard Mr. Traynor mention her name:

“Miss Amy Templeton, Ned.”

The girl saw and understood. Colonel Minimil and Lawyer Lathrop might be in Philadelphia to look up the past performances and pedigree of the Templetons but at least they had not followed her, like two silly detectives. The lawyer was obviously as surprised as the Colonel and Minimil in his appearance as King Solomon on the clubhouse terrace. The rest of the sketch would be simple. She knew him and he knew her but he didn’t know she knew and she did know that he knew.

**XVII**

Mr. Lathrop was a golf player. Occasionally he shot under 80, which will explain a lot of things to various of his clients who had wondered why he was so frequently out of town on business during the golfing season. Mr. Lathrop loved a close contest. It irked him that he should meet Miss Amy here under the unfortunate necessity of playing golf with her during the afternoon and asking her why was she a gold digger in the evening. But that latter event could take care of itself. As long as it was afternoon and eighteen holes of good golf stretched out ahead of them, why, he would play golf. He at least would show Miss Templeton that he was able to get both distance and direction and make ’em plunk down, once he was on the green.

Miss Templeton also was a golf player. She never shot under 80 in her life but she had come close to it. She was what is known in the sport page as a money player. The greater the necessity for good shots, the better were her shots. She would now show this lawyer for the Minimil family that she was pretty fair on distance, direction and that her putting touch could turn a five into a par four.

Mr. Traynor never will forget that game of golf. He was out of it from the start. He watched a handsome, accomplished, skillful New York lawyer hook up with a lovely, determined and hard hitting girl. Mr. Lathrop sensed the spirit of conflict in her and his spirit rose to meet hers. They halved the first hole in four, Miss Amy took the second with a five to Mr. Lathrop’s six and the lawyer evened it up on the third when he made a birdie three against Miss Amy’s good par four.

“I say,” said the bewildered Mr. Traynor as they walked to the fourth tee, “one would think you folks had been waiting for years to settle a golf game instead of having met for the first time today.”

“Let us alone, Ned,” laughed Mr. Lathrop, “something tells me that a woman is going to almost lick me for the first time in my golfing career.”

“You put it conservatively,” exclaimed Miss Amy.

They finished the first nine with honors even. They continued on, seesawing, ding-donging, fighting for every break, studying every putt. On the sixteenth the girl hooked her drive into the rough and disaster appeared imminent. She got out with a beautiful nubick and was on in two. Mr. Lathrop’s second shot went dead to the pin. Miss Amy looked at the twelve-foot putt that confronted her, took her stance and swung the club in a pendulous, graceful arc, that sent the ball spinning across the velvety turf. The ball rolled lazily toward the cup, straight as a taut string, seemingly controlled by the magic of the young lady’s determination, even after it had departed.

(Continued on page 50)
Suggestions About Supers

By ARMSTRONG PERRY

The way to be happy with a superheterodyne radio receiver is to treat it as a sensible man does a new wife: try to control it and, if you can, don't worry because you cannot understand it.

For distance, volume and quality the superheterodyne is as far ahead of other types of receivers as a high-power rifle is ahead of a boy with a snowball. That is, if you have a super that works. However, the snowball, because of its very simplicity, hits many a plug hat that has never been knocked off by more complicated weapons.

It is just as easy to build a super that will work as it is to build one that will not work. These two kinds look almost exactly alike. The main difference is that the ones that work were designed by someone who knew what he was doing and were built by someone who did exactly what the designer told him to do.

The first step toward success is to go to a reliable radio shop and buy a set of blue prints, templates and instructions. A reliable radio shop, from our point of view, is one in which the management always is ready to back up any statement that it makes, by furnishing new parts, by giving free service, or by doing anything else that may be necessary in order to make a set operate as guaranteed. The dealer who sells an outfit with a statement that it will deliver certain results, and who meets complaints with suggestions about spending more money when the set fails to deliver those results, we do not rate as reliable.

The customer who stands next to you at the counter may tell you, while the clerk is wrapping your outfit, of many improvements that you can make by substituting different condensers, coils, tubes, transformers and other parts for those specified by the engineer who designed the outfit. This eus may tell of no end of supers that he has built, and how he gets Japan on the loud speaker almost every night. Go over to his house any evening to see how he secures his marvelous results and you will find, usually, that he has just taken his set apart because he knows of a hook-up much better than the one he used before, so he cannot give you a demonstration. With an imagination like his you would not need any receiver.

Radio experts do pick up separate parts and construct superheterodyne receivers that give maximum results. That is because they know how to measure inductances, capacities, resistances and voltages, how to plot curves, how to operate tubes at the proper position on their characteristic curves, how to test each piece of apparatus, how to locate the causes of trouble and how to remove them. But the average set builder, working a few hours in the evening and after church on Sunday, has a long course of study and experimentation ahead of him unless he takes plans and instructions worked out by a competent radio engineer and follows them.

It is an easy matter to lay a tem-plate on a panel and drill the holes for the apparatus that is to be fastened to it. Anyone who is handy with tools can do that. But it takes a thorough mechanic to lay out the template with the degree of accuracy required to make a super supel.

Knowledge and understanding grow, of course, as the set builder follows the plans. That is why it is ten times more fun to build a set that is to be built than that is all ready to use. One of the first and most pleasing discoveries is that the superheterodyne receiver consists of four distinct and comparatively simple sections, each of which may be constructed and tested separately. These are: the first detector, the oscillator, the intermediate-frequency amplifier, and the second detector. This does not include the aerial and the condenser used in tuning it, nor the audio-frequency amplifier that some builders may wish to add, but these present no problems that are peculiar to the superheterodyne.

The tremendous amplification of the superheterodyne receiver makes it possible to cover long distances with a loop aerial, and this usually is tuned with a variable condenser. Sometimes the loop is tapped, so that more or less turns may be used.

The aerial picks up energy from the radio waves and delivers it to the first detector. The detector circuits are much the same as those of any other receiver. The energy passes through a grid condenser to the grid. There is a grid leak shunted across this condenser. The filament is connected to the "A" battery in the usual way. The plate output goes to the primary coil of a transformer, the same as in any set with a transformer-coupled amplifier.

The main difference between the wiring diagram of the superheterodyne and those of other receivers is discovered in the grid-filament circuit. The inductance coil in this circuit is placed in inductive relation with coils that connect with the oscil-

(Continued on page 33.)
The September Skies

By JAMES STOKLEY
Science Service Staff Writer

WITH the coming of autumn, the skies take on a different aspect from what they had during the summer. Look high overhead this evening. There, up above you, shines Cygnus, the Swan, or the "Northern Cross." Near it are seen the Lyre and the Eagle. To the student of the stars, whether he be professional astronomer, or the merest layman, these groups in this position mean autumn just as clearly as do the falling leaves from the trees.

Let us look at Cygnus. Its long neck points to the southwest, with the brilliant Albireo—beta Cygni, the astronomer calls it—to mark the head. And to the northeast the still brighter Deneb, or alpha Cygni, marks the bird’s tail. Then the two stars that form the tips of the transverse of the cross, also mark the wings of the swan.

Just why there should be a swan in the heavens is not certain. In the ancient mythology, there are several stories to account for it. According to one of them it was Orpheus, the marvelous musician. He wooed and won for his bride the beautiful Eurydice, but after that was murdered. Then he was turned into a swan, and put into the heavens near his favorite harp, which is represented by the nearby Lyre. Another story has it that the swan is the one into which Jupiter changed himself in order to deceive Leda, the queen of Sparta.

When seen with a powerful telescope, alpha Cygni, or Deneb, is found to have a companion star. But as the brighter body is of the first magnitude, and the companion of the twelfth, it is difficult to see. Albireo, the star at the southernmost end of the cross, however, is also double, and is one of the most beautiful in the sky. A small telescope, or even a good pair of powerful binoculars, if they are steadily held, shows up the two members of the pair. They are of nearly the same brightness, but of very different colors, as one is distinctly yellowish, and the other blue.

A little to the north and east of the star epsilon Cygni, which is the easternmost star in the transverse of the cross, is a famous star known as 61 Cygni. This is so faint that optical aid is needed to see it well, but faint though it is, it is one of the closest stars in the heavens. It was the first star to have its distance measured.

This was done in 1838 by the great German astronomer Friedrich Wilhelm Bessel, who succeeded where astronomers for centuries had failed. After Copernicus proposed his theory in 1543, that the earth revolves in an orbit around the sun, it took many years for it to gain wide acceptance. One group of opponents of the theory, the fundamentalists of the day, objected to it on theological grounds. But there were others whose objections were more reasonable. They thought that the Copernican ideas did not explain all the observed facts, and so quite properly withheld their acceptance.

To this latter group belonged Tycho Brahe, the great Danish astronomer, and the last in the days which preceded the invention of the telescope. Tycho said that if the earth revolved around the sun in so wide an orbit, the stars should have
a yearly displacement. An object on the earth is seen in a different direction from different places, and so Tycho argued that if the earth was in one part of the year many millions of miles away from where it had been six months earlier, or where it would be six months later, the stars should be seen in a slightly different place in the sky. He had the most complete observatory, and the finest instruments that had been made up to his time. He failed to discover any annual change in the star positions. Therefore, he concluded, the earth remained in the same place with respect to the stars.

Tycho died in 1601. The telescope was invented in 1610. But even with this aid, no displacement of the stars by reason of the earth’s motion was observed for many years. Finally, however, it became evident why it could not, and the Copernican system, with the sun at the center, and the earth revolving around it, found universal adherence. The reason was simply that the stars were so exceedingly distant, compared with the size of the earth’s orbit, that the change in the star’s position, or parallax, as it is called, was too small to be measured.

Until 1838, all efforts at measuring parallax were unsuccessful, but then Bessel succeeded. A new epoch in astronomy was inaugurated. One of the difficulties in making parallax measurements is in seasonal changes. If the astronomer measures the position of a star in the sky in January and July, for instance, with accurate instruments, the star will be found to have an apparently different place. But the change isn’t all parallax. A large part of it is due to differences in temperature and other atmospheric conditions. It is very difficult to figure just how much of the difference these seasonal changes account for, and so another method is used.

A very simple experiment will illustrate the method. Hold your right index finger a foot in front of your face, and between you and some distant object, like a house. Close your right eye, and look at the house. Your finger will obscure part of the house. Now close your left eye and look at the house with your right eye. Your finger will seem some distance away from the place that it previously covered. Repeat the experiment with your finger at arm’s length. Hold your finger so that when you close your right eye the same part of the house is obscured as before. But then when you look at the house with your right eye, your finger will not seem to change its position against the background as much as previously.

Precisely the same procedure is used to measure star distances. A close star takes the place of your finger. A distant one is the substitute for the house in the background. In January the close star might appear near the distant one. In June it seems a bit farther away from the distant one. The farther away from the earth the closer star is, the less is the change, or the parallax. From this can be figured the actual distance from the earth. When a star is very far away, of course, the chance is so minute that it cannot be detected. Such methods of measurement can only be used on the closer stars.

No star is so close as to have a parallax as large as a second. A second of arc is the apparent diameter of a dime about two and a half miles away. That is, if some one two and a half miles away holds up a dime, facing you, the distance from one side to the other is larger than the change in the position of the nearest star due to the earth’s yearly motion. And this despite the fact that the earth revolves around an orbit 186,000,000 miles in diameter! No wonder Tycho Brahe could not detect it! The parallax of 61 Cygni proves to be about three-tenths of a second. This is equivalent to a distance of 11 light years. A light year is the astronomical yard. Light travels at a speed of 186,000 miles — about seven times the circumference of the earth — in a second. The distance that it will go in a year, about 6,000,000,-000,000 miles, is a light year. Alpha Centauri, the closest of all the known stars, which can only be seen from southern countries, is about four and a third light years away. Its parallax is about three-fourths of a second.

Venus, the brilliant planet in the west, which has been so conspicuous in the early summer months, has now disappeared from the evening sky. But it will soon reappear in the east before sunrise. It is now getting close to the sun. On September 10, it will be at inferior conjunction, which means that it is between the sun and earth. Then it will move to the west of the sun, so that it will rise before it in the morning. By the end of the month, it will rise two hours before the sun, and will be conspicuous to the person who stays up late — or rises that early!

(Continued on page 37)
Using the New AC Tubes in a Six-Tube R. F. Receiver

By Frank Freimann

Much interest has been aroused by the announcement last month of two new A. C. types, which were to have been on the market July 1. The tubes have at this writing not been available to the public, but information from manufacturers leads us to believe that dealers will have a supply of tubes when this issue of Radio Age reaches our readers.

Our laboratory’s search for sample tubes with which to experiment, resulted in getting a set of Van Horn tubes, which are similar in characteristics to the type CX-326 Cunningham tubes, and a Cunningham C-327 tube. The Thordarson Electric Co. courteously furnished a filament-heating transformer. This transformer will be on the market when the tubes are available.

It was decided to incorporate the new A. C. tubes in a six-tube single-dial radio frequency set with other new parts that have made their appearance on the market for the new season. A photograph shows the general construction of the receiver, and pictures clearly the parts used therein. The new Remler three gang condenser tunes three Aero Coil radio frequency transformers which are the new development of the Aero Products Co. Thordarson transformers constitute the audio amplifier.

With the application of the A. C. tubes are a few problems not encountered in the ordinary tube set which utilizes either storage batteries or some “eliminating” device. After one is once familiar with the function and characteristics of the tubes, however, these problems disappear and obvious facts are presented. The tubes seem adaptable to any of our present popular receivers when these facts are observed and small deviations made to compensate for the slight difference in characteristics from those of the type 201A tubes. The object—heating the filaments with house lighting current without introducing hum into the loud-speaker—is well accomplished. Very little hum is present even when one listens very carefully for it, and then only a few feet away from the speaker. The hum is not noticeable when a station is tuned in, nor is there any distortion of the music or voice.

The complete data on the characteristics of the Cunningham type CX-326 and C-327 is given in a separate article in this issue.

The Thordarson filament heating transformer has three sets of filament voltage taps at one end, and a cord and plug at the other end. The two top connectors are from the one and one-half volt winding which supplies current to the four “326” tubes, the middle set of terminals are the two and one-half volt winding for the heater element of the C-327 tube,
the center terminal is connected to plus forty-volt connection, and the lower set of terminals are for the filament of the CX171 tube in the last stage of audio amplification; the center tap here is for the plate current return. In series with this plate current return lead is a 2500 ohm Carter fixed resistor R. The voltage drop due to the plate current flowing through it, is impressed on the grid of the CX171 tube and acts as a bias. The transformer has an electrostatic shield between the primary and secondary windings and is encased in a heavy iron case which acts as a magnetic shield and prevents induction of the 60 cycle current into other parts of the circuit and causing hum. Both of these features are quite essential to operation without noticeable hum.

Since the current supplied to the filaments of the tubes is many times larger than in any of the tubes formerly operated from battery supply, the filament wiring must be given careful study. The leads should be twisted wire to minimize induction, and should be quite heavy, though ordinary rubber covered No. 14 flexible wire was used in this set. The wires carrying alternating current should be as far removed from the coils and grid wires as possible. In this case the tubes are mounted so that the filament terminals are at the back of base board and away from the coils, except for the third r. f. tube which is mounted between the first and third r. f. transformer. A Carter heavy duty rheostat is connected in the 1½ volt filament lead to cut the voltage to 1 volt, to accommodate the use of Van Horn tubes which have a filament terminal voltage of 1 volt. This rheostat can be left out if CX-326 tubes are to be used.

No doubt there will be cries of “wrong wiring diagram” when some of the readers take their first glance at the diagram and see the 45 volt line connected to what looks like the plate current return. But it’s all right; the plate current return is to the oxide coated metal cylinder cathode which is electrically insulated from the heater filament and the high voltage through the transformer winding. This unusual connection is probably made to eliminate capacitive coupling between the plate and heater, since they are now both at the same potential.

The grid return wires are all connected through a 1000 ohm resistance to the movable connection on a 20 ohm potentiometer which has its outer terminals across the 1½ volt winding and rheostat. The plate current to all the “326” tubes flows through this resistance and the voltage drop of about 12 volts biases the grids. This is indicated in the diagram as Rs and is by-passed by a 1 m. f. condenser C. The by-pass condensers across both of the bias resistors Rs and Rg are quite important, when these are left off a continuous audible oscillation will very likely be the result.

The Remler “right-hand” drum dial is mounted in the exact center of the front panel and the gang condenser is mounted on it, this divides the set in half, the radio frequency stages and detector are on the left side and the audio stages and filament heating transformer on the right. The first tube is a antenna coupling tube and will not add very much to the amplification of the set, but it permits any length of antenna to be used without throwing “off” the tuned stages.

The radio frequency transformers are staggered to afford the greatest spacing between coils and at the same time to allow short leads and of uniform lengths. The first and second transformers are two and one half inches apart, and the second and third transformers are three and a half inches apart, while the space between the first and third transformers is five inches. It is vitally important that the wires running from the condensers to the coils are all about the same length. The wires running to the terminals No. 6 and the condenser terminals should be 4½ inches for transformer T1 and Tc (first and third), and 5½ inches for transformer T2, the transformer mounted at the rear of the board. The terminals No. 5 on transformers T1 and Tc could be connected together with a piece of bus-bar wire about seven inches long, and No. 5 of transformer Tc can be connected with a 3½ inch wire to the exact center of

**PRELIMINARY SPECIFICATIONS A. C. FILAMENT TUBES**

<table>
<thead>
<tr>
<th>TYPE CX-326</th>
<th>TYPE C-327</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament voltage</td>
<td>1.5 volts</td>
</tr>
<tr>
<td>Filament current</td>
<td>1.05 amperes</td>
</tr>
<tr>
<td>Plate voltage recommended</td>
<td>90-135 volts</td>
</tr>
<tr>
<td>Maximum</td>
<td>180</td>
</tr>
<tr>
<td>Grid bias at 180 volts</td>
<td>16.5 volts negative</td>
</tr>
<tr>
<td>at 135 volts</td>
<td>12 volts negative</td>
</tr>
<tr>
<td>at 90 volts</td>
<td>6 volts negative</td>
</tr>
<tr>
<td>Amplification factor</td>
<td>8.2</td>
</tr>
<tr>
<td>Plate impedance at 180 volts</td>
<td>9,400 ohms</td>
</tr>
<tr>
<td>at 135 volts</td>
<td>10,000 ohms</td>
</tr>
<tr>
<td>at 90 volts</td>
<td>9,400 ohms</td>
</tr>
<tr>
<td>Mutual conductance</td>
<td>180 volts, 880 micromhos</td>
</tr>
<tr>
<td>135 volts, 820 micromhos</td>
<td>820 micromhos</td>
</tr>
<tr>
<td>90 volts, 875 micromhos</td>
<td>725 micromhos</td>
</tr>
<tr>
<td>Plate current</td>
<td>3.0 milliamperes</td>
</tr>
<tr>
<td>180 volts</td>
<td>3.8 milliamperes</td>
</tr>
<tr>
<td>135 volts</td>
<td>3.0 milliamperes</td>
</tr>
<tr>
<td>90 volts</td>
<td>3.7 milliamperes</td>
</tr>
<tr>
<td>Interelectrode capacity (plate grid)</td>
<td>10.5 m. m. f.</td>
</tr>
<tr>
<td>Maximum undistorted output</td>
<td>0.160 watt</td>
</tr>
<tr>
<td>at 180 volts</td>
<td>0.070 watt</td>
</tr>
<tr>
<td>135 volts</td>
<td>0.020 watt</td>
</tr>
<tr>
<td>Base—Standard Large “CX”</td>
<td>Special 5 prong type</td>
</tr>
</tbody>
</table>

**Mechanical Dimensions:**
- Maximum overall length: 4½ inches
- Maximum diameter: 1½ inches
- 4½ inches
- 1½ inches
the bus-bar wire, from where a wire leads to the center terminal on the other side of the condensers (the side paralleling the panel). The other two terminals on that side of the condenser are also connected to the center terminal as they are all common and are finally connected to one end of resistor \( R_c \), the other side of which is connected to the center of the potentiometer \( R_t \). The lead that connects to \( R_t \) should be run to the center of the bus wire connecting the three No. 5 terminals together.

The Aero r. f. transformers are furnished in matched units, three in one box. To have the same amount on inductance in each circuit (comprised of a transformer and condenser) the above precautions in keeping all the wires the same length are necessary. The coils should not be handled roughly for the windings are supported only in three places by narrow bakelite strips and can easily be bent out of form. When this happens the set of coils will no longer be matched.

Ordinarily the method of preventing oscillations and maintaining the same sensitivity over the whole wavelength range is that of varying the plate current to the tubes, and therefore for the amplification, by means of a variable resistance in the plate current supply lead. This form of oscillation control, or that of varying the filament temperature with a rheostat, is not advocated by the tube manufacturers on claims that noticeable hum is bound to result. In our experience we found neither of these methods very efficient and a quite different scheme was resorted to—that of varying the impedance of the primary of the second transformer. Instead of connecting the plate of the second tube to terminal No. 2 as in the other two transformers, it is connected to terminal No. 3 to increase the impedance of that plate circuit. A \( .001 \) m. f. condenser, \( C_s \), is connected in series with the primary winding which helps to some degree in stabilizing the r. f. \( R_c \) is connected directly across the primary and stabilizing condenser from No. 1 terminal on the transformer to "P" on the socket. To further stabilize the r. f. circuits resistors \( R_s \) and \( R_c \) are connected in series with grids of the second and third tube (second and third stage). The oscillations can be controlled very easily over the whole wavelength range by increasing or decreasing the primary impedance with changes in the value of resistor \( R_s \). There is however one disadvantage in using this circuit for stabilizing; that is, the secondary circuit of transformer \( T_r \) is detuned slightly when the shunt resistor is at a low value, nevertheless there was no effective loss of selectivity noticeable.

The audio frequency amplifier is very general. The grid bias for the first audio tube is the same as that for the r. f. tubes. All of the transformer cases should be connected together and "grounded" to the center of the potentiometer, this is quite important in preventing a. c. pick-up, and also audio oscillations. A Thordarson R76 out-put transformer is an asset in this receiver, as the current which would otherwise be flowing through the loud-speaker windings might injure the speaker. A 500,000 ohm potentiometer connected across the secondary of the first audio transformer makes a very effective volume control. The two outside terminals are connected directly across the transformer terminals and the grid of the first audio tube is connected to the center of the potentiometer. The wires to the potentiometer should be twisted together into a three conductor cable.

If Van Horn tubes are employed the rheostat should be adjusted for maximum amplification and minimum hum. In any event, however, the rheostat should never be turned full on, as the tubes might be burned out. About one third of the resistance on the rheostat should be in the circuit. Once this adjustment is made it should be left that way. Likewise the potentiometer; it should be to the point where the hum disappears or is at a minimum. The rheostat and potentiometer are mounted on a strip of bakelite two inches wide and four and one half inches long, and spaced three inches apart. Four binding posts are mounted on a strip \( \frac{3}{4} \) inches wide and four inches long, spaced

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**LISTS OF PARTS**

The following are the parts used in the construction of the RADIO AGE Six Tube R. F. Receiver using the new A. C. tubes. Other parts having the same values may be substituted:

1. Panel 7"x11/3/8
2. Base Board 20"x12/1/2
3. Frost sockets No. 530
4. Silver-Marshall No. 512—five-prong socket
5. Aero Choke Coil-60 L
6. U-123 Aero Universal Tuned R. F. Kit (T1, T2, T3)
7. Thordarson R200 Audio Transformers
8. Thordarson R76 Out-put transformer
9. Thordarson Filament-heating transformer
10. Remler 3-in-line Remler Condenser No. 633/C1, C2, C3
11. Remler Drum Dial No. 110
12. Carter Code No. MW-1/5.2 ohm rheostat (R1)
13. Carter Code No. MP-20 20 ohm potentiometer (R2)
14. Carter 500,000 ohm Hi-pot Code No. 55 (R3)
15. Code No. H-400 resistors (Carter) (R5, R6)
16. Code No. P-2500-40 2500 ohm resistor (Carter) (R4)
17. Code No. H-1000 1000 ohm resistor (Carter) (R5)
18. X-Hi-ohm (Carter) (R7)
19. Carter Short Jack—open circuit Code No. 1
20. Tube 1m.f. by-pass condensers (C5, C6, C7)
21. Sangamo .002 condenser (C8)
22. Sangamo .001 condenser (C4)
23. Sangamo grid condenser
24. Cuttler-Hammer filament switch
25. 3 meg-ohm grid leak
26. Eby binding posts
one inch apart. An extra binding post is shown in the photograph which may be disregarded.

The set is ready for a test after all the connections are checked and re-checked. On turning on the light current to the transformer and B eliminator, if one is used, there will be a very loud hum bursting out of the speaker. After the set "hums" for about a half minute (until the detector tube heater is white hot) the hum will suddenly subside, and then with adjustment of the potentiometer will disappear. The drum dial is then revolved until a station is heard on the upper part of the drum. But before tuning in your station loosen all of the adjustment screws of the alignment condensers which are between each set of plates. Screw down the adjustment screw nearest to the drum dial until the signal is the loudest; if the station gets weaker loosen the screw to the point where it will be loudest again. Now make the same adjustment on the middle alignment condenser. In approaching the point of maximum signal strength the set may break into oscillation. In that case set the stabilizing resistance to a point where the set will stop oscillating. The next alignment condenser is then adjusted, and in the same manner. After this adjustment turn the drum dial back and forth across the station, that is, so the station will be tuned in and out, and at the same time go over the condensers again until the loudest signal is heard, or until oscillations occur. It is a good idea to adjust the stabilizer to a position right below the point where oscillations start, and then make the alignment adjustments until oscillations start, then back off the stabilizer to stop the oscillations, and again make your condenser adjustments until oscillations occur, finally the further adjustment on the condensers will not induce oscillations (whistles), unless the stabilizer is turned up. The circuits will now be tuned to resonance at the high wave-lengths. If the coils are properly matched and the gang condenser is accurate the alignment should hold for the lower wave-lengths. A slight re-adjustment will soon determine this. If re-adjustment is necessary to get the loudest signal it means that either the coils are not matched or the gang condenser is "off." During all these adjustments a small antenna of about twenty feet should be used.

The total current consumed in the plate circuits is about fifty milliamperes. The average B battery eliminator will handle the set, though the voltage to the plate of the 171 tube will be less than 200 volts. It will be about 150. The bias regulation however, will be automatic, and adjust itself to any plate voltage. A B battery eliminator having about a 80 millampere capacity is advantageous, and in a set where more than six tubes are used is absolutely necessary.
Radio Beacons to Aid Air Mail Flyers

By S. R. Winters

At College Park, Maryland, where six years ago the Air-Mail Service of the United States Post Office Department was inaugurated, there has just been dedicated the first aircraft radio beacon for the promotion of civil aviation. There, at this landing field, the first airplane laden with postal matter departed from the now time-worn hangars for New York City; today, this same spot marks the genesis of radio aids to air navigation.

The dedication of the College Park aircraft radio beacon station—the

This is Captain Maurice Graham, Western Air Express Pilot, flying the air mail between Los Angeles and Salt Lake, who in thirteen months from April 17, 1926, to May 17, 1927, has flown 125,000 miles, a world's record for any similar period of time. During that time, Graham has never been forced down for trouble or weather, has never defaulted a trip for any cause, and has never failed to start on scheduled time regardless of weather conditions. This is said to be a record unparalleled in the history of flying. He is to be nominated for the Clifford B. Harmon trophy given each year to the most meritorious feat for the advancement of aviation.
forerunner of 40 similar installations along the 8,234 miles of civil airways across the continent—was without formal exercises. The event, none the less impressive, was attended by Dr. George K. Burgess, Director of the Bureau of Standards; Dr. J. H. Dellinger, Chief of the Radio Laboratory, and the technical staff responsible for the erection of the station. Appropriately signalizing the completion of this safety aid to flying, Dr. Burgess congratulated Haraden Pratt, actively in charge of the work, while the latter was winging his way far above the field in the test airplane. Using a radio telephone, located in a wooden shack on the outskirts of the College Park aviation field, the Director of the Bureau of Standards, in communicating with the airplane in flight, said: "Mr. Pratt, I hear you very plainly. I am interested in what you are doing out here and am pleased to note that you have such a complete setup. Now, I must be going back to the Bureau to do some work. Goodbye."

Previously, Dr. Burgess had inspected the directive beacon for guiding aircraft in a zone of safety; he had donned a helmet and climbed aboard the radio-equipped flying craft; and then posed with Dr. Dellinger and the eight members of his technical staff for a photograph. The Director of the Bureau of Standards listened attentively to Dr. Dellinger as the latter related how the ignition system of this airplane had been shielded to minimize interference with radio communication; how a satisfactory receiving set, with but one control, had been installed on this craft; and how, by means of a visual indicator, aviators may be directed in a zone of safety by slender beams of radio when consulting a device on the instrument board of the airplane.

In the sense of being the genesis of radio aids to civilian aeronautics, the beacon station at College Park bears an analogy to the relation between the "Zero Milestone," in Washington, D. C., to the public highway system. The latter is the starting point in reckoning the mileage of the network of highways; this beacon station not only marks the starting point in developing radio aids to air navigation but the results of experiments now in progress will serve as a chart for erecting more than 40 other radio beacons along airways across the United States—for directing aircraft carrying passengers, postal matter, and express.

The directive beacons in transmitting a double-beam radio wave will set up a well-defined path or zone of safety for the airplane in flight. Established at intervals of

The "Wireless Airplane" has arrived! Dr. George K. Burgess, Director of the Bureau of Standards, and Dr. J. H. Dellinger, Chief of the Radio Laboratory of the Bureau and other members of the laboratory staff, are seen examining the airplane at College Park, Maryland, which is guided exclusively by radio waves. The course of safety is automatically indicated by vari-colored lights flashed on the instrument board of the airplane.
200 miles along the airways, in their functioning they are somewhat like marine radio beacons or lighthouses for mariners, in that aviators are thus offered a guiding hand when enveloped in fog or obscured in darkness. This beacon transmits two directed radio beams, continuously sending on each a characteristic signal. The airplane, equipped with an ordinary radio receiving set, if traveling at equal distances from the lines set up by these radio beams will receive signals of equal intensity; off the well-defined path, there is an inequality of signals and the pilot corrects his course until the signals are again equalized.

The marker beacons, established at 25-mile intervals along the 8,234 miles of airways, will serve as mileposts to aviators, indicating the distance already traveled and how many more miles must be traversed before reaching their destination. These marker beacons do not overlap the function of the directive beacon since the former do not define the course of flight. Instead, these very low-power radio transmitting stations will flash a characteristic signal and upon being intercepted by the aviator he is automatically informed of his location. Extremely simple transmitting sets have been designed for this purpose and these mileposts along the air highways instead of conflicting with the function of the directive beacon will materially supplement its effectiveness.

Radio-telephone stations, located at 200-mile intervals along the more than 8,000 miles of civil airways, will serve as mediums for imparting weather forecasts, information about landing fields, and other navigational facts, to aircraft in flight. For this purpose, radio telephony is necessary since aviators are not usually trained in the technique of the Morse International telegraph code and are not, therefore, qualified telegraph operators. The use of the radio telephone on aircraft necessitates the adoption of specially armored cable for the engine ignition systems. Once the engines have been shielded to eliminate interference, conversations between pilots in flight and persons at ground radio stations may be effected at distances of 100 miles or more. Officials of the Bureau of Standards recently conducted experiments which form the basis of this estimate.

The aircraft radio beacon station at College Park, Maryland, is at once the original and model of all future radio aids to air navigation. There, under the direction of Dr. J. H. Dellinger, Chief of the Radio Laboratory of the Bureau of Standards, the first radio beacon was erected under authority of the United States Department of Commerce for the development of civilian aeronautics. A similar installation is being made by the Bureau at Bellefonte, Pennsylvania, and both of these beacon stations will be available for radio service to commercial air lines after July 1. The other four aircraft radio beacon stations available now or soon are: The station of the Army Air Corps at McCook Field, Dayton, Ohio; two stations of the Ford Motor Company, located respectively at Dearborn, Michigan, and Chicago; and a station installed by the General Electric Company at Hadley Field, New Brunswick, New Jersey. The commercial lines which these radio aids will serve are, respectively, the Piteirn Company, operating the New York to Atlanta route, and the National Air Transport, Inc., operating the New York to Chicago route; and the Ford Motor Company, operating out of Detroit.

The model station at College Park includes a wooden tower, 70 feet high, painted a deep shade of yellow, with a flag at its apex. This towering latticework is the main supporting structure for two triangular loop antennas, from which double-beam radio waves are emitted for guiding aircraft. A radio room, 10x14 feet in dimension, containing the vacuum-tube transmitting set, the goniometer, and other necessary radio equipment, is located directly un-
nder this tower. The tower is approximately 10 feet in circumference at its base; gradually narrowing down to a peak at its apex. It extends over the top of the radio room so that there will not be an unbalanced electrical effect in the operation of the radio equipment in conjunction with the triangular loop-antenna.

Extending from the apex of this tower are four wires, running to four points of the compass, to distances of 150 feet. At the termini, the wires are connected to pulleys, which in turn are staked to posts by means of 200-pound weights. These antenna wires, forming a single-turn triangular loop, are run back to the radio room, the wires being supported 8 feet above the ground by three posts set in concrete. These so-called base wires are insulated from the posts by use of large glass insulators. The 200-pound weights at the termini of the base wires serve the purpose of slackening or tightening the antenna.

The wires leading from the top of the tower appear, at first glance, to be guy wires but in reality they constitute the antenna system—the somewhat odd arrangement of two enormous loops crossed at right angles. It is a giant loop antenna when compared with our usual conception of loops; 1,256 feet of wire being utilized in constructing the two single-turn triangular loops. The College Park aircraft radio beacon station was constructed by Haraden Pratt, Francis W. Dunmore, and Carl B. Hempel of the Radio Laboratory of the Bureau of Standards. The radio aids to air navigation are being developed and perfected under the direction of Dr. J. H. Dellinger, Chief of the Radio Laboratory, who is leaving Washington soon for a three months’ study of aids to air navigation in European countries. The Aeronautics Branch of the Department of Commerce is vested with the work of establishing radio beacon stations, a step of far-reaching significance.

Preliminary to determining the equisignal zone of a directive radio beacon, the Bureau of Standards made ground tests with radio equipment installed on a motor truck. Fortunately, the equisignal line corresponded with the test road, thus facilitating the ease of making observations. At points 13, 21, 34, 38, and 51 miles distant from the transmitting station observations were made on crossroads running perpendicular to the equisignal line. The width of the zone at these points was found to be as follows: at 13 miles 360 feet, at 21 miles 400 feet, at 34 miles 400 feet, at 38 miles 450 feet, at 51 miles 500 feet. In measuring the width of the zone at these points the following method was used:

The signals were tuned in and the radio amplifier adjusted until the strength of the signals was of medium intensity. The motor truck was then driven back and forth on a line at right angles to the equisignal line until the middle point was found; that is, where the intensities of the signals were equal. Then the truck was slowly driven north until the inequality of the signals became noticeable, this point being taken as one limit of the zone. The truck was then driven due south past the middle point of the zone until the inequality of the signals again became noticeable. This point was taken as the other limit of the zone, the distance between the two limits as determined was taken as the width of the zone.

The equisignal zone thus determined was found to extend due west, not exceeding 500 feet in width at any point up to 50 miles from the transmitting station. "As the distance from the transmitting station increased," reports the Bureau of Standards, "the sharpness of the zone decreased, which necessitated closer observation to determine the exact width of the zone. It is interesting to note that observations could not be made close to overhead wires of any kind or in the lee of a high hill or wooded section. It was found that wires running parallel to and in the immediate vicinity of the equisignal zone have the effect of blending the two signals, distorting the position of the zone, and in many cases doubling the strength of both signals."

In an airplane test using a 200-foot trailing wire antenna the results were markedly different, owing to the directional characteristics of the trailing wire. This test showed that signals were stronger when the airplane was flying away from the transmitting station than when flying toward it. This effect resulted in an apparent shifting of the equisignal.

(Continued on page 48)
Electric Arc Decomposes Water

What will 6,000 volts of direct current, at the rate of 5 to 6 amperes, do to a stream of water? Here's the answer. The heavy current decomposes the water into its constituents, hydrogen and oxygen, and returns the hydrogen to form more water.

In addition, slight impurities in the water are burned, the flame being colored reddish-purple by potassium salts, golden yellow by sodium, and green by copper.

The photograph was taken in the East Pittsburgh works. A. S. A. of the Westinghouse Electric and Manufacturing Company, where the machine was under test as a generator of plate current for radio work. One side of the circuit was the water pipe, from which a piece of heavy copper wire dipped into a porcelain insulator. As the water flowed into the bowl-like top of the insulator and spilled over the sides, the current arced through the water and returned to the generator through a wire entering the lower portion of the insulator.

The arc varied in length from three to five inches, and expended 25 kilowatts power—enough to light 600 ordinary 40-watt house lamps.

Film Feeding Device

Edward Amet, Los Angeles inventor, exhibits a model of a new film feeding device which can take from 1 to 25,000 pictures per second. This invention, he believes, is the only bona fide fast film feed in existence, aside from the secret methods used by the Government in aerial photography.

"B" Batteries encased in a parachute sack as they looked after their 25,000 foot drop from an army balloon. They were still good for further use.

Batteries Drop 25,000 Feet Still Working O. K.

Just how durable is a radio dry battery? Captain Hawthorne C. Gray of the U. S. Army Air Corps, satisfied himself on this point recently when he broke all previous world altitude records for free balloon flights in reaching a height of 42,470 feet at Scott Field Air Depot, Belleville, Ill.

At a height of approximately 25,000 feet, the radio "B" batteries and dry cells, with which his balloon was equipped, were hurled overboard in a specially made parachute; were recovered uninjured and returned by parcel post to Captain Gray without packing, in the condition shown in these photographs.

Captain Gray, in a letter to National Carbon Company, makers of the Everready Batteries so ingenuously treated, writes:

"The same set of batteries was used in my altitude flight of March 9th and is still in condition to be used again. The "B" batteries tested 21 volts each, and "A" batteries tested 23 amps."

Diagram Shows Plane Features

This diagram gives some of the new details of the construction of Commander Noel Davis' plane "Pathfinder" in which he will attempt the 5,600 mile non-stop flight from New York to Paris this summer for the $25,000 Orteig prize. Some of its unusual features are—

the huge 900 gallon gas tank in the fuselage, smaller gas tanks in the wings of the plane, which are of unusual thickness, shock absorbers on landing gear, deflated life preserver raft stored in the fuselage and a special designed instrument which shows whether the ship is on even keel. The "Pathfinder," now in process of construction at the Keystone Aircraft Factory, Bristol, Pa., is to have three Wright whirlwind engines developing over 200 H. P. each. The plan also has a short-wave broadcasting set. The large gas tank is divided into partitions to prevent the splashing which might disturb the equilibrium of the ship.

Edward Manley, radio operator of Putnam-Baffin Island Expedition, testing out his transmitting apparatus.

Radio Nearest Pole

When the schooner "Morrissey," in charge of Captain "Bob" Bartlett, Peary's skipper of his North Pole days, comes abreast of West Baffin Island with the members of the Putnam-Baffin Island Expedition aboard, it will mark the nearest that radio has ever been taken to the Magnetic Pole.

The Putnam-Baffin Island Expedition, headed by George-Palmer Putnam, left New York on June 11 for West Baffin Island, a region unvisited by white men since its discovery by Luke Fox in 1631. Radio scientists are especially interested in the outcome of radio experiments so near the actual center of the earth's magnetic force. Radio operations and experimental work will be in charge of Edward Manley, of Marietta, Ohio. The Morrissey's radio equipment, as shown here, includes a generator-powered transmitter (shown at extreme left of picture), a battery-powered transmitter with the UX 852 tube (shown at top of wooden shelf), two especially built radio receivers, one short wave, one long wave, and a portable battery transmitter. Equipment includes 37 dry batteries, which can be used for portable purposes.

The battery-powered transmitter shown above, in addition to the UX 852 tube, which will be used for the first time in Northern waters, has four radio frequency chokes. The circuit is shown as a tuned plate and tuned grid circuit, for use on 33 and 20 meters. Twenty "B" batteries supply 900 volts as power.
Astronomer Plans $12,000,000 Telescope

By JAMES STOKLEY
Science Service Staff Writer

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The astronomer is never satisfied.

Recently Dr. Edwin Hubble, of the Mt. Wilson Observatory, estimated that he had observed nebulae in the sky so far distant that their light takes 140,000,000 years to reach us. As light travels 186,000 miles in a single second, these distant objects are something like 840 million million miles away.

And yet the human eye desires to see still farther, and better.

To do this three things are necessary, in the opinion of Dr. Hubble. His views are shared by other astronomers.

First of all, astronomers need better photographic plates.

Then they need more big telescopes in the southern hemisphere.

Lastly, they need one or more super-giant telescopes. Such an instrument has already been planned by Francis G. Pease, builder of the great 100-inch reflecting telescope at Mt. Wilson—the one with which Dr. Hubble worked.

The need of the big telescopes in the southern hemisphere arises from the shape of the globe on which we live. Unless a telescope is precisely on the equator, there is a piece of the sky that it can never observe. If the telescope is in the northern hemisphere, like those in the United States, there is a large circular area, centered at the South Pole of the heavens, which never rises above the horizon at all. And a still larger circle of stars never rises high enough to be really satisfactorily observed.

The equator is not the ideal location for a telescope, however. While on this imaginary line it is theoretically possible to see every star in the heavens at some time or other, those around both poles never rise very high. The best way to do is to have two telescopes. One should be well to the north of the equator, the other well to the south.

For many years several American observatories have had branches in southern countries. The Lick Ob-
servatory, of the University of California, has one in Chile. Here are observed stars that are invisible in California. The observatory of Harvard University has had a branch since 1889 in Peru. Now they are moving to South Africa, where conditions are better.

Largest Southern Telescope

At this branch will be not only the instruments from Peru, but also some new ones. Chief of these will be a great reflecting telescope with a mirror five feet in diameter. This will be the largest telescope in the southern hemisphere. It is already being constructed in a plant in Pittsburgh. This is the same plant that made the six-foot mirror for the big telescope at Victoria, B. C., the largest outside of the United States.

Like all reflecting telescopes, this great instrument will have a mirror which takes the place of the convex lens in the telescope of most familiar type. The mirror is dish-shaped, and faces the stars. It is at the bottom of the telescope. The light of the star is reflected back from it, and a smaller mirror at the top of the telescope reflects the light to the side. Here it can enter the eye of the astronomer or fall on the sensitive photographic plate.

The Harvard astronomers will have company, even though they are so far away from home. Within the last two years the University of Michigan and Yale University have established branch observatories in South Africa, but at both of these stations are refracting telescopes, not reflectors.

There are other reflecting telescopes in the southern hemisphere, though not as large as the new Harvard one. Nearly a century ago, the great English astronomer Sir John Herschel, took his great 4-foot telescope, at that time one of the largest that had been built, to the Cape of Good Hope. He was the first astronomer to use a large instrument in southern latitudes. From his researches arose the British Royal Observatory at the Cape.

Australia also has a big reflector. This is a more modern instrument than Sir John's, for it was built in 1870. Its mirror is also four feet in diameter. This year it has been overhauled for use in observing Pons-Winnecke comet.

$12,000,000 Telescope Planned

But all these instruments fade into insignificance before a telescope that has been planned by F. G. Pease, designer and constructor of the 100-inch Mt. Wilson telescope. According to Mr. Pease, the principal item necessary for the construction of this monster research instrument is the cost. Twelve million dollars, he estimates, would provide it. A large amount, of course, but only about a third the cost of a modern battleship! And how much more good would the telescope do for the world than the battleship, for it would increase man's knowledge of the universe about him!

There are mechanical difficulties to be solved before such an instrument could be made, it is true. However, Mr. Pease probably knows more about such matters than any man living. This is what he says:

"The question has often been asked 'How large a telescope can be built today?' My reply would be that anything up to a hundred feet in aperture can be built provided one wants to pay for it."

One of the problems to be solved is the material of which to make the mirror. Present telescope mirrors are mostly made of glass. On this is coated a layer of silver to reflect the light, much as in the ordinary looking glass. The chief difference is that the telescope mirror is silvered on the front instead of the back. Hold a coin to your looking glass and you will see the reason. In the glass you see two coins, one bright, reflected from the silver on back, and one faint, reflected from the glass surface. In astronomy such a double image would be a serious defect. So the silver is coated on the front, and
is renewed occasionally.

However, in the large size contemplated there might be some defects of a block of glass as huge as would be required. Glass transmits heat slowly. When the temperature goes down, the great mirror would cool on its surface sooner than inside. The result would be that the outside would contract a little and the mirror would be slightly twisted until it reached the same temperature throughout. Though very minute, the twisting would be enough to be serious in accurate observing. So it may be that some metallic alloy, which transmits heat quickly to its interior, will prove better than glass.

**Faster Photographic Plates**

But astronomy doesn't want merely bigger telescopes. Even more welcome to the world of star-gazers would be better and faster photographic plates. Most astronomical observations today are made with the aid of photography. If you visit the modern astronomer at an observatory, you are not likely to find him peering through a telescope. Instead, you will probably find him looking through a microscope at a photographic negative made with the telescope.

In a single night at a big observatory enough photographs might be made to keep the astronomers busy for a month. The plate has one great advantage over the eye because it doesn't get tired. If you look through a telescope, you see as much in the first second as you will see if you look steadily for an hour. Of course, if there is a lot of fine detail, it may take time to give it careful scrutiny. But long gazing doesn't make details visible which were at first invisible. In fact, the eye gets tired, and really sees less after prolonged looking than at first.

The photographic plate is untiring. If a star of a certain brightness can be photographed in five minutes, one half as bright can be photographed in ten minutes, or one a quarter as bright in twenty. Some nebulae are so faint that even in the great Mt. Wilson telescope they can not be seen with the eye. But when a photograph of one is made with a long exposure, it is revealed in all its glory. Sometimes exposures as long as twenty or thirty hours are made, on several nights. All night long the plate is exposed, and then covered at the approach of dawn. Then the next night it is again uncovered, and it is kept pointed at the object for all of that night. In this way things are seen in the sky that without photography would have remained ever beyond our ken.

But photographic plates are not perfect. Some are more sensitive to light than others. The fast plates that the newspaper photographers use in their cameras record a scene even in poor light in a fraction of a second. The "wet plates" that the photoengraver used in making the illustrations for this article require long exposures with brilliant arc lights.

**Fast Plates Show "Grain"**

It might then seem that the astronomer should merely use the same kind of plates as the newspaper camera man. However, as soon as you begin to magnify the picture on one of these plates, the "grain" appears. It is like looking at a halftone reproduction of the photograph of Mr. Pease on this page. As soon as you look at it through a magnifying glass, the dots that make up the picture become so evident that the picture is no longer recognizable. In the plate, the grain is irregular, unlike the uniform rows of dots, but it is no less troublesome.

The plate of the photoengraver does not suffer from this defect. Even

(Continued on page 37)
Improved Radiophone
Modulation Circuit
By CHARLES F. FELSTEAD, 6CU

If the modulation transformer circuit shown in the accompanying diagram is used by the transmitting amateur, not only are switches and jack eliminated in the radiophone transmitter, but the wiring is made much less complicated. In the usual modulation circuit, a jack is connected to the modulation transformer primary and the D battery, and plugs are connected to the microphone, and buzzer and key. If a push button is put in series with the microphone as shown, the operation of the set will be more simple; and the cost of the jack and plugs will be saved. Some manufactured microphone assemblies have push buttons built into the handles; so, when a microphone of that type is used, no extra push button is necessary. Otherwise, with the ordinary microphone, a push button is necessary to connect the microphone to the modulation transformer when it is desired to modulate. By putting a push button in series with the microphone, the modulation transformer is not energized when the microphone is not used for modulation.

Colonel Clair Foster, radio amateur, of Carmel, California, has just set a record for his fellow members of that exclusive amateur club known as WAC—"worked all continents"—to shoot at.

Colonel Foster on June 10, communicated from California with an amateur station in South Africa, working with only a standard broadcast listener's receiving tube as a transmitter and with B battery power. It has just become known that on the same day Foster successfully worked with Shanghai, China.

By establishing communications with South Africa and China, Colonel Foster has now worked all of the continents, in each case accomplishing communication by means of the ordinary receiving tube and B batteries. The conversation in Africa was carried on with folSR, J. M. Davidson, Salisbury, Rhodesia, and in China with ac8HB, P. O. Box 266, Shanghai.

Regarding his record-making talks with these two continents, Mr. Foster says: "This makes all continents worked with my little transmitter, with the same identical 201A tube and Eveready batteries."

All the foreign stations were worked on 38.2 meters, or near it, except eg5HS, in England, on 20.2 meters.

Mr. Foster's accomplishment is believed to set a record for long distance communication with low power. In the California to Africa conversation, a distance of 14,000 miles was traversed.

Amateurs Elect Kerrigan

Vincent Kerrigan, head of the Inspection and Test Department of the Bremer-Tully Mfg. Company at Chicago has been elected President of the Chicago Nines Club. Other officers elected at the semi-annual business meeting, July 5, are Clifford Agazim, Vice-President, George Schmidt, Secretary, and Elmer Enke, Treasurer.

As many will remember, the Chicago Nines Club was organized in December, 1925, by a number of active Chicago amateurs. The first meeting, held at station 9VJ owned by Elmer Enke had nine charter members. At the present time the club has thirty members, the limit set by its constitution. The members are all licensed amateurs and many of them are employed in the engineering and laboratory departments of Chicago radio manufacturers.

The Club is operating its own station 9CN, operating on 21 and 42 meters with 250 watts.

For Superhet Fans

The most popular series of How-to-Make articles ever published in Radio Age were those on the Worlds Record Super 8 and 9. These articles were published in the issues of Nov. 1926 and January, February, April and May, 1927 and included blueprints. We have a limited supply of these back numbers at 30 cents each. Send stamps, currency or money order.
Crosley Extends Programs

Announcement is made today by the National Broadcasting Company that Powel Crosley, Jr., president of The Crosley Radio Corporation of Cincinnati, has purchased the programs of the Blue Chain for broadcast through the Crosley station, WLW.

The Blue Chain programs will be brought to Cincinnati after the first week in September. They will go on from 8:00 o'clock to 10:00 o'clock on Wednesday and Friday nights with the possibility of the addition of Collier's hour from 9:30 to 10:30 on Sunday nights. The New York broadcasts through WLW will include such entertainment features as the Maxwell Coffee hour, Don Amaizto, and others already popular. Besides these, the station will broadcast such national events as have been the Presidential messages, the receptions in Washington and New York for Lindbergh, the Eucharistic Congress, and the Dempsey-Tunney fight.

With the purchase of the Blue Chain programs by WLW, Cincinnati takes its place as one of the greatest radio centers in the world. Three big chains may now be heard there without interference, in addition to the excellent programs furnished by the Cincinnati stations.

New Wisconsin Station

Wisconsin has a new radio station—WTMJ, The Milwaukee Journal. Upon completion of the new station, The Journal, following the suggestion of the Federal Radio commission, will discontinue broadcasting over WHAD, which it has operated jointly with Marquette University since 1923. Marquette will retain the license of WHAD and operate as the station of an educational institution.

Journal officials also announce the purchase of WKAF. WTMJ will replace the old call letters.

THE FROTH ESTATE

(Continued From Page 11)

from the impact of the clubhead. It touched the very rim of the cup and trembled there—and failed to drop. One would have said that Mr. Lathrop's hands trembled a bit as he grimly sank the easy putt which gave him the hole and put him one up.

Miss Amy laughed and in her cheerful congratulations of the hated enemy there was not the least evidence of repressed dismay.

"What a great sport that girl is!" said Mr. Lathrop to himself. "I wish Col. Minimil was in hell."

"I'll lick him if I have to break an arm," said Miss Amy. "If I can't choose Col. Minimil's tailor I at least can spoil his lawyer's afternoon."

"Never saw anything like it," said Mr. Traynor. "Neither of them know I am here."

Miss Amy won the seventeenth hole by smashing a long drive straight for the green, lifting a spoon shot to the edge and chipping dead to the pin. She had made par and Mr. Lathrop was one over.

Thus they walked to the eighteenth tee all even. The lawyer, watching the girl as she teed up for what was likely to be the deciding shot of the game, inwardly prayed that she would get a good drive. He hoped she would win. But he was determined she should not. It wouldn't be fair to her to let down an ounce. What a hard-shooting, genuine jewel she was!

Miss Amy having teed up the ball, stood and silently contemplated it for a moment. She was conjuring up a fancy that the little pellet was Col. Minimil and she was going to sock him. It was her star drive of the afternoon. Two hundred yards down the fairway and well on the way to another par.

Mr. Lathrop, on the other hand, addressed his ball with a secret wish that it were the seat of a pair of tremendously plaid trousers. He also made a magnificent drive. The girl was on with her second. A long putt would give her a birdie. His second rolled into a trap at the edge of the green. He would need two to get down, barring a miracle of luck. Mr. Lathrop walked up to his ball and prepared for the last desperate chance to halve the hole and avert defeat. He lifted it to within two inches of the cup, a marvelous shot out of the sand and over a mat of rough that bordered the trap.

Miss Amy met his eye as he stepped to the side of the green. She smiled her appreciation of his fine skill. Mr. Traynor, twenty yards off the green, carelessly chipped up, and realizing that he was of only nominal consequence in this strange threesome he asked permission to hole out and make way for the final effort of the two embattled ones.

That left the field to Miss Amy. Once again she studied the slopes of the undulating green. She surveyed every inch of the ten feet that separated her ball from the cup and victory. She settled herself for the stroke and from the instant the clubhead touched the ball it was apparent the lawyer from New York had lost a contest. As the ball clinked into the cup Mr. Lathrop strode over to shake Miss Amy's hand. "Immense," he said, "Great! It is an honor to have been whipped by you."

She and Mr. Lathrop were comparing cards as they walked up to the clubhouse, Mr. Traynor preceding them. She stopped a moment and as the big brief and lawsuit man from New York paused with her she asked him in a very calm little voice and with the ghost of a smile at the corners of a really serious mouth: "Mr. Lathrop, you will admit, won't you, that even a woman sometimes plays the game?"

The legal gentleman laughed an uneasy acquiescence. What more did she mean than what she had merely said?

"How," asked the tortured Mr. Lathrop of himself, "am I ever going to tell this girl I am Col. Minimil's lawyer?"
RADIO AGE for September, 1927

A MARVELOUS RECEIVER

has been developed in the

RESEARCH LABORATORIES

of the

SCOTT TRANSFORMER CO.

It’s the Receiver You’ve Been Waiting For

Full Particulars Will Be Given In

OCTOBER RADIO AGE

JOBBERS—We have a real proposition for you.

Write for it.

SCOTT TRANSFORMER CO., 7620 Eastlake Tr., CHICAGO

Best Hookups—Thirty Cents Each!

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed the best hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired

March, 1926
—Improving the Browning-Drake.
—Rheostatless Tubes in a Set.
—How to Make a Wave-meter—Blueprint.

May, 1926
—Short Wave Transmitter—Blueprint.
—Simplifying Battery Charging.
—Protecting Your Inventions.

June, 1926
—Simple Crystal Set.
—Golden Rule Receiver—Blueprints.

August, 1926
—Receiver, Transmitter and Wavemeter.
—Beginners 200 mile Crystal Set.
—Changing to Single Control.

September, 1926
—How to Make a Grid Meter Driver.
—Short Wave Wavemeter.
—Power Amplifier for Quality (Blueprint)

October, 1926
—Crystal Control Low Power Transmitter (Blueprint)
—Raytheon Design for A B C Elimination
—What Type Loud Speaker to Use.
—Nine Tube Super Brings Back Faith.

November, 1926
—Blueprints of the Henry-Lyford.
—Worlds Record Super With Large Tubes.
—How to Use a Power Tube in Your Set.

December, 1926
—Starting Radio with Crystal Set.
—Six Tube Shielded Receiver.
—Types of Rectifiers Discussed.

January, 1927
—Full Data on Worlds Record Set.
—Dual TC Receiver.
—Clough Super Design.

February, 1927
—Building the Hammarlund-Roberts.
—Making a 36 Inch Cone Speaker.
—Browning Drake Power Operated.

March, 1927
—Ideal Model Worlds Record Super.
—Building the Hammarlund-Roberts.
—Ridding Supers of Repeat Points.
—Loop and Four Tubes.

April, 1927
—Ideal Model Worlds Record.
—Inexpensive B. Eliminator.
—One Spot Superhet.

May-June, 1927
—Complete Trouble Shooter for Supers.
—9 Tubes for Worlds Record Super.

July-August, 1927
—Building Vacuum Tube Voltmeter.
—Low Power Crystal Control Transmitter.

Radio Age, Inc., 500-510 N. Dearborn St., Chicago
The New A C Tube

(Continued from page 6)

will be a loud hum on turning on the set. The hum disappears in about 30 seconds and the set starts functioning properly.

Fig. 4 shows the grid voltage plate current curves for the C327 tube, for 45 and for 90 volts. When the tube is operated at about 50 volts the same grid bias may be applied to it as for the amplifier tubes. The grid return is connected with the cathode cylinder and to the bias resistor. The grid return to the center of the potentiometer is not at all critical.

Mechanically the construction of both tubes is more rugged than that of any of the earlier tubes. The detector tube seems more free from mechanical vibrations which are transmitted to the loud-speaker than in the case of the tube with a light filament. The filament voltage, by the way, is not as critical as the type 326 tube. In any case variation in line voltage will not affect the tubes sufficiently to make any difference in their characteristics, either the 326 or 327.

The circuit diagram, Fig. 5, is typical for a five tube receiver using house lighting current for power supply to filaments and plates of the tubes. This circuit shows a single transformer for both high and low voltage, although a separate transformer may be used for filament and for plate current supply, in fact, it is the recommendation of transformer manufacturers to have it so, for flexible operation. The by-pass condensers C1 and C2 are not necessary, though they may prove of advantage in reducing interstage coupling in some cases. The radio frequency transformers and variable condensers may be of any type or manufacture. A 171 type tube is recommended for the last stage.

The grid return is to bias resistor R2 which should have a value of about 2500 ohms for correct voltage drop to be impressed on the grid of the CX171. R1 is the bias resistor for the three CX326 tubes. Since the three tubes draw about 90 milliamperes (at 135v.) the value of this resistor should be 1300 ohms. (.009 amperes X 1300 ohms equals 11.7 volts), the voltage drop will increase for larger plate voltage automatically. In figuring the bias resistor R1 the plate current for the CX326 tubes only should be considered, as the plate current return for the CX371 and C327 is not through this resistor. The bias resistor for two CX326 tubes would be 2000 ohms (.003 X 2000 is 12 volts drop), similarly the proper bias resistance for one tube would be 4000 ohms, for four tubes 1000 ohms, and for five and six tubes, 800 and 700 ohms respectively. The voltage drop across the bias resistance is not effective on the plate of the tube and should be subtracted from the total plate voltage. The voltage drop across the bias resistors can be measured with a high resistance voltmeter used for measuring voltages supplied from "B" eliminators.

There is no volume control shown in this diagram, but a variable resistance of about 10,000 ohms may be connected across the primary of one of the r. f. transformers, or a potentiometer connected across (500,000 ohms) the secondary of the first audio transformer with the grid connected to the sliding arm instead of directly to the transformer.

The "B" eliminator is connected as usual, but only two voltage taps are shown here, the 45 and 160 volt taps. The eliminator should be in a metal case if it is to be installed in the same case with the receiver, and should be "grounded".

Editor's Note—Other articles on the use of A. C. tubes in various types of receivers will be published in early issues of Radio Age. The A. C. tube in Super construction will be an early and interesting feature.

Radio World's Fair

The Radio World's Fair of 1927 will be held at the Madison Square Garden, New York, September 19 to 24 and G. Clayton Irwin, Jr., general manager, declares it will be the finest exhibition thus far presented in the radio field in this country. The New York and Chicago shows are thoroughly national in character and they are not only interesting to the public but provide a stimulus for the trade that could not be achieved in any other way.

Several important radio events will take place in New York during the week of the show. The fourth annual radio industries banquet will be held in the Hotel Astor on the evening of September 21. Major Herbert H. Frost, chairman of the speakers' committee, visited President Coolidge at Rapid City, S. D., recently and invited the chief executive to be the speaker of the evening. The President's reply will be received at an early date. The proceedings will be broadcast. It is expected that seventy stations will be connected in the chain that will give the country an opportunity to hear the music and speeches. More than three hundred entertainers will participate in the program.

Realizing the public interest in the broadcast of this event the committee has decided to designate the day of the banquet as "National Radio Day." Broadcasting will begin from the banquet hall at 9 p. m., New York time. Broadcasters are to be requested to make their programs for Wednesday, September 21, "National Radio Day Programs," stirring interest in the occasion by the character of their broadcast and, as last year, presenting a program that will lead up to the beginning of the banquet program at 9 o'clock, Eastern time.

The National Association of Broadcasters will hold its fifth annual convention during the week of September 19 at the Hotel Astor. Officers will be elected on the morning of the 21st.

The Garden display will include scores of improved radio products for the 1927-1928 fan.
Suggestions About Supers
(Continued from page 12)

labor tube. This oscillator tube takes energy from the batteries and produces an oscillating current. The frequency of the oscillations may be varied by a tuning condenser and the frequency always is different from that of the wave that is being received through the aerial.

For example, if the set is tuned to receive a 100-meter station, the incoming waves have a frequency of 3,000,000 per second. The oscillator may be tuned to produce 3,100,000 waves or oscillations per second. These oscillations will combine with those received from the transmitting station and, by heterodyne action, a frequency of 100,000 is passed along to the first amplifying tube. The reason that only 100,000 oscillations per second reach the amplifier is that 100,000 times per second the oscillations from the two sources of power, the transmitting station and the oscillator tube of the receiver, get in step and help each other, while the rest of the time they buck each other and prevent each other from going on. The rectifying action of the detector tube is necessary here, in order to produce this beat frequency of 100,000 per second, but this first detector does not reduce the frequency enough to produce sound waves in a phone.

It is this reduction of high frequencies to lower frequencies that gives the superheterodyne receiver its distinctive character and its high amplifying power. High-frequency current always is more difficult to control than low-frequency current.

Inductance coils, resistances and almost every part of a set through which high-frequency current passes shows effects different from those produced by low-frequency current. Energy may be transferred from one part of a circuit to other parts or to other circuits where it is not wanted and where it makes trouble. The more the high-frequency current is amplified, the more troublesome it becomes.

The superheterodyne receiver rids itself of these troublesome high frequencies right at the first tube, with the help of the oscillator. After that it amplifies the low-frequency current to any desired extent and finally passes it through the second detector, which reduces it to audible frequencies. When the frequencies are low enough to produce sound, they can be passed along to an audio-frequency amplifier, or directly into the phones or loud speaker. The changes of frequency have no more effect upon the words or music that are being received than the number of

The September issue of the CITIZENS RADIO CALL BOOK is now on sale.

This issue contains a complete and up-to-date list of all broadcasting stations with new assignments of wavelengths, etc., a wonderful rotogravure section showing pictures of your favorite radio artists and the latest hints on how to improve your receiver for best reception.

Also, a wonderful array of construction articles showing how to build all of the latest circuits which have been thoroughly tested and designed in our laboratory complete with fine drawings and illustrations so simply arranged that any novice can build the highest grade receivers.

On sale at all the leading radio stores and newsstands. Published four times yearly.
times a ball is thrown or batted has on the shape of the ball, unless distortion occurs by reason of faulty design or operation of the circuits.

The third section of the superheterodyne is the intermediate-frequency amplifier. This may contain from one to three tubes, or more. The circuits are typical amplifier circuits. The plate output of the first detector tube goes to the primary coil of the first transformer. It produces a current of higher voltage in the secondary coil of this transformer, by induction, and this goes to the grid of the first amplifier tube. The plate output of this tube goes to the primary coil of the next amplifying transformer, and from the secondary coil of this transformer a current of still higher voltage goes to the grid of the next tube, and so on.

Both the primary and secondary coils of the first transformer, which receives the output of the detector tube, are shunted by condensers. The transformers that receive the output of the amplifier tubes have no such condensers.

The primary coils of the transformers that receive the output of the amplifying tubes connect with the positive terminal of the “B” battery, at the end of the coils opposite the plate connection. They connect also with a coil in the plate circuit of the oscillator tube. The secondary coils of the first two of these amplifying transformers are connected back to the secondary coil of the transformer between the first detector and the first amplifier tube. The secondary coil of the third amplifying transformer connects with the grid leak and condenser of the second detector tube, on one end. The other end of this coil connects with the plate of the second detector tube, through a condenser. Also it connects with the filaments of all tubes except the oscillator, on the positive side.

The fourth section of the receiver is the second detector. This tube receives the amplified radio-frequency current from the last amplifier and reduces it to audible frequencies. The current passes into the phones or loud speaker, or into an audio-frequency transformer if one is added, through

A superheterodyne receiver in the experimental stage. It is a good idea to make panels of dry wood, mount the parts and try out the set. This may prevent mistakes that would be costly with more expensive materials.

the plate circuit. The return wire from the phones, speaker or amplifier goes to the negative terminal of the “B” battery. Also it connects with the primary coil of the transformer that is next to the first detector tube, and with the positive terminal of the filament of the first detector tube. There is another wire from the plate of the second detector tube to a condenser and a wire from the other side of the condenser to the positive terminal of the “A” battery.

The negative terminals of the filaments of all the tubes connect with a rheostat that governs the supply of current from the “A” battery. As is usual in radio-frequency amplification, the “A” battery is shunted by a potentiometer, which steadies the action of the tubes. The sliding contact in the middle of this potentiometer leads to the secondary coils of three of the transformers: the one next to the first detector and those in the first and second stages of amplification. There is a by-pass condenser between the slider and the potentiometer and the wire leading from the positive terminal of the “A” battery to the filaments.

The oscillator circuit is the only one that looks exceptional to a man who has studied the diagrams of other types of receivers. The grid and plate are connected by a variable condenser. The wires from the grid and plate each go to a coil. These two coils are separated by a condenser. The positive terminal of the filament, which connects of course with the “A” battery, connects also with the coil in the grid lead and with the condenser that separates this coil from the coil in the plate lead.

If an outside antenna is used with a superheterodyne receiver it should be designed to work with the receiver. Usually, fifty feet is long enough. The longer the antenna the more it broadens the tuning and decreases selectivity. For the super, the antenna does not need to be as high as for less powerful sets.

Ordinary types of audio-frequency amplifiers can be used to increase the volume of the super. They are connected to the second detector in the usual way. It is not necessary to tear down the super and build the audio-frequency amplifier into it. The amplifier can be built as a separate unit and connected.

Shielding is important in the superheterodyne. Usually it is provided for in the kit and instructions.

Amateurs who want to bring in code signals from stations that transmit continuous waves add a second tube to the oscillator of the super.

Parts for a superheterodyne receiver cost well over a hundred dollars. The work of assembling these requires a considerable amount of time. It is folly, therefore, to try to save a few dollars by buying poor parts. The condensers should be of exactly the capacities specified. There are many small fixed condensers that are satisfactory for some purposes but that do not have the exact capacity indicated on the labels.

H. A. Snow, formerly with the United States Bureau of Standards, found in his experiments that the amplification factor in a superhetrodyne receiver using four tubes ahead of the second detector was 3500. A receiver using uncompensated untuned radio-frequency amplification with three tubes has an amplification factor of about 600. This explains why a super often brings in stations all the way across the continent, even in the worst radio weather of summer. It is not always easy to build and adjust one so that it works perfectly, but the results that it will deliver make it worth all the effort.
WLW’s Artists’ Bureau
Formation of an Artists’ Bureau, announced by Powel Crosley, Jr., president of the Crosley Radio Corporation, Cincinnati, Ohio, who operate the well-known broadcasting station WLW, is said to mark the beginning of a new epoch in broadcasting studio management. In the opening of this Bureau, which provides a booking service for the station’s outstanding individual artists and organizations, a step has been taken in the direction of a closer relationship between the artists and the studio, and toward a more complete service to the public in making available for outside appearance the most successful of its performers.

Artists and organizations who have affiliated themselves with the Bureau are: the Heermann trio; William J. Kopp, orchestra director; Lydia Cleary Dozier, soprano; Marjory Garrigus Smith, pianist; the Lyric Male Quartet; the Crosley “Pups”; Johanna Grosse, organist; the Crosley Cossacks; and Melville Ray, tenor.

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The exhibits of new inventions and developments in radio receivers, parts and accessories will be of great interest to all amateurs, professionals and radio fans.

You will also meet radio’s most popular entertainers and announcers. Among the many new inventions will be “The Theatre of Wonders,” a storehouse of magical and practical inventions you can’t afford to miss.

Special business sessions for the trade.

Radio shows open daily from 1:00 p. m. until 11:00 p. m., Monday to Saturday inclusive.

**National Radio Day**
September 21
How To Make An Outdoor Gym

BY ALL means make an outdoor gym this fall if you have even a small plot of vacant ground, such as back of the house. It will give you pleasure, not only in the building of it, but particularly after it has been made. More than this you can invite your friends and thus make your own home the most popular place in the neighborhood. Here are a few plans and suggestions you can use.

Some boys find that it pays to enlist the aid and enthusiasm of other boys right from the start. Then the work of construction is lessened and all of the boys have a mutual interest. You can form a committee consisting of your friends and have each agree to do an equal part. Anyone who joins the agreement will vote as do the others in special problems which come up.

If possible, choose a place where there are a few trees. These not only give shade but will help to support some of the apparatus. If you wish you can set a timber in a crotch formed by a large limb and support the other end with a post of suitable height. The horizontal beam can be from eight to twelve feet long. The ends must be securely wired or nailed in place. A block under the outer end will prevent the nails from pulling out.

From this beam you can hang a swing, and also a piece of gas pipe for doing "stunts." There may also be room enough for a single rope and an old auto tire. If you wish you can run a short piece out from the right end, one end nailed to the tall post, the other supported by a short stake. This, then forms a suitable support for a teeter-totter and requires only a plank to complete it. Cleats nailed to the underside of the plank at the middle, will prevent it from working out of balance. Even though the post is set snugly in the ground, braces of either wire or wood should be set each side, anchored near the top and set in the ground to prevent side-play.

Figure 2 shows an interesting merry-go-round that is really different. Fasten a short piece of chain to a limb and attach a swivel to it, preferably with a ring. Attach a longer chain to this and run it through a gas pipe. Fit a large iron wheel with a plank on top onto the lower end of the pipe, setting it fast with a set screw. The lower end of the chain is kept from slipping up the pipe by tying or otherwise securing it to a block of wood or piece of iron.

In use this merry-go-round not only revolves very freely, but there is an up-and-down motion, too, which is quite exciting. The swivel prevents twisting the chain in two and it can be used indefinitely. Wire the plank to the wheel. As a rule the plank should be at least three feet from the ground. The pipe lends stiffness which is desirable.

For a separate teeter-totter, the type shown in figure 3 will serve well. The support is a piece of plank of the same width as that used for the teeter-totter, sunk in the ground at least three feet and braced well on each side. The plank should be at least twelve feet long and two inches thick. Cleats are nailed cross-ways of the plank at the center on the underside. Notice that the edges of the cleats are rounded off as well as the upper edge of the plank support. This permits easy operation. The two heavy sheet iron pieces on each side of the plank prevents it from moving out of place.

These and many other pieces of apparatus can be made from scrap materials.

<table>
<thead>
<tr>
<th>CARTER PARTS</th>
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<tr>
<td>Specified as usual in Radio Age A C Tube Receiver</td>
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<tr>
<td>CARTER Rheostats</td>
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<td>CARTER Potentiometers</td>
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<tr>
<td>CARTER Fixed Resistors</td>
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<td>CARTER Jacks</td>
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<td>CARTER Volume Controls</td>
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Leading Engineers always specify CARTER parts to insure satisfying results.

Any Dealer Can Supply
In Canada: Carter Radio Co., Ltd., Toronto

Carter Radio Co.
CHICAGO

October Supers
Get the October Issue of Radio Age for latest circuits
September Skies
(Continued from page 14)
But Saturn, the ringed planet, is still with us in the evening sky, in the constellation of the Scorpion, while Jupiter is now visible throughout the night. It is in the constellation of the Fishes.

One astronomical event that is not always so welcome, is the coming of autumn. This occurs on the evening of September 23, at 8:17 p. m. At that moment the sun will be directly over a point on the earth’s equator and will enter the sign of Libra, the scales. This is the autumnal equinox, and days and nights will be of equal length. But this will be attended by no earthly happenings connected with or caused by it. The old idea of the “equinoctial storm” has been completely overthrown by science, though of course, like so many old superstitions, many people still believe in it.—Copyright 1927, by Science Service, Inc.

$12,000,000 Telescope
(Continued from page 28)
with the most powerful microscope, no one has ever seen the grain of a wet plate of this kind. But the astronomer cannot use it, because it would take such long exposures.

What a boon it would be for him if he had a plate as fast as the news plate and as grainless as the wet plate! Perhaps this is an ideal impossible of attainment, but photographic research laboratories are working on the problem. Even a plate twice as fast as those used at present and with no coarser grain would mean that every existing photographic telescope would immediately have its light-gathering power doubled. So perhaps the next great advance in astronomy will originate in the chemical laboratory of a photographic plate factory!

This was the idea expressed by Dr. Hubble. In his estimation, the needs of astronomers at present are three-fold. First of all, is needed better and faster plates. And then, comes more large telescopes in the southern hemisphere. Last of all comes the great telescopes surpassing in size the present instruments.
### Correct List of Broadcast Stations

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<tr>
<th>Call Letters</th>
<th>Station Name</th>
<th>City/Location</th>
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<tr>
<td>KFRC</td>
<td>Radio Electric Co.</td>
<td>Devils Lake, N. D.</td>
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<tr>
<td>KIYT</td>
<td>Intermountain Life &amp; Power Co.</td>
<td>Circle City, Mont.</td>
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<td>KELW</td>
<td>Earl L. White</td>
<td>Burbank, Calif.</td>
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<tr>
<td>KEXM</td>
<td>Western Broadcasting Company</td>
<td>Portland, Ore.</td>
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<tr>
<td>KFAB</td>
<td>Nebraska Buick Auto Co.</td>
<td>Lincoln, Neb.</td>
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<tr>
<td>KFAD</td>
<td>Electrical Equipment Co.</td>
<td>Phoenix, Ariz.</td>
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<td>KFBB</td>
<td>Independent School Dist.</td>
<td>Boise, Idaho</td>
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<td>KFBC</td>
<td>F. E. Fricke Co.</td>
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<td>KFBCB</td>
<td>W. Z. Azbill</td>
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<td>KFBK</td>
<td>Sacramento Bee</td>
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<td>KFBL</td>
<td>Leese Bros.</td>
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<td>KFBS</td>
<td>School District No. One</td>
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<td>KFBI</td>
<td>Bishop N. Thomas, S. J.</td>
<td>Laramie, Wyo.</td>
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<td>KFGRB</td>
<td>Santa Barbara Broadcasting Co.</td>
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<td>KFDM</td>
<td>Magnolia Petroleum Co.</td>
<td>Beaumont, Texas</td>
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<td>KFDX</td>
<td>First Baptist Church</td>
<td>Shreveport, La.</td>
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<td>KFDY</td>
<td>South Dakota State College</td>
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<td>Harry O. Iverson</td>
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<td>KFEG</td>
<td>Meier &amp; Frank</td>
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<td>KFEL</td>
<td>Eugene P. O'Fallon, Inc.</td>
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<td>KFEY</td>
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<td>Boone Biblical College</td>
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<td>KFHP</td>
<td>Hotel Hopkins</td>
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<td>KFIL</td>
<td>E. C. Anthony, Inc.</td>
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<td>Benson Polytechnic Institute</td>
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<td>North Central High School</td>
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<td>KFIZ</td>
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<td>KFIU</td>
<td>Alaska Electric Co.</td>
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<td>KFJB</td>
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<td>KFTR</td>
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<td>W. E. Branch</td>
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<td>KFNF</td>
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<td>KFOA</td>
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<td>Nicholas &amp; Warriner, Inc.</td>
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<td>KFOQ</td>
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<td>KFPL</td>
<td>C. C. Baxter</td>
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<td>KFPM</td>
<td>The New Furniture Co.</td>
<td>Greenville, Tex.</td>
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<td>KFPR</td>
<td>Los Angeles County Forestry Dept.</td>
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<td>KFUL</td>
<td>Thomas Grogan &amp; Bros.</td>
<td>Galveston, Texas</td>
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Time To Build
(Continued from page 4)
that should be read and saves unnecessary reading.
Most men are interested in science, but it is almost impossible to grasp scientific conceptions without having some scientific experience. The fact that so few men maintain chemical laboratories, astronomical observatories, botanical gardens or zoological collections indicates that most forms of scientific research are beyond the reach of the multitude. Radio, one of the newest sciences, is basically as old as any; it is the only one that is wide open to rich and poor, sound and crippled, educated and unschooled.

It is impossible to build a radio set without opening the mind to new worlds of thought. It is impossible not to wonder how a smelly liquid, poured into a container with leaden plates, will cause a current of electricity to flow through wires and make a fibre of metal become luminous. A set builder cannot escape the thrill that comes when a slight adjustment causes an inert tangle of wires and metal plates to come to life and open the door for him into the midst of a frenzied multitude yelling because a horsehide-covered sphere, rebounding from a willow stick, has flown over a fence and escaped from the scene of its recent activities.

A set builder who studies radio cannot but be awed by the mystery of the electron, which he can control in some of its wanderings although he cannot see it. According to science it is the very basis of our physical being, the things from which all other things, animate and inanimate, are formed.

Radio An Obligation
It is time to build. Domestic duty requires that our homes shall not remain below the general level, that our loved ones shall have every opportunity that others enjoy. One home in five has radio—the rest should have it.

Civic duty demands that we do our best to follow the trend of politics and the devious ways of politicians. Public works worth a million dollars cost us two millions, or possibly five, by the time they are paid for. The money comes directly out of our pockets, it is taken from those who are dependent upon us. War plunges us into debts from which there is no escape; our last war with Mexico, which was fought nearly a century ago, is not paid for yet but there are those who want to start another one.

We cannot read all the political propaganda, yet it is necessary to know two sides all the time or run the risk of becoming the tools of predatory groups whose real leaders have not the nerve to face an honest man and answer a straight question. Radio helps, because character is revealed in a voice even when lying words are carefully studied and artfully spoken. We can listen, and then get behind the real leader who knows the situation and is ready to help us fight our battles.

It is time to build. What is the use of living in the greatest age in history and not being a part of it?

Radio Aids Miners
(Continued from page 7)
paratus. After the required locations and measurements are made test drilling is done to obtain definite information of the ore deposit.

For thousands of years the great underground mineral mysteries have been held as silent secrets of nature until here and there a prospector or mining company locates some trace of the great fortunes yet unknown. Millions of dollars have been expended in searching for mineral deposits which might be located in northern Alaska or in Southern Africa, but no better method other than the faithful pick and shovel or diamond drilling has been used. But today a new method of prospecting and exploration has entered the mining world with the development of the radiorc process which has electrical eyes more powerful than any human's eyes. Nature's mineral secrets will be revealed where least expected. The future will see even a greater development of radio as the most valuable tool in the mining world.
Readers of Radio Age, and all radio constructors who have been following the development of radio since the early days of broadcasting will learn with poignant regret of the passing of Frank D. Pearne in June. Mr. Pearne was found lifeless at the wheel of his car in a garage near his home in Chicago. Mr. Pearne had been suffering from heart trouble and had been planning a long rest. His funeral was directed by Masonic brothers and was an impressive ceremony, attended by a large number of personal and professional friends who admired and loved Mr. Pearne for his sturdy character, his unfailing kindness and his important contributions to the art of radio transmission and reception.

Simultaneously with the inauguration of popular broadcasting in 1922 Mr. Pearne became a friend of those who wanted to know how to build sets. He had been instructor in electricity at Lane Technical High School for more than ten years at that time and was already familiar with the practice and theory of radio. His forte was the helping of beginners. Thousands of readers of Radio Age in 1922 and 1923 depended upon Mr. Pearne to help them over the rough spots. His articles and drawings appeared in Radio Age regularly and he was technical editor of this magazine, as well as technical editor of the Chicago Herald and Examiner.

The editor of Radio Age has probably a better knowledge of the unselfish work performed by Mr. Pearne in behalf of radio beginners than has any other person, except probably Mrs. Pearne. She many times had to protect Mr. Pearne from the hundreds of persons who called his residence by telephone by day and night, threatening to deprive him of needed rest and of time for his high school work. No letter was too insignificant for this friend of radio. He answered all queries personally, giving the same time and careful thought to the reply to the small boy who was experimenting with crystal sets as he gave to the
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<tr>
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<td>C. H. Meister</td>
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<td>C. G. Under</td>
<td>Lakewood, N. J.</td>
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<td>Cap City</td>
<td>Cape City, N. Y.</td>
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<td>WCLS</td>
<td>WCLS, Inc</td>
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<td>WCM</td>
<td>Culver Military Academy</td>
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<td>WCOA</td>
<td>City of Pensacola</td>
<td>Pensacola, Fla.</td>
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<td>WCOF</td>
<td>Crystal Oil Co</td>
<td>Columbus, Miss.</td>
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<td>WCOM</td>
<td>172nd Field Artillery</td>
<td>Manchester, N. H.</td>
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<td>Jacob Conklin</td>
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<td>WCWR</td>
<td>Clinton R. White</td>
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<td>WCSS</td>
<td>Congress Square Hotel Co</td>
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<td>WCSO</td>
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<td>WDAT</td>
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<td>WDAY</td>
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<td>WDBZ</td>
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<td>Kingston, N. Y.</td>
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<td>WDW</td>
<td>Wilmington Elec. Specialty Co</td>
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<td>WDG</td>
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<td>WDO</td>
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<td>WDRC</td>
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<td>WEAM</td>
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<td>North Plainfield, N. J.</td>
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<td>WEAN</td>
<td>The Shepard Co</td>
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<td>WEO</td>
<td>Ohio State University</td>
<td>Columbus, Ohio</td>
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<tr>
<td>WEG</td>
<td>Florida Storage Battery Co</td>
<td>Miami, Fla.</td>
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<tr>
<td>WEB</td>
<td>Headquarters of the Radio Station</td>
<td>Superior, Wis.</td>
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<td>WEBE</td>
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<td>Cambridge, Ohio</td>
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<td>WEBH</td>
<td>Edgewater Beach Hotel</td>
<td>Chicago, Ill.</td>
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<td>WEBJ</td>
<td>Third Avenue Railway Co</td>
<td>New York, N. Y.</td>
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<tr>
<td>WEBQ</td>
<td>Tate Radio Corp</td>
<td>Harrisburg, Ill.</td>
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<td>WEBR</td>
<td>Head of the Lake Radio Station</td>
<td>Superior, Wis.</td>
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<td>WEBY</td>
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<td>WEBZ</td>
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<td>WEC</td>
<td>The Edison Elec. Illuminating Co</td>
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<td>WEDS</td>
<td>A. T. Becker</td>
<td>Evanston, Ill.</td>
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<td>WEMS</td>
<td>Emanuel Missionary College</td>
<td>Berrien Springs, Mich.</td>
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<td>WENR</td>
<td>Great Lakes Broadcasting Co</td>
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<td>WFAW</td>
<td>Times Publishing Co</td>
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<td>WFB</td>
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<td>WFBG</td>
<td>Wm. F. Gable Co</td>
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<td>WFBJ</td>
<td>St. John's College</td>
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<td>WFBK</td>
<td>The Onondaga Co</td>
<td>Syracuse, N. Y.</td>
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<td>WFBM</td>
<td>Indianapolis Power &amp; Light Co</td>
<td>Indianapolis, Ind.</td>
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<td>WFBR</td>
<td>Fifth Infantry National Guard</td>
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<td>WFBH</td>
<td>Knoll Radio</td>
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<td>WFCI</td>
<td>Frank Cook, Inc</td>
<td>Pawtucket, R. I.</td>
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<td>WFD</td>
<td>F. D. Fallan</td>
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<td>WFHH</td>
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<td>WFM</td>
<td>The Amic Mills, Inc</td>
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<td>WFKE</td>
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<td>WGBC</td>
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<td>R. T. Garfield</td>
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<td>Federal T. and Co</td>
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<td>Stambaugh &amp; Co</td>
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<td>WHAR</td>
<td>F. D. Cooks Sons</td>
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<td>WHAT</td>
<td>Courrier-Journal &amp; Louisville Times</td>
<td>Louisville, Ky.</td>
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<td>Rensselaer Polytechnic Institute</td>
<td>Troy, N. Y.</td>
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<td>WHEW</td>
<td>Sweeney School Co</td>
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<td>WHBE</td>
<td>C. C. Shaffer</td>
<td>Oil City, Pa.</td>
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<td>First Ave. Methodist Church</td>
<td>St. Petersburg, Fla.</td>
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<td>Young Brothers, Inc</td>
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<td>H. W. Dunwoody Institute</td>
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<td>Hickson Electric Co.</td>
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<td>Triangle Broadcasters</td>
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<td>WHK</td>
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<td>Cleveland, Ohio</td>
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<td>Loew's State Broadcasting Station</td>
<td>N. Y. City, N. Y.</td>
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<td>Banker's Life Co</td>
<td>Des Moines, Ia.</td>
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<td>Frederic B. Zittel, Jr.</td>
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<td>WJAD</td>
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<td>Red Bank, N. J.</td>
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<td>Wm. Gushard Dry Goods Co</td>
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<td>WJBO</td>
<td>Valdemar Jensen</td>
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<td>WJBU</td>
<td>Bucknell University</td>
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The NEW "ENSCO" 3-Ft. Cone Wall Type Speaker

Complete "ENSCO" Kit $10.00 With Hardwood Wall Frame $11.00

Kits contain "ENSCO" patent protected parts, designed and patented by Clyde J. Fitch; Beautiblly decorated and assembled. PGC-39/C Case Material; Metal Aparatus; Extension Pits and 18 page illustrated Book of Instructions for assembly of any of six sizes of Cone or Bell shape Wall, Pedestal or Console speakers. You can build it in less than an hour. Static materially reduced—winter results all summer.

The "World's Fairest Loud Speaker" Now within the range of everyone. At your dealer's or direct from the office listed below. Send check, money order or C. O. D. Shipping charges paid. Absolute (money-back) guarantee.

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advanced student of radio who was working on super hets.

Radio Age takes this opportunity gladly to say for the thousands of radio fans who knew and loved him that he has left a record of service that will stand as an enduring monument to remind us of a man who was big enough to give the best he had to his fellows with little thought to immediate rewards. Frank D. Pearne was a kindly neighbor, a patient instructor, a loyal friend. His passing is a great loss to radio.

Brazil a Growing Market

Brazil is a good market for radio receiving sets, according to a trade bulletin issued by the Electrical Equipment Division of the Department of Commerce. There are many crystal receivers of local manufacture in use, the report states but the demand for the larger types of tube sets is growing rapidly because of the general desire of the listeners to pick up Buenos Aires broadcasting stations. In many parts of Brazil it is necessary to use a large receiver in order to hear the nearest station satisfactorily. Practically all complete receiving sets and parts now imported into Brazil are of American origin.

The development of the demand for radio receiving sets during the last few years, though impeded a great deal in the beginning by Government regulations, has of late been rapid, the report reveals. Radio enthusiasts have formed societies in Rio de Janeiro, Sao Paulo and fourteen other cities, thus stimulating interest.

ELECTRAD Royalty Variable High Resistances

Tests have proven them to be the most accurate and reliable for all circuit work. That's why radio experts insist on them. Note these features denoting quality.

1—Resistance element not exposed to mechanical wear.  
2—Electrical contact made positive by metallic arm on wire-wound.)  
3—Resistance under control in manufacture and does not change with use.

A range for every purpose—designated A to I. Type E—$2.00. All other types $1.50.

Write for free hook-up circular
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ELECTRAC PRODUCTS

X-L Products

Pep up Your Set!

MODEL "N"—Variable inductance...MODEL "G"—Obtains correct resistance...

X-L PUSH POST—Push it down with your thumb, insert wire, remove pressure, wire is firmly held. Vibrations will not loosen, release instantly. Price each, 15c. Also in strip of 10 on black panel marked in white. Price 1.50.

FREE: circuit diagram showing use of X-L units in the NEW LNF-1610 complete supplies radio. Frequency 1060 to 1250 kilocycles, in other popular bands on request.

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Mailing Lists

Will help you increase sales beats in your window, radio, records and books, at your best profit. 25c a list. Will make special mailing list for you at moderate cost. Write for details and rates.

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NEW YEAR—NEW IDEA

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For further information, write:

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New Aero Circuits
Worth Investigating

The Improved Aero-Dyne 6 and the Aero 7 and Aero 4 are destined to be immensely popular this season!

Radio Tabloids
(Continued from page 8)

It is difficult to refer to the results of broadcast advertising without mentioning specific cases which might be undesirable, but ample evidence of its efficacy is available. The manufacturer of a tooth paste, whose product sold side by side with that of competitors, put on a radio "hour." He could not fail to notice that in districts covered by the broadcasting his sales increased many fold, while in other districts they remained about the same. Similar results have been had in radio receiving sets

* * *

Chinese Radio

Admiral W. H. G. Bullard, in an address before the National Electrical Manufacturers' Association.

Radio both for broadcasting or communication plays a very small part in the Republic of China. The Chinese Government maintains a few small powered costal stations for communication with ships at sea. The importation into China of any form of radio apparatus is prohibited by decree of Chinese Government, as such apparatus is classified as munition of war, although for those who have the proper influence, the ban may be lifted. An attempt to bring in radio apparatus is not an offense and if one is caught doing so, there is no penalty nor is the apparatus confiscated; it is simply not allowed to enter, and if one is caught in one port it is usually the practice to try another port.

Broadcasting as practiced in the United States is practically unknown. There is one small station in the International Settlement in Shanghai and the owner simply has to pay the police to keep away from it to allow him to continue. Recently, a change is coming over responsible officials, particularly in the Northern sections, notably in Manchuria, where the so called ruling War Lord has been convinced by one of his aids—a returned United States student—that radio broadcasting might fulfill a long felt want. In consequence, an American doing business in China has given a contract to erect a broadcast station in Mukden which is about ready to operate.
<table>
<thead>
<tr>
<th>Call Letters</th>
<th>City, State</th>
</tr>
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<tbody>
<tr>
<td>WRNY</td>
<td>City of Dallas, Texas 353</td>
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<td>WRR</td>
<td>F. G. Lavenworth, Racine, Wis. 322</td>
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<tr>
<td>WRSC</td>
<td>The Radio Shop, Chelsea, Mass. 205</td>
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<td>WRST</td>
<td>Radiotrol Mfg. Co., Inc., Bay Shore, N. Y. 211</td>
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<td>WRA</td>
<td>Larus &amp; Brother Co., Inc., Richmond, Va. 254</td>
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<td>WSAI</td>
<td>United States Playing Card Co., Cincinnati, Ohio 361</td>
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<td>WSAJ</td>
<td>Grove City College, Grove City, Pa. 224</td>
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<td>WSAN</td>
<td>Allentown Call Publishing Co., Inc., Allentown, Pa. 222</td>
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<td>WSAK</td>
<td>Daughy &amp; Welch Electrical Co., Fall River, Mass. 252</td>
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<td>WSAZ</td>
<td>Chase Electric Shop, Huntington, W. Va. 242</td>
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<td>WSB</td>
<td>Atlanta Journal, Atlanta, Ga. 425</td>
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<tr>
<td>WSBC</td>
<td>World Battery Co., Chicago, Ill. 352</td>
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<tr>
<td>WSBF</td>
<td>Broadcasters, St. Louis, Mo. 441</td>
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<td>WSBT</td>
<td>South Bend Tribune, South Bend, Ind. 238</td>
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<td>City Temple, New York, N. Y. 277</td>
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<td>WSEA</td>
<td>Virginia Beach Broadcasting Co., Virginia Beach, Va. 334</td>
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<td>WSIX</td>
<td>638 Tire &amp; Yule Co., Springfield, Tenn. 213</td>
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<td>World's Star Knitting Co., Bay City, Mich. 492</td>
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<td>Nashville Life &amp; Accident Ins. Co., Nashville, Tenn. 341</td>
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<td>Saenger Amuse. Co., New Orleans, La. 322</td>
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<td>S. M. K. Radio Corp., Dayton, Ohio 297</td>
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<td>WSOE</td>
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<tr>
<td>WSYM</td>
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**Dominion of Canada**

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<td>CFCH</td>
<td>Marconi Wireless Tele., Ltd., Ca. Mont, Que. 411</td>
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<td>CJGC</td>
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<tr>
<td>CNRR</td>
<td>Canadian National Railways, Winnipeg, Man. 405</td>
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</tbody>
</table>

**October—The Super Number!**

At least three of the latest super designs will be fully described and illustrated in the October issue of Radio Age.

*The 1928 Infradyne World's Record 10 Tube Thompson Super Seven*

It is going to be a super year in more ways than one. Get the October issue for an early start on your building program. The circuits mentioned above are only a part of the volume of good things scheduled for that issue. On the stands about September 25, or send thirty cents in stamps to Radio Age

500 North Dearborn Street
Chicago
Home-Made Cooler

Cool water for the home, summer cottage, or golf course may be provided by the installation of a simple cooling system. This arrangement consists essentially of an ordinary galvanized iron hot-water tank buried in a horizontal position at least eight feet below the surface of the ground and connected to a drinking fountain or faucet placed at the surface.

The tank should be placed so that one end will be slightly lower than the other. The inlet pipe is connected to the higher end. To the lower end, at the bottom, is attached a drain pipe which is used to remove water from the tank during cold weather or when the system is cleaned. The outlet pipe to the fountain or faucet runs from the upper side of the lower end. To facilitate draining, the tank should be placed near an embankment, or near a cellar into which the drain pipe is run.

Several coolers of this type have been installed at the Fairlawn golf course near Akron, Ohio. Water from the surface sprinkling system often reaches a temperature near the boiling point, but after being passed through the tank it emerges from the fountain at about fifty degrees Fahrenheit.

The most satisfactory size of tank is a 40-gallon one. Where the consumption of water is great, a larger size should be used. It has been found that cooler water will be produced if the tank is buried in clay soil, rather than in sand.
Radio Aids Air Mail
(Continued from page 24)
zone in the direction of flight—when flying across the equisignal zone. The shift was greatest when the airplane was flown at right angles to the equisignal line. When flying to or from the transmitting coil the shift was not noticed.

The apparent displacement of the equisignal zone in the direction of flight was more marked the greater the altitude of flight. Twenty miles from the radio beacon station this shift at an altitude of 1,000 feet was found to be one mile; that is, an airplane flying in one direction across the equisignal zone found this zone displaced from its true position one mile in the direction of flight; an airplane flying in the opposite direction found the equisignal zone displaced one mile in the new direction of flight. At 2,000 feet this zone displacement appeared to be 2 miles, and at 3,000 feet it appeared to be 4 miles. At all altitudes, however, with the airplane in a stall so that the trailing antenna hung vertically or when the airplane was flying toward or away from the beacon station there was no zone displacement, the zone being located in the position determined by ground tests.

"The results of these tests," indicated the Bureau of Standards, "in which a light antenna weight and a 200-foot trailing wire were used, showed that the apparent shift in the equisignal zone was due entirely to the type of receiving antenna used and its inclination to the vertical. By using a short trailing wire with a much heavier weight the antenna hung in a nearly vertical position, thus eliminating the zone displacement effect to a large extent. Such an antenna is best suited for this type of reception, as any ambiguities arising from an apparent shift in the equisignal zone when the airplane is turned are practically overcome. The use of a coil antenna in place of a trailing wire is equally effective in this respect, but cannot be worked over as great a distance."

Of the future of this far-reaching system of guiding aircraft by slender beams of directed radio, Dr. Dellinger states:

"In carrying out its newly assigned responsibilities to provide aids to air navigation on the civil airways, the Department of Commerce has concluded that radio aids are indispensable. As the first step in establishing these radio aids the Bureau of Standards has been assigned certain research work and is setting up model installations.

"It has been established that the airways must be provided with a system of radio telephone transmitting stations and directive beacons at certain intervals. At smaller intervals between the directive beacon, probably every 25 miles, are to be located the marker beacons. It is not yet certain whether the beacons will operate by means of an audible or a visual signal on the airplane, and the determination of this is one of the principal objects of the investigations now in progress."
CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook RADIO AGE's classified advertisements.

The classified advertising rates are but four cents per word for a single insertion. Liberal discounts are allowed on six and twelve-time insertions, making rates of 3 and 2 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All Classified ads for October issue must be sent in by Aug. 25.

AGENTS


Self Radio Sets at time $19.00 down buys 8 tube set. Agents get my special prices. Bargain Speakers; order now. T. King, 809 Grand St., Syracuse, N. Y.

AIRPLANES

SEND for free illustrations and plans of our won- dervful two-place, companion type, clean, cheap 30 lb. wing monoplane, and information how to build this ship, and be sure it will fly also propeller lighter. Craw- ford Airplane Mfrs., 2225 Avenue, Long Branch, California.

BOOKS AND MAGAZINES


FREE—Two Big New Magazines and Information worth hundreds of dollars to you. Envelope to claim. Sales- man, Box 74-R, Beaver Dam, Wisconsin.

What could be better than a magazine subscription for gifts. Send your order to us now. Over 200 new issues of technical standard Periodicals. Dept. R, R. 32, 524 Courland Ave., Park Ridge, Ill.

Twentieth Century Book of Receipts. Formulas and processes, on 807 cloth bound book containing 18,000 proven formulas for the manufacturer, workshop, laboratory, office and home. Send prepaid upon receipt of $5.00. Send dies for our 46 page catalog. Latest and best practical scientific and industrial books. Medin Products Co., Dept. RT, R. 82, 30 Courland Ave., Park Ridge, Ill.

BOYS

Boy get a three feet model airplane free. No selling. Write for particulars. Aero Shop, 3600 Wurfbain Ave., Detroit, Michigan.

RADIO SET FREE, farm magazines clubs among Primes. Club list free. Sponsored Agencies, Los Angeles, Brunswick Heights, Michigan.

BUSINESS OPPORTUNITIES


LAND FREE if planted to bananas. Bananas bear fall crop the second year. $5.00 monthly will plant 100 acres, which will produce large profit annually. Re- liable Companies will cultivate and market your bananas for $1.25 per hundred day and you get every 90 days. For particulars address Janice Plantation Co., Empire Building, 267 27th, Pittsb- urgh, Pa.

FOR SALE—Pail on fountain muff and duster. I have forty to offer to take five hundred dollars each per month. Lester Dink, McMinnville, Tennessee.

DOGS


ELECTRICAL

ELECTRIC FANCY! Seventy unusual, 110 volt, 6A Current, Campbell, Calif.

FORMULAS


MISCELLANEOUS

NEUTROHYDE AND HETERODYNE ARE GOOD AS A ROYALTY FREE FORMULA. PLACE YOUR ORDER FOR REPELAER 1B 21-D-8-O-N-E (see-back). SATIS- FACTOR GUARANTEED. 1 CENT TUBES BY I-ONEINE PRODUCTS COMPANY, LAUREL, MISSIS.

"MUSIC Composed" to words. E. B. Brinckel, Opp., Oshkosh, Wis.

GILLETTE STYLE Razor with 10 Blades 65c Proored, Loud Speaker $2.85, Speaker Unit $1.10 prepaid, Trans- former 25c, Male Stereo A, New Haven, Conn.

PANEL ENGRAVING

SINGLE PANEL, a medium quantity engraving of highest quality. Also panel drilling, motor currents and multi-layer printing, an attention to detail, panel and special work. Write for price list. A. Woody, 19 3. Wells Streets, Chicago.

PERSONAL


RADIO

EXTRA HEAVY Antenna wire 7 No. 18 #500 100 feet each. 17 No. 22 braded 2 3/4 wide $2.00 100 feet all pre- paid. George Senata, Columbus, Michigan.

MR. H. BADZECK, 165 Addison St., Chicago, III., write us at once; "I bought one of your Radio Telephone-Shooters. Just the thing I have been looking for. Don'te want ad catalog or literature of other parts you carry, Thanking you for this favor, I am (signed) H. Badzeck." It will pay you to investi- gate at Universal Test Equipment Co., 2039 N. Oakley Ave., Chicago, Ill.

RUBBER STAMPS

RUBBER STAMPS and supplies. 25c per line. Copper Perfected Publishing. Catalog for stamp, Newman & Son, Auburn, Nebraska.

RUBBER STAMPS: Name, Address, two Lines 25c. 3 Lines 35c. C. Brush Company, Auburn, Nebraska.

SALESMEN WANTED

75 MILES ON 1 GALLON—New Moisture Gas Saver. All Cars. I Free. CRITCHLOW, Al-O, Wheaton, Ill.

STAMMERING


TYPOWRITERS


WANTED TO BUY

Full paid value for old GOLD Jewelry, silver or plat- inum. Packages returned if our offer not satisfactory. Elston Specialty Company, 3303 Ave. G, Fort Worth, Texas.
The BANDBOX $75
A 6 tube Receiver
No Radio Experience Necessary

There is No Oscillation
The Bandbox employs completely balanced or neutralized radio frequency stages to prevent oscillation, instead of the common form of lesser method. More easily, to be sure, but extremely necessary in achieving such results as are obtained by this marvel of radio reception.

For Sharpness—The Acumulators
"Bandbox" acumulators enable "tuners" for distant stations to bring them in loud and clear. As powerful telescopes magnify distant scenes, acumulators increase the volume of far-away signals so they seem like local programs.

Volume Control
This is another big "Bandbox" feature which permits full brass band power for those who want their dance notes strong and loud. For others, it cuts volume down to a soft and gentle murmur, without distortion.

Illuminated Dial
A Master Station Selector has an illuminated dial for easy reading in shadowy corners. A single knob permits full tuning for ordinary reception of local, nearby and super-powered stations.

Installation Simplified
A woven cable, containing vari-colored rubber covered leads makes installation and look-up easy for the vertifed novice. No waiting for the radio service man, should the batteries be changed.

Easily Adapted to Consoles
Simply remove screws in esecutcheon and in base of set. Lift off metal case. Chassis now stands ready for installation in console cabinet. Opening in console cabinet permits control knobs to protrude. Essecutcheon screws in place and— Presto! the console radio is complete.

For A C Operation
a special Bandbox is available at $65, wired specially for use with the Crosley Power Converter at $60. This special Bandbox utilizes the new R.C.A. AC tubes which have made the operation of radio receivers direct from house current so simple, efficient and dependable. The first three tubes employed in the AC model are UX 226. These go into the radio frequency stages. The detector tube is UX 227, with indirectly heated emitter. Another UX 226 is in the last radio stage. This makes the "dog houses" rumble notoriously and the bass drums deeply boom.

**The Power Converter**
The power converter which smooths the alternating current is a marvel of engineering ingenuity. Only half the size of an ordinary 110-volt storage battery, it supplies the required A and C currents, without hum. Finished in brown frosted crystalline. It is an AC and 60 cycle current. A snap switch shuts down the set and power converter completely.

**Price of Power Converter—$60**
You owe it to yourself to see the "Bandbox" and listen to its remarkable performance. If you cannot easily locate the nearest Crosley dealer, his name and address will be supplied on request. Write Dept. 63.

---

**A tremendous Crosley radio achievement for 1927-28**

Recent court decisions which clarified the radio patent situation have paved the way for still greater Crosley triumphs.

Now—completely available to Crosley—and simplifying Crosley supremacy in fullest measure, are the enormous resources, great discoveries and ideas embodied in patents of

1. The Crosley Radio Corporation
2. The General Electric Co.
3. The Crosley Electric Corp.
4. The General Telephone & Telegraph Co.
5. The Hazeltine Corporation
6. The Lauter Corporation
7. Under which Crosley is licensed to manufacture.

Here are the seven big things which represent radio's greatest advancement, brought together by Crosley and combined with the experience, mass production methods, and leadership of the Crosley organization. No wonder a waiting radio world pronounces the "Bandbox" at the unprecedented price of $55, Crosley's paramount achievement.

**The Bandbox is Shielded**
Radio coils are surrounded by magnetic fields similar in every respect to the magnetic field around the earth that moves the needle of a compass, but around radio coils these fields make an easy method of coil and shielding back on each other. Heretofore, it has been customary to make inefficient coils with inefficient fields to prevent such feeding back. The Crosley Bandbox incorporates copper shields around each coil to prevent such feeding back. The coils can be made and are very much more efficient. The amplification of the receiver is, therefore, much higher— the sensitivity is greatly increased. Condensers are also completely shielded from each other in separate metal compartments. Hilberts—only high priced sets have enjoyed this super radio advantage.

---

**CROSLEY**

**CROSLEY RADIO CORPORATION**

Paul Croxler, Jr., Pres., Cincinnati, O.

Prices slightly higher west of the Rocky Mountains.
Everyday Mechanics

RADIO AGE

FIG. 4 SCHEMATIC CIRCUIT RADIO AGE MODEL

OCTOBER — 1927
25 Cents

Current Science
30 Days FREE TRIAL

The Randolph

Single Control - Illuminated Drum

POWERFUL seven-tube radio at factory price. Test it without spending a cent. We claim the Randolph Seven will out-perform any radio and we want you to satisfy yourself that it will. To do this, we will send you this powerful radio to try for 30 days. Test it for distance, clearness, ease of operation, tone and every other way you can. Unless it more than satisfies you, return it to us. Every Randolph set must make good before it is sold.

Battery All Electric Operation

The Randolph Seven is sold for use with batteries or for operation direct to electric light socket—absolutely batteries—no chargers or batteries—just plug in and tune in. 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities and leading radio and scientific publications.

Single Control—Illuminated Drum

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a 7-tube tuned radio frequency receiver with power transformers and power amplification. Space wound solenoid coils. Full and completely shielded. A real receiver of the highest quality. Tremendous distance, wonderful tone quality, simple to operate. The Randolph cabinets are in themselves beautiful pieces of furniture made of carefully selected solid burled walnut. Bass relief bronze escutcheon plates are mounted on the dial panel. In design and appearance it is a cabinet worthy of the high-quality radio it contains. Solid walnut beautifully shaped surrounds the soft green panel. Nothing has been spared to make the Randolph Seven the leading radio receiver. We are sure that it will surpass even your best hopes that we know how safe we are in making the 30 day free trial offer.

Read What Owners Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas.
I have logged 25 stations from Cuba to Seattle—the set is a world beater.—J. Tampkinson, Detroit, Mich.
Your set is a revelation—has all others tied to the post for distance and selectivity.—Waldo Powers, Vernon, Vermont.
On strength of its performance sold two more sets this week. T. Seabrook, Orlando, Florida.

Beautiful Ampliphonic Console Set

Made of the finest carefully selected solid walnut, Two-tone finish. Bass relief bronze escutcheon plate has built-in cutout for speaker that compares with any on the market and accurately reproduces high and low notes. Send for the folder today that shows this beautiful console in full color and gives complete details. Compare with most table sets in price. For battery or all-electric operation ready to plug in and tune in. Write for complete descriptions.

Randolph Radio Corporation
711 W. Lake St. Dept. 124, Chicago, Ill.
I Thought Success Was For Others
 Believe It Or Not, Just Twelve Months Ago
 I Was Next Thing To “Down-and-Out”

TODAY I’m sole owner of the fastest-growing Radio store in town. And I’m on good terms with my banker, too—not like the old days only a year ago, when often I didn’t have one dollar to knock against another in my pocket. My wife and I live in the snuggest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlord when she came to collect the rent for the little bedroom I called “home”!

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the “end of a blind alley.” I thought I never had had a chance in my life, and I thought I never would have one. But it was waking up that I needed, and here’s the story of how I got it.

I WAS a clerk, working at the usual miserable salary such jobs pay. Somehow I’d never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—all the really well-paid vacancies I ever heard of seemed to be out of my line, to call for some kind of knowledge I didn’t have.

And I wanted to get married. A fine situation, wasn’t it? Mary would have agreed to try it—but it wouldn’t have been fair to her.

Mary had told me, “You can’t get ahead where you are. Why don’t you get into another line of work, somewhere that you can advance?”

“That’s fine, Mary,” I replied, “but what line? I’ve always got my eyes open for a better job, but I never seem to hear of a really good job that I can handle.”

Mary didn’t seem to be satisfied with the answer but I didn’t know what else to tell her.

It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about my boys. Some words that were the cause of the turning point in my life!

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors—the people who knew me best—really thought of me?

“Bargain counter sheik—look how that suit fits,” one fellow had said in a low Voice. “Bet he hasn’t got a dollar in those pockets.” “Oh, it’s just ‘Useless’ Anderson,” said another. “He’s got a wishbone where his brain ought to be.”

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so satisfied with my answer that “I hadn’t had enough sense to think that too” and after all, wasn’t it true, that I had a “wish-bone” where my back-bone ought to be? Wasn’t that why I was still a clerk, making one dollar a day? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed through a magazine on the table, searching for an advertisement that I’d seen many times but passed up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field, and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision. WHAT’S happened in the twelve months since that day, as I’ve already told you, seems almost like a dream to me now. For ten of those twelve months, I’ve had a Radio business of my own! At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn’t long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I’ve gone right on up, always under the watchful guidance of the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building retail and business stations, as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I’d been wailing “I never had a chance!”

NOW I’m making real money, I drive a good-looking car of my own. Mary and I don’t own the house in full yet, but I’ve made a substantial down payment, and I’m not straining myself any to meet the installments.

Here’s a real tip. You may not be as bad-off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you’d better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating and well-paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look at their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody’s time. You will place yourself under no obligation—the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. M-91, Washington, D. C.

[Signature]
J. E. Smith, President,
National Radio Institute,
Dept. M-91, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesman will call on me.

Name ____________________________
Address __________________________
Town ____________________________

Please Mention Radio Age When Writing to Advertisers.
Everyday Mechanics

Radio Age

Current Science

Established March, 1922

Volume 7

October, 1927

Number 2

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Chats

WE HAVE developed in the Radio Age laboratory a seven tube super receiver that is remarkable for the simplicity of its construction. Notwithstanding the ease with which its parts may be assembled it produces results in tone quality, selectivity and power that one would look for in the best eight tube super.

But the most important fact about the new super is that it incorporates a new piece of equipment that has never before been called to the attention of radio fans. This feature alone would be enough to command the interest of fans all over the country. We are going to tell all about the receiver in our November issue and with the editorial text we are going to print drawings, photographs and blueprints. We suspect that this set will be the one many fans will decide to build as a foundation for their winter radio adventures. Frankly, we hope thousands will build it.

**  **

Radio Age has always been a magazine for the man who builds his own. We pioneered in the hook-up field five years and more ago and we have been printing hook-ups in blueprints for so long that the average fan calls us the "blueprint magazine." The thought gives us some pleasure in view of the fact that the set-makers are coming into their own again. Manufacturers who for a time devoted most of their attention to making complete sets, have returned to the business of making parts. New manufacturers with solid resources and extensive experience in manufacturing have entered the parts field. Home experimenters are on the increase. We will have constructive articles in ample volume for them in each forthcoming issue.

Frederick Smith

Editor of RADIO AGE.
Restored Enchantment

There is no doubt of it—radio is better with Battery Power. And never was radio so worthy of the perfection of reception that batteries, and batteries alone, make possible. Today more than ever you need what batteries give—pure DC, Direct Current, electricity that flows smoothly, quietly, noiselessly. When such is the current that operates your receiver, you are unconscious of its mechanism, for you do not hear it humming, buzzing, crackling. The enchantment of the program is complete.

Batteries themselves have improved, as has radio. Today they are so perfect, and so long-lasting, as to be equal to the demands of the modern receiver. Power your set with the Eveready Layerbilt "B" Battery No. 486. This is the battery whose unique, exclusive construction makes it last longer than any other Eveready. Could more be said? In most homes a set of Layerbilts lasts an entire season. This is the battery that brings you Battery Power with all its advantages, conferring benefits and enjoyments that are really tremendous when compared with the small cost and effort involved in replacements at long intervals. For the best in radio, use the Eveready Layerbilt.

Radio is better with Battery Power

At a turn of the dial a radio program comes to you. It is clear. It is true. It is natural. You thank the powers of nature that have once more brought quiet to the distant reaches of the radio-swept air. You are grateful to the broadcasters whose programs were never so enjoyable, so enchanting. You call down blessings upon the authority that has allotted to each station its proper place. And, if you are radio-wise, you will be thankful that you bought a new set of "B" batteries to make the most out of radio's newest and most glorious season.

NATIONAL CARBON CO., INC. 
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time

<table>
<thead>
<tr>
<th>Station</th>
<th>City</th>
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<tbody>
<tr>
<td>WJAR</td>
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<tr>
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<td>WEHI</td>
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Pacific Coast Stations—9 P. M., Pacific Standard Time

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<td>KFI</td>
<td>Los Angeles</td>
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<tr>
<td>KGW</td>
<td>Portland</td>
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</tbody>
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Have you heard the new Victor record by the Eveready Hour Group—orchestra and singers—in Middleton's Down South Overture and Dvořák's Goin' Home?
Current Radio Wisdom in Tabloids

Extract from a speech by O. H. Caldwell, member Federal Radio Commission, at meeting of manufacturers in Chicago.

THERE, as I see it, is the far bigger job that faces you, the radio manufacturers, jobbers and dealers of the country,—the job of putting adequate radio service into every one of America's 22,000,000 homes! For what will it avail the American public to have good broadcast programs and clear undisturbed reception if only a small fraction of our citizens actually have radio sets in their homes, as at present?

So far, only a bare start has been made on this huge task of equipping the Great American Family with radio, for to date we have fitted up only 6,000,000 homes with radios, out of the 22,000,000 homes on the Continent,—a saturation of barely 25 per cent. Yet the figures of the United States have 18,000,000 automobiles, 16,000,000 wired homes, 16,000,000 telephones, and 11,000,000 phonographs, and only 6,000,000 radios.

From an address by Admiral W. H. C. Bullard, of the National Radio Commission, read to the National Electrical Manufacturers Association.

The craze for radio broadcasting has swept Japan and in an hour's ride from Yokohama to Tokio on the trolley, an attempt to count the antennas would make one dizzy.

Broadcasting in that country is under the supervision and regulation of the government though the broadcasting companies are privately owned. The government says what stations shall broadcast and what shall not. Every purchaser of a radio receiving set is required to pay the government an annual tax which cannot even be considered moderate. It is a yen (50 cents in gold) a month, and the government, after retaining its share based on the cost of administration and clerical work necessary to collect it, returns to owners of the broadcast stations the remainder and prorates the amount among the different stations which it has licensed. This provides a considerable amount for each station and allows the administration of each station to acquire the best talent possible for educational and entertainment purposes. Moreover, all the transmitting stations are opened freely to any manufacture bureau or office that wishes to broadcast events which the government desires to inform the public.


Whether or not the law will eventually permit us to forbid ownership of frequencies is still in question. Once started along that line it would not be long before all available frequencies would be taken up and the free development of radio rendered impossible. Of course the framers of the Constitution could have in mind no such problem, but the attempt is being made to cover it with the clause permitting regulation of interstate commerce.

From an interview with David Sarnoff, Vice-President and General Manager, Radio Corporation of America.

The Radio Corporation of America was formed to play its own part in the development of the radio art and the radio industry. Essentially, we are an operating and sales organization, vitally concerned also with research and manufacture. We are not merely a patent holding or a licensing company.

We are licensing competitors under patents necessary for the type and character of set upon which they have built their business.

While it is true that our own line this year will cover every type of modern radio set, fact remains that we have specialized in the development and manufacture of super-heterodyne sets. It is the one element in our line that most distinguishes it from competitive radio equipment. To divide the use of our super-heterodyne patents would be almost to offer our trademark for competitive exploitation.

In the second place, the super-heterodyne is a circuit of such finely-balanced electrical perfection that to give these patents to other manufacturers would be to "sell" rather than to "deliver." The high character of the several types of radio equipment now on the market is not the result of patent development alone—manufacturing experience, equipment and organization are also important factors.

The fact is significant that while a number of manufacturers have succeeded with other types of sets covered by our patents, there is no successful imitation of the super-heterodyne circuit.

From an interview with Mrs. Lotta Harrauff, who was crowned Queen of American Radio at the Radio World's Fair last year:

Our Radio Commission has had a hard task thrust upon it and we cannot be certain of the result until colder weather comes, when distant reception is to be had, and until that time comes I do not believe anyone is qualified to say that the assignment of wave lengths is or is not a failure. Personally I do think that the best results will be gained by the changing of wave lengths.

Living in the center of the United States, I have tuned in stations from every direction consistently, and my belief is that the broadcasting stations must be put into zones and the hours divided.

We will not be too harsh with our Radio Commission for their is a tremendous task, but we would ask that they come to this part of the country and make tests. What would be perfection in New York would be chaos here.

From an article by E. E. Free, Ph. D., special contributor to Radio Age on Scientific subjects.

Radio echoes that probably travel entirely around the earth before they are heard have been noticed by British radio amateurs who listen to the powerful transmitting station PCJJ at Eindhoven, Holland. This station has been relaying English broadcast programs and listeners have heard two distinct sounds for each note; one a fraction later than the other, as though some kind of echo were present in the transmitting studio. A similar effect is heard sometimes in music halls the acoustic properties of which are bad, one sound coming directly from the singer or player and the echo of this sound arriving an instant later from the walls or ceiling of the room.

In the ease of the PCJJ radio program, such echoes originating in the broadcasting studio have been proved not to occur and it is believed that the second sound heard by the listeners is due to a radio wave which travels around the earth. It is thus delayed a fraction of a second, so that it arrives slightly after the wave which crosses the Channel directly from Holland to England. The speed of radio waves is believed to be so great that such a wave would pass entirely around the earth in about one-seventh of a second. This would make the radio-echo that much later than the direct wave; a difference corresponding to a real echo cast by a wall about seventy-five feet away.

Transmission of tables of figures by wire in a manner to avoid errors is described in a telephone company magazine:

The Bell Laboratories Record, an internal publication of the scientific laboratories of the Bell Telephone System, describes a recent instance in which a collection of important numerical data had to be sent hurriedly from Los Angeles to New York City. The figures were typewritten on sheets of paper and carefully checked. These sheets were then transmitted by wire, just as a photograph would be transmitted. The entire process being automatic, no mistakes in the figures were possible. The copies received in New York were unquestionably true copies of the original documents in Los Angeles. Some experts predict that methods of transmitting written or printed documents will be perfected so that all telegrams will be sent in this way instead of by the present translation into code and back again into words.
Bringing the Old Super Up to Date

HARKING back to the old days of the UV-1716 transformer—when that item was the only available one at the disposal of the broadcast listener that could be used as an intermediate transformer in superheterodyne construction, and following this circuit to the present day, it is apparent, above all other things, that a proper intermediate amplifier is the very key to the whole superheterodyne situation. Realizing this and also taking into consideration the added density of broadcast station population it is not hard to see that receivers of this type constructed sometime ago were not built to function to the point of present day standards, especially as far as selectivity and sensitivity—which means DX reception—is concerned. Two principal factors are responsible for this, first the situation that concerns intermediate frequency transformers, the other the broadcast situation. Up to the present time the builder of a superheterodyne was always forced to rely upon individual units for the construction of the intermediate amplifier—usually three or four transformers—most of the time selected out of random stock—and at other times on transformers which were sold as being peaked but which when assembled and in operation had entirely different characteristics in the receiver than when they were matched. This resulted not only in a lack of selectivity and sensitivity, far from the real possibilities of a superheterodyne circuit, but in many cases resulted in a tone quality with which discriminating ears were not satisfied because of the cutting of the side bands owing to improper peaking.

It is generally conceded by all of those who have studied the various characteristics of receiver designs on the market that the superheterodyne principal of reception allows not only the sharpest of tuning and the ability to reach out farther than any other circuit, but to make these possibilities a reality requires 100% efficiency in each of the circuits that comprise the whole. On the other hand, a super-heterodyne that served our purpose two or three years ago with broadcast intermediates, is no longer able to cope with present day broadcasting conditions because where we had one station three years ago we probably have ten today. The old set with broad intermediates was sharp enough for the condition of those days but now the set probably will not even be able to break through where broadcasting stations abound, especially in localities like New York and Chicago. There is also another item that has not been mentioned before and that is the increase in power used by broadcasting stations and this in congested areas has further handicapped the older receiver while, on the other hand, this condition with a really sharp set of intermediates if anything has been "pie" for the super built for present day broadcast reception.

We now find upon the market a Jewelers’ Time Signal Amplifier which adapts itself effectively to a super-heterodyne intermediate amplifier and through the use of which all of the difficulties experienced in this particular section of the receiver are overcome. This Jewelers’ Time Amplifier consists of three stages of R.F. amplification and a detector—a unit designed primarily for the jewelry trade in receiving the time signals from station NAA—Arlington—which wavelength is 2677 or 112 K.C. This unit is constructed to automatically tune in that station and no other—sharply peaked to NAA frequency and with a band so narrow as to prevent interference from any other station. As one fan remarked recently, this amplifier used as an intermediate unit in a super in reality amounts to a "band-pass amplifier." How this works out can best be realized when we stop to consider that the signal band in this amplifier is but 10, sometimes 7 K.C. wide. As all broadcast stations are separated at least by 10 K.C. this unit is by far the most selective and sensitive that has been on the market.

The amplifier is peaked and wired and ready to hook into the circuit. The four component circuits of the amplifier are peaked as one unit instead of four, in other words, our intermediates can be treated as one unit rather than a number as previously. Large air core transformers with a tremendous amplification gain are used in every stage—the secondaries all being tuned with matched fixed condensers. Each stage is individually shielded and the entire assembly is housed in a copper and brass catacomb which does away absolutely with any possibility of interaction of circuits or the pick up of parasitic noises. The amplification gain as measured in laboratory tests exceeds considerably that of any amplifier that can be built of individual parts for here is found an amplification gain of 10 per stage or a total amplification factor of 10,000 for the unit with the unit non-critically adjusted.

This Jewelers’ Time Signal Amplifier being absolutely complete in itself (with the exception of tubes) contains all of the parts that are usually found in an intermediate frequency amplifier. In the assembly in addition to the four large air core transformers are four tube sockets, four fixed tuning capacities (one across the secondary of each transformer), two bypass condensers, of 1 mf. capacity and one fixed condenser of .002 mf. capacity.
In adapting the time signal amplifier to super-heterodynes that have been built previously our task is very simple. The outward appearance of the old set can remain exactly as it now is, the controls in no way being different. This is of considerable importance because it means that the new catacomb can be dropped right into the receiver in place of the old A. F. amplifier. As a matter of fact there is but one control for the time signal amplifier, the oscillation control which is simply the conventional potentiometer. In substituting this efficient time signal amplifier, therefore, in place of our old intermediates the front end of our super and the A. F. amplifier remains exactly as it was. The customary first detector and oscillator stage are not affected, the catacomb merely displacing the old intermediate stage and the second detector. Inasmuch as the Jewelers' Time Amplifier is but 15" long, 5" wide and 3" deep we will usually be able to displace the units which are being removed and find room to spare. The audio amplifier system of the receiver, providing of course that it delivers the tone quality that we demand today, remains intact exactly as it is.

On the Jewelers' Time Amplifier we will find eight binding posts, four on the left hand side and four on the right. The left hand side binding posts are marked N, +90, B and P. The N terminal is connected to the center arm of the potentiometer on our panel and controls the oscillation of the intermediates (a 3/4 or 1 mf. bypass condenser connects across the arm and minus end of the potentiometer). We all know that with an intermediate amplifier the closer we approach to the oscillating point (toward the negative side) the more sensitive the receiver becomes and with a proportionate volume increase. This control works exactly the same in the time signal amplifier as it does with ordinary intermediates. The +90 terminal connects to the 90 volt B battery line. The terminal marked B connects to the 45 volt battery line and the terminal marked P is the one that is connected to the plate of the tube socket of our first detector—this carrying the signal from the detector tube to the first stage of the time amplifier. A choke coil should be included in this lead, such as the S-M 275, if a split loop circuit is used.

On the right hand end are four terminals marked —4½, P, —6 and +6. The terminal marked —4½ goes to the negative of our 4½ volt detector C battery. Rectification of the signal in what then becomes our second detector, which is the detector in the time amplifier, is brought about by the use of a C battery rather than by a grid condenser and leak, because of the advantages of greater handling capacity. The P terminal carries our signal to the first audio transformer. The —6 terminal is negative A battery lead and the +6 terminal is the one going to the positive side of the A battery. In the time signal amplifier we will find that the negative A terminal is grounded, in other words, the entire housing as well as the shields in the housing that separate each stage from the other are connected to A.

Inasmuch as the Jewelers' Time Amplifier is completely wired the matter of bringing an old super-heterodyne up-to-date requires but a very few hours. In all probability it will take longer to tear out the old intermediates than to substitute this new unit. With this substitution the old super-heterodyne is not only brought up to date but a careful search of what the market affords has also definitely demonstrated that there is nothing to be had that will give the results of the renovated receiver. As has already been said the Jewelers' Time Amplifier with an amplification factor of approximately 10,000 gives us an amplification gain in the intermediate stages far beyond that to be found in ordinary amplifiers. Comparative laboratory tests have shown that through the use of the time signal amplifier owing to its tremendous per stage gain, distant stations could be brought in with loud speaker volume barely audible with other sets with an equal number of tubes. The selectivity is such that in Chicago it will allow reception of out of town stations within 10 K.C. of powerful locals.

90,000,000 Radio People

Approximately 90,000,000 of the 1,000,-000,000 people living within the world's constant radio reception area receive radio broadcast programs, in some form according to a report on potential markets for receiving sets by Lawrence D. Batson, Forensic Equipment Division, Department of Commerce.

About 18,000,000 receiving sets are now in use, according to Batson, who estimates that 200,000,000 sets would be required to service all of the people within the constant reception area on a basis of five members to each family.

Fifty-seven foreign countries now maintain regular broadcast service with Canada, Cuba, Russia, Sweden, Australia, Germany, United Kingdom, Argentina, and Mexico ranking first in order of number of broadcasting stations maintained and regularly operated.

Radio broadcasting, according to Batson, has attained as great importance in international, national, and family life abroad as it has in the United States, all circumstances considered, and has now been recognized by all of the principal foreign governments as an important means of disseminating entertainment, information, and instruction.

Radio programs have a striking similarity all over the world and it is not without some basis of possibility that programs broadcast throughout the whole universe may be expected to prove more popular than those of local origin, the report states.

More news and some direct advertising find place in foreign programs and government communications are formally presented to the people through the microphone, but in general a typical American program is likewise typical for any part of the world, according to Batson.

Congestion of broadcasting stations has occurred so far only in the United States, Canada, and Europe. Mexico City, Buenos Aires, Sydney, and Melbourne and a few other cities having sufficient number of stations to require particular attention to wave lengths in order to prevent interference but their problem has been simplified in these places by the fact that the full wave band is available. These cities are favored, too, by the fact that there are no other stations operated in close proximity to the city limits, according to the report.

North America and Europe have broadcasting stations scattered throughout the inhabitable area. South America is well served except in the interior and the extreme northwestern part of the continent. Other developments are spotty except in Australia and New Zealand where stations are well distributed.

Some foreign countries regulate radio broadcasting on a strictly commercial basis with broadcasting corporations holding exclusive or quasi-exclusive concessions. Where such regulation is enforced, owners of receiving sets are usually assessed a fee for reception privileges, according to Batson.

In countries where monopolies do not obtain, any person or firm showing satisfactory general qualifications is granted permission to operate a broadcasting station. In a few countries where unusual political or economic conditions prevail, the possession of broadcasting and reception equipment is rigidly denied, according to the report.

SEE NOVEMBER ISSUE FOR SUPERHETERODYNE WITH NEW FEATURES.
The Thompson Super Seven
Incorporating the Latest Ideas in Tone Quality and Selectivity
By SIDNEY J. THOMPSON

IN DESIGNING the seven-tube super described in this article the two main objectives were to devise a superheterodyne receiver which would possess the excellent qualities expected of this most interesting of radio receiving instruments but which would combine this satisfactory result with a low cost. Considerable experimental work was done and many intermediate transformers were tried. Some of these were low-priced transformers which were immediately discarded because of their lack of ability to reach the standard demanded by the designer for this receiver.

It finally appeared that the only alternative was to produce a super that could deliver the goods but to proceed blindfolded, so far as cost was concerned. This would have defeated us as trying to reach one of our chief objectives.

As a last resort, several manufacturers of high grade products were called upon and the cooperation of their engineering staffs requested. Then there began an elimination contest which was to result finally in the selection of a combination of quality parts to produce the two desired results. No attention whatsoever was paid to the products used, for the engineers were instructed to produce the finest reasonably priced superheterodyne that could be built with quality products.

Tonal Quality and Overtones
Let us consider what is required to produce true rendition of the original broadcast. It is not a difficult matter to obtain excellent high note reproduction, likewise it is not difficult to obtain excellent low note reproduction.

Audio amplifying systems can be developed to accentuate either high or low notes. In a great many cases it is more pleasing to accentuate, for instance, the low base notes. To some this accentuation gives a soft deep tone that is rather pleasing. Other tastes for music frequently vary the other way, preference being given to accentuation of the higher notes. Obviously, neither one of these systems can produce perfect reproduction of the original broadcast and neither one would satisfy a trained musician.

The perfect audio system then would be one wherein the loud speaker and the Audio Transformers were so balanced that a flat amplification curve is obtained not for the Audio system alone nor for the loud speaker, but for the entire combination of receiving set and speaker.

The output from the loud speaker should represent, in other words, a perfectly flat

List of Parts for the Thompson Super Seven

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Price</th>
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<tbody>
<tr>
<td>1 Silver Marshall No. 340 Midget Condenser</td>
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</tr>
<tr>
<td>2 Silver Marshall Tube Sockets, 50c ea.</td>
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</tr>
<tr>
<td>2 Silver Marshall Drum Type Dials No. 805, $3.00 ea.</td>
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<tr>
<td>1 Pair Silver Marshall Brackets</td>
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<td>1 Vaxley Filament Switch</td>
<td>$0.50</td>
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<tr>
<td>2 Vaxley Imp. Jacks, 25c pr.</td>
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<tr>
<td>1 Vaxley 2 L Resistance</td>
<td>$0.15</td>
</tr>
<tr>
<td>1 Vaxley 3 L Resistance</td>
<td>$0.15</td>
</tr>
<tr>
<td>1 Vaxley 30 Ohm Rheostat</td>
<td>$1.35</td>
</tr>
<tr>
<td>1 Tobe .006 Condenser</td>
<td>$0.45</td>
</tr>
<tr>
<td>1 Tobe 1 mfd. Condenser</td>
<td>$0.90</td>
</tr>
<tr>
<td>1 Tobe .002 Condenser</td>
<td>$0.40</td>
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<tr>
<td>1 Tobe .00025 Condenser</td>
<td>$0.35</td>
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<tr>
<td>1 Tobe .001 Condenser</td>
<td>$0.40</td>
</tr>
<tr>
<td>2 Halldorson Precision Iron Core No. 540 Transformers, $6.00 ea.</td>
<td>$12.00</td>
</tr>
<tr>
<td>1 Halldorson Precision No. 541 Filter Transformer</td>
<td>$6.00</td>
</tr>
<tr>
<td>3 Halldorson Overtone Audio Transformers, $6.00 ea.</td>
<td>$12.00</td>
</tr>
<tr>
<td>1 Halldorson Overtone Output Transformers</td>
<td>$6.00</td>
</tr>
<tr>
<td>7x21 Panel drilled and engraved</td>
<td>$3.40</td>
</tr>
<tr>
<td>1 9x20 sub panel drilled and engraved</td>
<td>$4.95</td>
</tr>
<tr>
<td>1 3 meg. grid leak</td>
<td>$0.50</td>
</tr>
<tr>
<td>3 Resistor Mounting</td>
<td>$0.35</td>
</tr>
<tr>
<td>2 Camfield .005 mfd. Condensers, $6.00 ea.</td>
<td>$12.00</td>
</tr>
<tr>
<td>10 X. L. Spring Binding Posts 15c ea.</td>
<td>$1.50</td>
</tr>
<tr>
<td>1 Ellis Oscillator Coupler</td>
<td>$3.00</td>
</tr>
<tr>
<td>1 Spring Socket</td>
<td>$0.75</td>
</tr>
</tbody>
</table>

Total | $78.55 |

When aerial and ground operation is desired in preference to a loop, Use:

1 No. 2 Ellis Antenna Coupler | $3.00 |
line giving even amplification throughout the entire audible range. This range should take in at least eight thousand cycles, for in many instances true amplification of frequencies above seven to eight thousand cycles are required. Should they be left out entirely, as is frequently the case, the result is powerful base note amplification, fair amplification of the middle register, but a suppression of the high notes with a corresponding decrease in loss in shadings and overtones of the voice.

Overtone amplification is obtained in but one manner. The ability of the Audio Transformers to produce an output energy which does not overly accentuate nor suppress any frequencies. This allows full amplification of both high or low notes together with any given intermediate frequencies and the overtones are recreated. Only in this way is it possible to obtain perfect amplification accurately following the true shadings of the artist's voice.

When an Audio amplifying system over amplifies some frequencies and suppresses others, the same effect will appear in the overtones where the rich deep shadings and life of music are produced. If the amplifying system does not faithfully reproduce the weak delicate shadings of the overtones they will become entirely unlike the original, for even the faintest trace of under-exaggeration amplification on a very delicate overtone gives a false reproduction of the most important element of music.

The system of amplification used in this receiver has been worked out according to the above theory. The overtones that distinguish the work of an amateur between that of our old masters have received the greatest consideration throughout the entire receiver and the result of this consideration is truly a revelation in the faithful reproduction of music that is thrilling both to the music lover and D. X. hound alike.

Precision Selectivity

The problem of selectivity alone is somewhat easily overcome, but to obtain selectivity, tonal quality and distance combined is a decidedly different problem. To obtain selectivity and still pass a wide enough frequency requires an extremely careful balancing of the component parts of the receiver. It is necessary, in order to retain amplification over the entire audible range that we have a band of at least ten kilocycles in which to work. If we increase the selectivity beyond this point, we immediately enter the field of reproduction and begin to cut out side bands of the music and loss of high audio frequencies is the result.

The problem, therefore, is to get as close as possible to the point where we do not cut side bands. When this is done we have reached what might be called the peak of selectivity. We can go no further. This point can be only obtained by precision peaking of the filter transformer to cut off on either side the ten kilocycle band, five kilocycles each side of the peak.

We continually see glowing reports of hair splitting selectivity, knife edge selectivity, and so forth, but to the seasoned engineer and I hope eventually to the fan and set builder all of these superlative adjectives mean but one thing—"hokum"—for the very simple reason that any Super can be designed so selective that a station cannot even get through. Yes! Knife edge and hair splitting selectivity, but is it of any value to the fellow who wants to get stations with a smooth comfortable ease without interference and maintain the finest tonal quality? This can only be done, not by freakish transformers nor freakish methods of filtering, but by precision methods of calibrating.

Sensitivity

Sensitivity is rather difficult to define. It might be likened to the acceleration of a motor car. Its chief requirement is that every part in the receiver operates at maximum efficiency. Coupled with this, of course, is the number of R. F. stages used. The number of stages, or the number of tubes as one might wish to look at it, is, however, rather poor guide as to the sensitivity of a receiver.

As an illustration of this, a set may be built using ten or twelve tubes, each tube operating perhaps only 50 per cent efficient. The over all result in sensitivity then, we will say, would be little better than a five tube receiver. For this reason, it is far more important that the efficiency of each stage of amplification be taken into consideration more so than the number of tubes used in the receiver.

The machine described used only seven tubes but the efficiency of every tube is as high as it is possible to attain.

Constructional Details

The first step in the construction of the receiver is a careful study of the different diagrams.

On page 8 is the schematic from which a bird's-eye view of the receiver and circuit may be obtained.

On page 8 is the pictorial wiring diagram. A study of this diagram before beginning the wiring is advised. All parts have been marked on this drawing to conform as closely as possible with the general layout plan and no trouble should be experienced in wiring the receiver from this drawing.

On page 9 is the layout and drilling plan. Again every instrument has been marked to indicate its location in the receiver. From these drawings the builder may if he wishes build the set on a wooden baseboard; for the arrangement of parts allows sufficient room to place all parts above the sub-panel.

While the use of a wooden baseboard will decrease the cost somewhat the slight extra cost for a bakelite sub-panel is well worth while from a standpoint of appearance.

The sub-panel is not mounted directly against the front panel but should be one and one-half inches from the front to allow room for the rheostat.

Looking at the diagram on page 9 the left hand condenser is the oscillator and the right hand one the antenna or loop.

Volume and Oscillation Control

There is only one rheostat in the entire receiver; this controls the volume and also any tendency of the R. F. tubes to oscillate. This rheostat being used in the R. F. tubes alone does not effect the tonal quality of the receiver when the volume is decreased and at the same time it allows control of volume from a whisper to maximum with smooth variation.

For the sake of simplicity binding posts have been used throughout the entire receiver. A Yaxley cable could very nicely be worked in, however, at the rear of the panel and the leads will brought direct to the cable.

Antenna or Loop Operation

Either an antenna or a loop may be used. The loop will give somewhat better selectivity on local stations but of course does not have quite the range of the aerial and ground. When a straight wire antenna is used the additional coupling coil is required and should be connected as shown in the schematic diagram of page 8, however, if the set is to be operated on a loop antenna the Ellis antenna coupler may be left off the sub-panel.

The pictorial wiring does not show the connection of the antenna coupler. When this is used it should be mounted directly behind the first detector tube socket. The few simple connections required will be seen on the schematic diagram. The G. A.
and P. leads of the coupler are connected to the loop binding posts or if an antenna will be used regularly the loop binding posts may be used for the antenna and ground and the coupler connections made in the receiver permanently.

Oscillator Condensers
Care should be taken to connect the rotor plates of the oscillator condenser to the plate terminal of the tube, and the stator plates to the grid. This will eliminate body capacity.

C Battery
The use of a C battery has been very liberal, a C bias being used on the R. F. tubes in preference to the usual potentiometer. This method is slightly more efficient and due to the fact that it decreases the B battery consumption there is practically no danger of the set motor boating on a B eliminator.

Intermediate Stages
One point that will probably strike the fan as being contrary to the general trend is the use of two iron core transformers and one filter. It was mentioned earlier that the sensitivity of a super depended primarily upon the efficiency of each R. F. stage. By using two long wave iron core transformers with a very high R. F. gain the efficiency or amplification is brought up very high. In order to obtain the desired selectivity with this system the filter transformer carefully designed by precision methods. Its amplification cuts off very sharply on either side of a ten kilocycle band.

Beginning the Construction
The foregoing points have been covered in order that the builder may have a more general idea of the points to watch for in the construction of the receiver. The list of parts should now be procured and then carefully examined to see that all parts are in good order. Construction can now be begun.

The front panel should be started first. The condensers should be mounted then the rheostat, filament switch and regenerative condenser. If both condensers are the same it will be necessary to reverse the shaft in one of the Camfield condensers first. This can be done by removing the cover nut at the back of the condenser, loosening up the set screw that holds the shaft and then pushing the shaft through to the other side. Tighten up the set screw again and replace the nut on the reverse side.

After the front panel has been assembled lay it aside and proceed with the assembly of the baseboard. By following the layout diagram this operation will be very simple and should not take more than an hour. The Ellis oscillator coupler should be left until the last so that it will not be damaged. When the parts are all mounted on the base board wiring can be started.

Wiring the Receiver
It is advisable to wire the baseboard first, without the front panel attached. The wiring can be done in progressive stages beginning with the first detector. The leads for the front panel must be left quite long. When the subpanel is fully wired mount the front panel and connect the leads to the controls on the front panel, and the receiver is then ready to test.

Tubes
U. X. 201 A tubes or their equivalent should be used throughout the entire receiver with the exception of the last stage where a 171 power tube is recommended.

If the wiring has been carefully done, there is no reason why the set should not operate perfectly from the very start. It may be necessary to vary slightly the "C" battery voltage but it will be found in most cases, if the tubes used are O. K., that the three volt "C" bias for the radio frequency tubes as shown on the diagram will be correct.

Should a "B" battery eliminator be used, one of sufficient output should be obtained, capable of delivering at least one hundred and eighty volts at about forty mils, since this is what the Thompson Super Seven will draw when a 171 power tube is used on the last stage.

The fact that almost every tube in the receiver is biased with a "C" battery reduces the battery current consumption considerably and practically prevents any danger of the set motor boating with a "B" eliminator. Should this difficulty arise, as it might in the case of some eliminating with a high internal resistance, it can be eliminated by by-passing the output of the eliminator with from two to ten Mfd. bypass condensers.

An eliminator that was found to work exceptionally well on the new Thompson Super Seven was the Silver Marshall Reservoir B. It delivers ample current and is silent in the operation. A distinct advance forward has been made in the Silver Marshall Eliminator by the use of a glow tube to maintain the output voltage constant. The glow tube eliminates entirely the necessity for any variable adjustments, as it automatically delivers the correct voltage regardless of the current drawn by the Receiver.

Accessories
A six volt storage battery will be needed to light the filaments of the tubes. If a Trickle charger is to be used, a battery of eighty amperes capacity will be sufficient, otherwise, it would be advisable to get a little larger storage battery.

The cabinet in which the set is pictured is the well known "Fritts." It needs no introduction to set builders; it is known to all for its distinguished appearance.

Cloyd Clevenger, world war ace and now pilot of the Alexander Airport, Denver, who gives aviation lessons to radio listeners.
Among the new radio receivers and equipment for the 1928 radio season we find the "1928 Infradyne" one of the most distinctive. Here is a radio set embodying really new features; interesting alike to the man who builds his own set and to the professional set builder. All the difficulties a man encounters in building, such as the tedious alignment of the tuned radio frequency stages, stabilizing it, preventing inter-stage coupling, etc., have been removed before the parts for the set reach him, and he has a much better chance of immediately getting perfect and gratifying results; still there is the satisfaction which every radio fan knows, derived from having constructed one's own set. The assembly of parts and wiring is a matter of two or three hours of interesting work and the result is a receiver which not only has the appearance of the finest factory built set, costing considerably more money, but also performs like the best of them. The creation of this set is certainly a progressive step in the industry.

Ten tubes are used throughout the set, two CX301As in the first two stages of tuned radio, one in the first detector socket, one as the second detector, and also one in the first stage of audio; three CX399 tubes are used in the Infradyne Amplifier unit and one more in the oscillator socket. Either a CX112 or CX371 is recommended for the last stage of audio.

The photo, Figure 1, shows the set as it looks completely assembled and housed in an all-metal cabinet, which provides an effective shield against picking up radio frequency and other electrical disturbances by the coils and associated wiring in the set, permitting only energy which is picked up on the antenna and going through the tuned channels to be amplified. Through the efficient shielding and very selective circuits all but the desired signals are rejected. The tuning controls or selectors are the two upper knobs on either side of the voltmeter, connecting with the two drum indicators which are mounted, one on the three-in-line Remler gang condenser to the left, and the other on the single Remler condenser to the right. A filament control is directly beneath the voltmeter, the voltage applied to the tubes being indicated on the meter. A volume control is on one side and "sensitivity" control on the other, both of these are rheostats mounted behind the condensers; extension shafts connect the rheostats with the knobs on the front panel.

A switch at the bottom of the front panel controls all the filaments. When the switch is at the "OFF" position all the filaments are out; when it is turned to "LOCAL" position the Infradyne amplifier is out of the circuit and only the radio frequency tube and audio frequency tubes are lighted, and when the switch is turned to "Distance" all the tubes are lighted and the Infradyne Amplifier is automatically put into operation.

Just above the base and to the left of the central control panel is a supplementary bronze shield carrying the antenna compensator control. The antenna compensator control knob is double, the larger part operating a three-point switch permitting variable antenna coupling and the smaller part controlling a small variometer connected in series with the secondary of the input radio frequency transformer or antenna coupler. Adjustment of the antenna compensator is made when the set is first put into operation after which the antenna circuit will stay in line with the remaining circuits over the entire wavelength band. A very slight adjustment of the antenna compensator might be desirable as a last step in obtaining the best possible reception of a distant station but under ordinary conditions it can be forgotten when it has once been correctly set. In the rear of the cabinet, at the end nearest the antenna compensator controls, are the "Antenna" and "Ground" binding posts, the battery cable and the jack for the loud speaker.

The whole receiver is made up of several units which are easily assembled. One of the most interesting features is the all metal base, with holes already drilled, and the completely assembled radio frequency amplifier which constitutes the front part of the set. The photo, Fig. 2, shows the complete layout of parts and the parts, Fig. 3, the radio frequency amplifier with the metal case removed. The r.f. amplifier is unique in many respects, and shows real engineering on the part of the designers. The three transformers are tuned with the single Remler three-in-line condenser to which is mechanically connected a shaft having the primaries of the transformers mounted thereto; as the capacity of the condenser is increased the coupling between primary and secondary of the transformers is increased, in a relation which tends to keep the greatest sensitivity without oscillation over the whole wavelength range; also, provision is made for two degrees of primary to secondary coupling so that the amplifier is readily adaptable to various broadcast conditions.

The coupling can also be changed by moving the secondary coils which are mounted on brass rods extending up through the center of the coils, up or down, thus changing the relation of the secondary to the primary coils. The coils are matched with the gang condenser at the factory, this eliminating trimmer condensers to compensate for deviations in the coils as the wavelength range is covered. For greater selectivity the coils are moved upward and for less selective tuning the coils are moved down.

Shields between stages minimize inter-stage coupling; together with the automatic coupling scheme, the amplifier is very stable over the whole wavelength range, and also at maximum sensitivity over the whole range. The front part, or radio frequency amplifier, of last year's infradyne was in some cases rather difficult to handle. In the new Infradyne this complication is eliminated.

At the rear of the set is mounted the Infradyne Amplifier. This is the same amplifier which has become so well known during the past year for its ability to sharpen tuning and to build up volume of signal without an annoying increase in background noise. In construction and per-
Figure 5—Wiring diagram of the “1928 Infraadyne,” showing also the color scheme for the battery cables

Figure 4—Bottom of the pressed steel base of the “1928 Infraadyne”

Figure 2—Layout of parts in the “1928 Infraadyne”

The performance of this amplifier has not been changed in any respect from that of last year.

Back of the bronze panel carrying the instrument controls is a pressed steel panel upon which are mounted the voltmeter, Infraadyne Amplifier rheostat, two drum dials, and the oscillator tuning condenser. Located directly in back of the drums are the two rheostats for volume and sensitivity control. From the layout it is obvious that the assembly of this receiver is far from complicated, and perfectly symmetrical.

The bottom of the pressed steel base is illustrated in the photograph, Figure 4. Since the holes are already drilled for mounting the instruments and running the wires the job of building the set is greatly simplified.

All the small parts used in the Infraadyne receiver, including nuts and screws, wire, etc., comprise the Infraadyne Foundation Kit, saving a lot of troublesome shopping for these odds and ends. The parts are as follows:

- Infraadyne Foundation Kit—Parts List.
  1. Pressed Steel base
  2. Pressed steel instrument panel
  3. Bronze control panels
  4. Remler No. 110 Drum Dial (Right-hand) with brace and lamp
  5. Remler No. 110 Drum Dial (Left-hand) with lamp
  6. Remler Type 659 Condenser
  7. Remler No. 50 Sockets
  8. Remler No. 35 Choke Coils with special spacers
  9. Special coil and spacer
  10. 10 ohm rheostat, extension shaft and bushing (Frost)
  11. 2½ ohm rheostat, extension shaft and bushing (Frost)
  12. 4 ohm rheostat (Frost)
  13. 2 ohm fixed resistor
  14. 4 ohm fixed resistor
  15. 6 ohm fixed resistor
  16. Electrad Type GS .00025 mfd. condenser
  17. Electrad Type P .00025 mfd. condenser
  18. 4 megohm grid leak
  19. Frost No. 953 Jack
  20. Frost No. 954 Jack
  21. Yaxley No. 69 Switch
  22. “Antenna” binding post
  23. “Ground” binding post
  24. Bakelite terminal strip 4” x 3/4” x ½”
  25. Special bakelite terminal blocks
  26. Battery cable
  27. 12 Lengths wire (colored as per code)

Necessary screws, nuts, washers, soldering lugs, spacers and brackets. The rest of the units are the Remler No. 710 Radio Frequency amplifier and Antenna Compensator, two Silver-Marshall Type 220 Audio Transformers, one Silver-Marshall Type 221 Output Transformer, and a Western Model 506 or Jewell Pattern 135 O-5 volt voltmeter.

A simple plan has been devised by the manufacturers for making up a cable harness. A full sized template is furnished showing the positions for the various nails on which the wires are wound to make up the panel. The plan is so simple that even a man who has had almost no experience whatever can easily complete the job.
RADIO Symmetrical

T HROUGH the courtesy of Mr. E. H. Scott of the Scott Transformer Company, we are able to present herewith an authentic and accurate description of the new World's Record Super 10, which has just made its appearance in the autumn displays of radio dealers. We forecast that this receiver will be one of the leading contenders for the favor of the set building public this season because it includes so many unusual and worth-while features in design. We are particularly pleased over the opportunity to present to our readers this description, as we have followed the activities of Mr. Scott and his organization very closely, printing from time to time photos and descriptions of models previous to the new World's Record Super 10. We believe that Mr. Scott has an unusually fine receiver, we know that he is making a good transformer, and we know that you will like this story of a super-radio, its peculiarities, advantages and performance.

By FELIX ANDERSON

In enumerating some of the advantages of the New World's Record Super 10, it is probably simplest to first discuss those most prominent, and then consider other departures of interest as they occur in our review. While there are several super-hetodyne receivers now available, which use radio frequency preceding the first detector, the New World's Record differs from these in a number of respects, and each dissimilarity is based upon intelligent thought and thorough research. It is the purpose of this description to acquaint the reader with the New World's Record Super and such original characteristics as set it apart from other receivers of the same general class.

The first impression upon viewing the World's Record Super 10 is that it is a truly pretty bit of radio design. Striking in appearance, the front panel controls kept down to a minimum consistent with efficiency, the receiver as a whole has that finished business-like appearance that all set builders strive to attain. The back panel is equally neat in appearance, having a symmetrical and systematic arrangement of the parts, so intriguing that even the most sophisticated radio engineer will stop to admire the effect.

The setting of the dials is easily observed through two portholes, the variation of the drums whereon the dials are located being accomplished by the rotation of two knobs slightly offset and below the portholes. These two controls form the main tuning adjustments, and are the ones most actively used. The left hand major control is that of the RF amplifier input circuit, and serves to rotate the sections of a Remoled 3-in-Line Condenser, which are all operated by the adjustment of the common shaft. This ingenious arrangement obviates the necessity of separate adjustment of each of the RF secondaries, and simplifies operation.

The right hand major control is the condenser varying the beat frequency, and is the key, figuratively speaking, to the Intermediate Frequency Amplifier which follows the first detector and RF train:

The three refining controls on the panel are non-active in actual operation, the adjustments being made when operation is begun and then left unattended, slight adjustments being made at times when tuning for long distances. No filament switch appears on the panel, this having been built into a special Carter rheostat directly under the 0-8 volt Jewell filament voltmeter. This rheostat automatically opens the filament circuit when in the off position, cutting out the filament current to the tubes in the set. The knob on the extreme left of the panel is a Silver-Marshall No. 340 Midget Condenser (000025 mfd) which is used to balance off any inequalities in the input tuning circuit caused by antennas of unusual characteristics. It is not a critical adjustment. The knob on the right end of the panel is the potentiometer, a Carter 400 ohm, and is labeled Modifier. A scaled drawing from which a drilling template can be made is illustrated in the blueprints.

The back panel is equally as good looking as the front, especially to radio enthusiasts who admire conservative workmanship and sub-panel mounting. The base mounting Selectone Units, which appear on the market new this season, have several advantages that are readily apparent. All connections to these units are made under the sub-panel, and such connections are inconceivably short and direct. Wiring is eliminated, and the construction of the New World's Record Super 10 is greatly facilitated, even to the extent of being more simple than any other previous model. A bottom view of the receiver (Figure 3) gives an idea of the ease with which the set may be wired. The layout lends itself to the use of either bus-bar, flexible cable or Celatsite as the assembler may prefer.

Study of the back panel photo (Figure 2) will disclose the use of Benjamin base...
mounting sockets, which directly become a part of the sub-base. These sockets and the Selectone units are so spaced as to make the plate and grid leads very short and convenient.

Eight Selectone series B units comprise the essential of this receiver, and these units can be identified as the Selectone B-530 Antenna-Coupler (looking from left to right on the photograph Figure 2) directly followed by the two Selectone B-520 RF Units, next a Selectone B-500 Intermediate Frequency Transformer, a Selectone B-510 Filter, another B-500 followed by a second B-510, which feeds the second detector with amplified signal. These new units are the heart of the World's Record Super 10, and are the result of more than five years of constant test and experiment in an effort to obtain optimum in efficiency, appearance and sensitivity. Housed in highly polished bakelite casings, all of the same appearance, they stand majestically like soldiers in a row, each of them designed to do their utmost in intercepting and amplifying faithfully weak and distant signals as well as those of local transmitters. The oscillator unit designated as Selectone B-540, sets between the two Remler drum controlled condensers. The selectivity enables the operator to tune in stations far away through heavy local interference, with ten kilocycle separation on all but the nearest ones, when a slightly greater margin must be allowed to avoid background noise.

All these new units are laboratory matched products. While the World's Record Super 10 is a receiver made of laboratory equipment, it must not be considered as an experiment. Each unit is closely matched and peaked, and every Selectone unit is held to a rigid standard of performance, uniformity and efficiency. The assembly of such units into a working component is obviously rewarded with crowning and brilliant result.

The New Selectone B-530 and B-520 RF Couplers are manufactured with as much precision and care as though each were going to be used in a highly important piece of test equipment. The winding of the coils is done in the most careful manner as to insure high efficiency and amplification. The assembly into cases is supervised closely by engineers to detect irregularities and defects, and when completed, the units are subjected to the gruelling test of a device that detects inequalities of more than one third of a turn of wire on the coil. In this test the coils are matched to a uniformity of less than one turn, and so that the secondary inductance is practically the same. The Lorenz type of winding, is used in the RF Couplers, and the cases are so placed that losses are at a minimum. Referring to the circuit diagram, in blueprint, it will be noted that the RF Couplers are stabilized by the voltage drop across the rheostat, limiting the electronic emission from filament to plate, that is, increasing or decreasing the working efficiency of the tubes. The coils themselves are proportioned and designed to adapt themselves to this method of control so that no difficulty is experienced in obtaining stability with good tone and maximum efficiency.

The pickup coil of the oscillator is located in the grid lead of the first detector, where it has been found most efficient. A grid leak and detector is used in the frequency changer, and a proper adjustment of this detector tube avails great sensitivity for the pickup stages. One of the departures from accepted procedure is evident in the grid return of the frequency changing tube (first detector). This has been made negative instead of positive as is customary, research disclosing that this is the best connection. A Remler RF Choke in the plate lead of the tube keeps RF strays from filtering into the Intermediate train where they might be troublesome.

This brings us to the Selectone B-500 Intermediate Frequency transformer, the first in the IF train, then to the Selectone B-510 and thus on to the second detector tube, which is activated by the secondary of the B-510 connected to its grid circuit. The intermediate stages themselves are not radical in their connections, the refinements having been restricted to the Intermediate Transformers themselves. The tubes are kept at the exact amplification point by the proper ratio of primary to secondary, and the relative spacing of the coils which governs stability, amplification and tone. The amplifier in entirety is stabilized by the 400 ohm Carter potentiometer which is connected in the usual fashion across the A negative and A positive filament potential.

Many radio enthusiasts fail to fully appreciate the importance of good intermediate frequency transformers, which explains generally why the super-heterodyne has been long considered as a complicated and difficult receiver to construct and operate satisfactorily. This erroneous conception is far from true. If the Intermediate Frequency transformers are really matched for peak frequency, regeneration and amplification, and if they are intelligently designed and wound to give

Fig. 3. Bottom view of the superheterodyne showing simplicity and neatness of wiring
the greatest sensitivity and selectivity with tone quality, the super-heterodyne becomes only a matter of the assembly of a few more pieces of equipment than the ordinary receiver, with considerably greater efficiency and enjoyment.

Just how the Selectone Intermediate Unit works is best shown by the figures. The uniform standard is an interesting procedure. The coils of the transformers are tested before assembly onto bobbins for open windings and short circuit turns using two oscillators driving at about 100 kc with a common plate supply and headset similar in the circuit that changes can be readily detected.

One of the oscillators is adjusted slightly below or above the 100 kc oscillator so as to give a beat note of 500 cycles, easily readable in the phones. The coil is then plugged in the test circuit and variations in the frequency of the beat note are listened for, if there are such. A change in the tone of the beat note indicates imperfect winding and such are unsuitable for use in the Selectone IF Units.

The condensers used to peak the transformers are carefully tested with a stabilized oscillator and a vacuum tube voltmeter on a standard transformer. Changes in capacity differing greater than five per cent above or below standard reject the condenser.

Under the close scrutiny of expert engineers, skillful assemblers put the coils on the bobbins, and affix thereto the condensers with which peak the transformers. The terminals are then carefully soldered into place on the new style bases, and the transformers undergo their first tests for amplification, peak frequency and spillover point. If the units conform to the standards demanded by the specifications, the units are removed from the impregnating and mounting department where they are dipped swiftly and skillfully in a special compound and mounted in the new highly finished bakelite housings. The impregnating operation is one of the most delicate of all, as a special condenser is required and the mixture must be kept at the proper temperature so as not to alter the characteristics of the transformer. This operation seals the windings, the condenser and the bobbins against atmospheric influences and further service to all leads and windings into place so that the characteristics cannot alter, due to dropping or handling.

The transformers are then ready for matching into sets. The apparatus used for this consists of a special stabilized oscillator with a uniform output over the entire scale of its variable capacity and the vacuum tube voltmeter. Great pains and precautions are taken to keep this oscillator stable and uniform, and the finest precision meters obtainable are used in the vacuum tube voltmeter which is also of special circuit and construction. The oscillator and voltmeter are heavily shielded to prevent pick-up of energy other than that obtained from the voltage drop across a resistor in the oscillator unit. The vacuum tube voltmeter is connected across the secondary of the transformer to be tested, the primary of the same transformer being coupled to a standardized 20A tube, operating under actual load conditions. The signal generated by the oscillator is impressed on the grid of the test stage or first tube, and the gain between the test tube and vacuum tube voltmeter is then observed on the very sensitive milliammeter in the plate circuit of the vacuum tube voltmeter. When resonance is obtained, that is, when the oscillator is driving at the peak frequency or point of maximum efficiency and amplification of the transformer, the milliammeter reads the setting of the oscillator, and with the aid of a powerful microscope observes the exact maximum deflection of the milliammeter in the vacuum tube voltmeter. The deflection of the meter is recorded as the value for the oscillator condenser. The latter reading represents the peak frequency of the transformer, and the milliammeter reading gives the gain of the transformer.

The transformers are then sorted into sets having the same oscillator reading (peak frequency) and are then sorted into sets consisting of two B-510 and two B-500 transformers having the same reading on the vacuum tube voltmeter.

The tests do not stop here however, as Mr. Scott feels that the one final and certain method to use, to absolutely prevent any defective units from leaving the laboratory, is to give them an actual air test on a standard receiver. A set of transformers can be dropped into their proper places on the special test set in less time than it takes to insert a set of tubes in their sockets. Every transformer is thus tested for selectivity, distance and tone quality before leaving the laboratory.

To continue with the description of the receiver. Grid bias rectification is used in the second detector for the very apparent reason that the heavily amplified signal impressed on the grid would overload the tube and cause distortion. Better tone quality is thus obtainable. The second detector is also outfitted with a Resistor RF Stage, and bypass Condenser, to block and bypass the interstage coupling of the plate circuit, so that only the direct current component passes into the audio amplifier transformer winding.

The audio amplifier is standard in design with the departure that the last stage employs a two-stage RC coupled stage in order to handle the tremendous amplitudes delivered by the RF, IF and first audio stages. Thordarson R-200 Audio transformers are used in the usual cascade circuit in conjunction with an A-76 Output Speaker Coupling Transformer which protects the speaker windings from the 400 volt plate current used to actuate the CX-310. The tonal quality obtainable with this widely known amplifier is now a tradition among radio enthusiasts, and needs no further description.

Battery connections are made with a Jones Cable, having 10 leads coded as follows: A positive red, A negative green, B negative yellow, B positive 45 volts blue, B positive 90 volts pink, B positive brown, B positive black, C 6-9 volts negative orange. The filament current for the UX-210 power tube, which is taken off the Eliminator is carried by twisted leads to two binding posts, and twisted leads connect the filaments of the 310 tube to the socket.

One of the unusual features of the New World's Record Super 10 is the specially designed eliminator to suit the receiver and its various load. Mr. Scott strongly recommends that this eliminator be used with the New Super 10 and will ensure the best performance from the receiver.

The construction of the eliminator is simple, in fact is decidedly less involved than the usual type of B power supply. The New Carter bypass condensers, (which are guaranteed to stand continuous operation) and fly back rectifiers are used in this circuit in connection with Thordarson T-2098 Power Transformer and T-2099 Choke Coil. Two CX-310 B Rectron Tubes are used, one on each side of the AC cycle so that full wave rectification is effected with ample current for all the loads required with the receiver. The circuit of connections appears in the blueprint and requires no additional mention.

The CX-301A tubes are used throughout the receiver, except as has been noted, the last stage which requires the CX-310. The filament current is from the usual storage battery. While considering this part of the circuit, it is strongly advised that a relay switch be used for automatic control of the A & B power supply. In actual practice this is almost a necessity of the receivers that must be taken with heavy current surges in the B Power Supply if the filament current is shut off before the eliminator is disconnected. It is well to remember that good quality and sensitivity do not keep company with dead A batteries.

This generally describes the most
prominent features of the new World's Record Super 10, with the exception of the filament circuit of the nine A tubes. Referring to diagrams, it will be noted that the receiver is practically master controlled, all the tubes exclusive to the two RF tubes, being fed through the Carter 1 ohm Heavy Duty rheostat. The RF tubes are operated on a separate 15 ohm rheostat in order to furnish control of oscillation. A separate rheostat located on sub panel is provided for the first detector in order to attain greater sensitivity and finer adjustment, but as this and the 1 ohm are not critical once they have been set, it has been found convenient to mount them on the sub-panel where they are less apt to be disturbed once the proper setting has been attained. The detector rheostat is a Carter 30 ohm and is connected in series with the master, as the blueprint indicates. The 0-8 Volt Jewell Filament Voltmeter facilitates the setting of the master rheostat, the proper adjustment being between 4½ and 5 on the scale.

The foregoing description explains to some extent just why the World's Record Super 10 is capable of heterodyne-superheterodyne combination, but hardly explains the excellent range and pickup characteristic of this new super-radio. A general summary of the World's Record Super 10 is helpful in obtaining an accurate idea of what the receiver can accomplish. This is best explained by first inspecting the input circuit of the set. Here he we have two stages of RF amplification, making possible the use of a short indoor antenna of from 25 to 30 feet as the pickup medium, even for the most distant stations. This eliminates the loop antenna, provides greater sensitivity, reduces harmonics and heterodyning, and because of the amplification of the tubes and transformers, extends the range of the set, simultaneously increased its volume. The RF pickup stages deliver to the detector of the set a greatly amplified input signal, assisting the work of the detector in producing a much better frequency for the IF stages to amplify. The selectivity of the IF stages can be adjusted by the IF stages in conjunction with the oscillator. Ten kilocycle separation is no longer a dream—having become a reality with the Super 10. The average radio enthusiast appreciates the sharpness of the superheterodyne as well as the popular radio frequency when both are combined into one working component without the loss of efficiency in either system, it can be readily appreciated that super selectivity is the result. In the World's Record Super 10, the RF and Hetrodyne systems of reception are so combined that the total output is much greater, than if one theoretically added the signal intensity of either system operated independently. Radio frequency pickup, and superheterodyne amplification when combined individually, or even each in efficiency and in results.

Granting that we have delivered an input signal of already considerable amplitude to the first detector, the Selectone IF amplifier boosts the signals to the point where second detection becomes a serious problem. The general sharpness of tuning, retained and aided by the careful manufacture and design of the Selectone units, is maintained throughout the amplifier by the proper setting of the potentiometer, without loss of tone due to the transformers being peaked too abruptly. The second detector with its grid bias rectification and radio frequency blocking system delivers to the audio system a wonderful signal to amplify, which the audio amplifier truly accomplishes. The net result is a thundering signal in the loudspeaker, yet beautiful in tone and depth, delicately controlled from a whisper to full volume by the manipulation of smoothly operating, non-critical controls on the panel. Even the most distant stations roar in with a mighty punch.

Performance is the clinching argument in any receiver. That being the case, let us turn to the file of verified receptions and note for you just what the set will accomplish.

The laboratory where the World's Record Super 10 was developed is located on the north side of Chicago, and every radio enthusiast knows that Chicago has plenty of broadcasting stations. WBBM has its home just two blocks west of the laboratory location. It operates on 1000 watts. WEBH, a 1500 watt station is just two miles south. WIBO, with 1000 is about 1½ miles distant, WMAQ, KYW, WGES, WMBI, WGN, WSBC, WLTS, WENR, WTAS, WCFL, WAAF, all not less than 500 watts (and in most cases 1000) are located not less than 10 miles air line, and cover the entire broadcast spectrum on the average five tube radio frequency receiver. Within a range of 50 miles we have WLIR, WHIT, WLS, WCBD, WJAZ, and numerous others, ranging from small fry to heavy power. What the Chicago stations miss in the ambition to smear the dial with local signals, these stations usually accomplish when everything is going full blast between 8 and 10 p.m.

Yet the World's Record Super 10 tunes between them! Using a 2½ ft. antenna, on the ground floor of the building, this amazing radio receiver accomplished tuning that can only be duplicated with another World's Record Super 10. Between WENR and WTMJ (Milwaukee, Wisconsin 80 miles distant) The Super 10 brought in CJBC of Toronto, Canada. Twenty kilocycle separation—that is, WENR 10 kc above CJBC and WTMJ 10 kc below. Between WGN on 990 kc and WLS (870 kc) it was possible to tune in WGR (970) KDKA (930), WGHP (940), WRRS (930), WABC (920), and WBZ (900). On each side of WLS (870) a 20 kilocycle separation brought in WHB (890) and WOC (850) the former Kansas City, the latter Davenport, Iowa. The dials, when tuned to WSAI (820), completely exclude WOC (850). WEBH, two miles away and only 10 kc below (820) does not interfere even to the extent of background noise.

WGY transmitting on 790 kc rolls in with the familiar punch and power, while WBBM, two blocks distant and 20 kc below is operating with 1000 watts. Twenty kilocycles below WBBM (770) WTAM is tuned in with ample volume, good tone, and no background interference. WTAM operates on 750 kc. Through WIBO or WHT (splitting time on 720 kc) and WMAQ or WOJ (splitting time on 670 kc) the World's Record Super 10 tuned WSUI (710), WLW (700), WJR (680), and WJZ (660). WJZ was so well received that it was possible to remove the antenna and hear the signals on the speaker with such volume that it could be heard 200 feet distant. At the upper end of the broadcast spectrum, WEA was easily separated from WCFL. These stations operate on a 10 kc separation, and WCFL is only 10 miles away. WHO (560) can be pried off the frequency of KYW (570) with comfortable margin, KYW being about 10 miles south.

![Fig. 1. The symmetrical arrangement of parts comprising the World's Record Super 10 gives this attractive appearance.](image-url)

**World Record Circuits at 30c**

Send 30 cents in stamps if you want complete instructions and drawings in back issues as follows.

**January, 1927**

Full Data on the Super 8

**March, 1927**

Building Ideal Model Super 8

**April, 1927**

One Spot Super and Power Compact

**May-June, 1927**

Using 9 Tubes on World's Record Super

RADIO AGE

500 North Dearborn St.

Chicago, Ill.
Diagram showing hook-up of heavy duty B eliminator. Trickle-charger, A battery, and Relay which automatically controls B eliminator and trickle charger. This eliminator is specified for the World's Record Super 10.
DX Reception Record

We have an interesting and convincing letter from Mr. John White who believes he holds the world's record for DX reception on regular broadcast frequencies. He has submitted for our examination a photograph of letters and cards varying his reception of broadcasts from 40G, Queensland Radio Service station at Brisbane Australia on 385 meters, 3AR at Melbourne, Australia, broadcasting on 484 meters and using a power output of less than half of station power. According to Mr. White's letter of verification which he received from Australia, it is now five kilowatts. This should be good game for DX hunters; 2FC Sydney, Australia, on 442 meters, EAJ7 at Madrid, Spain, on 372 meters, OAX, Lima, Peru, in South America, broadcasting on 389 meters, and of course the west coast stations. All the stations were picked up in Brooklyn, N. Y., where Mr. Whites lives, during the winter of 1926 and 27. He writes, "2FC, Sydney, Australia, was picked up by me the second time on Sunday morning, June 5, 1927. Held him from 3:07 a. m. to 3:20, then from 3:40 till 3:58." The letter of acknowledgement from 2FC verified the fact the program picked up.

Mr. White attributes his successful DX reception to the efficiency of his receiver which is an ordinary tuned radio frequency type. Four stages of tuned r. f. and a detector and two stages of transformer coupled audio frequency amplification comprise the set. However, each stage of r. f. is well shielded in rolled copper cans measuring 9x6x6 inches each. Every precaution was taken to minimize interstage coupling and to keep the resistance of the coils low. In each can is a variable condenser, a tube, r. f. transformer, and two by-pass condensers, 1 m. f. each. One by-pass condenser is connected across the filament and the other from the side of the transformer to neg. filament which is grounded to the can. It is pointed out in Mr. Whites letter that absolute shielding is important in making the set highly efficient, not a single opening should be in the cans to permit any leakage of energy; also the r. f. transformers should be at least 1½ inches away from any part of the can. A variable resistance in the B battery supply lead to control the current to the r. f. tubes is used as a volume and oscillation control in the set. Mr. White stresses the fact that his receiver employs nothing unusual, only the arrangement of the set has made the set perform so remarkably.

If anyone has a better record than Mr. White for DX reception in the United States or Canada it will be interesting to hear about it. With much of the former congestion removed and the excellent stations recently installed in different parts of the world there are new possibilities for receiving foreign stations here in North America.

Three New Radio Books

Several new books treating different phases of radio and the industry, have been published recently. Among them is the Drake's Radio Cyclopedia by Handly, a volume to provide the non-technical man with ready reference work of practical usefulness in solving their problems with radio receivers and reception. The arrangement is alphabetic, each article being complete in itself with cross references to all related subjects. The subjects are treated in a manner easily understood by the layman, with material that is useful to any experimenter or settler. Practically every phrase and term in the radio category may be found in the reference tables. Subjects such as rejuvenating vacuum tubes, locating trouble in a receiver, etc., are treated with completeness, as well as instructions for building equipment and receiving sets. The book contains more than 1500 subjects with illustrations, circuit diagrams, constructional layouts and graphic curves.

Another book is "Principles of Modern Radio Receiving," by L. Grant Hector, Ph. D., Assistant Professor of Physics, University of Buffalo. Modern theories on the propagation of radio waves through space, and the development and application of practically all of the new circuits and methods of receiving radio intelligence, are discussed in a technical but simple fashion which can be understood by most people interested in the business and technical progress of radio. None of the subjects is treated mathematically, except for a few simple algebraic equations. New circuits and theories about which there has been much controversy in the past are stated in an authoritative and convincing manner. The contents of this book were compiled by a physicist who has gone into extensive research to obtain accurate facts, and the material is not mere quotation of general beliefs. Every circuit from simple tuned detector circuits to superhetodyne and the most complicated of balanced r. f. circuits is described in detail. The Burton Publishing Co. put out this text.

A book dealing with an entirely different phase of radio is that written by Stephen Davis of the Department of Commerce—namely The Law of Radio Communication. Since the present radio laws are so new the discussion is of abstract principles. Cases paralleling those which might arise in radio broadcasting litigations are cited to illustrate the judgment of the law. The book explains clearly the rights of the broadcaster and the listener from the view point of the judge and logical reasoning. The Likhitec Foundation prize by the Faculty of Law of Northwestern University was awarded to the author who was formerly Associate Justice in the Supreme Court of New Mexico. The publishers are the McGraw-Hill Book Co., Inc.

Radio Warns of Quakes

A New Jersey radio amateur, Mr. William Andrew Mackay, believes that he has discovered an advance indicator of earthquake in the form of internal disturbance of the earth's crust evidenced by an alteration of radio conditions. Mr. Mackay's radio receiving apparatus is located on top of the Pafisades of the Hudson, the high cliff of basaltic rock that borders the Hudson River opposite to New York City. This basaltic rock contains a high percentage of iron and is more highly conducting for radio waves than are ordinary rocks. Mr. Mackay finds that occasionally the tuning constants of his radio receiver alter unexpectedly, in much the same way as they might if the electric condition of the rock beneath were changed.

This alteration of radio conditions is invariably followed within a few hours, Mr. Mackay reports, by a severe earthquake somewhere on earth. His radio apparatus served this kind of advance notice, he states, of the unusually severe earthquake in western China in May, of the Jerusalem earthquake in July and of five other severe shocks within the past six months.

The warning is not invariable, some severe earthquakes having occurred without any detected alteration of the radio conditions. Certain common rock minerals, notably quartz which is the commonest of all, alter their electrical conditions when compressed or stretched. Geologists do not consider it impossible, therefore, that the state of stress in the earth's crust preceding a severe earthquake might have an effect on earth electricity, perhaps detectable in the way that Mr. Mackay has noticed.
Are You Fit To Drive An Airplane?

By GLADYS MOON JONES

Science Service Staff Writer

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Would-be pilots are of two general classes with respect to altitude: fainters and non-fainters. The Army knows its unrestricted men, those who can go safely only to 15,000 feet and those who are still restricted to 8,000 feet. All flying above 18,000 feet must be done with oxygen. The limit of consciousness without oxygen is about 25,000 feet. This is because the effects of altitude depend not on oxygen percentage, but on oxygen pressure. If pure oxygen is breathed we may still get so high that its pressure is too low to sustain life.

If Lieut. James H. Doolittle of the Army can do an outside loop at about 350 miles an hour causing his eyeballs to become so extended that they touch his goggles, it does not follow that every one should try it. The best pilots “go black” at 250 miles an hour on a turn.

Just what per cent of the youth of this country is potentially Lindberghian is a question of intelligence tests and physical tests. Out of 547 midshipmen of the class of 1927 at Annapolis, 353 passed the Navy’s pilot tests. An official estimate is that fifty per cent of those who apply for training at Pensacola get there. Of these thirty per cent pass the pilot tests. And of this thirty per cent approximately twenty per cent make A1 pilots. From these estimates the ambitious boy can figure for himself that he has about one in twenty-

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**Emotional Stability**

**X Superior Education**

**Y Reaction**

**Z Coordination**

**X Eyes**

**Ears**

**Nose**

**Throat**

**Lungs**

**Heart**

**Digestive System**

**Kidneys**

**Steadiness**

**Bones**

**Joints**

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Everyday Mechanics

HOW often have you said, “If this old bus just had wings I would fly over this turn-up street.” It seems difficult to manage an automobile through the city’s bottle-necks. It takes physical and moral stamina.

Suppose your automobile should begin to fly. Could you pilot it? Could you handle an airplane? You could learn how to drive one perhaps, but have you the physical and mental qualifications essential in a competent flyer?

Specialists in aviation medicine have come to know more definitely just what an A1 pilot must be. Several opinions held during the war have been modified. Most important of these are the age and ear requirements. It was formerly thought that only young men could fly successfully. Twenty-four was old in aviation. Now, however, you may be as old as thirty-five and still make a good flyer.

If you can negotiate communication with your co-pilot or co-passenger, you may be deaf and still make a good aviator.

Aviation hygiene is an important new subject. Today’s physician is studying the matter. Tomorrow’s will advise us before we hop off and prevent our suffering from physical causes as well as from aerial diseases, dope poisoning, deafness, altitude faintness and other troubles. Day-beforeyesterday’s country doctor, who drove around with his horse and buggy at eight miles an hour, picked up those who had fallen from the higher plane of perfect health. More often than not, he was too late. However, he went out of fashion with his equipment. Medical men have long since seen that warnings before the fall were simpler and more efficacious than mending the troubles afterward.

**Flight Surgeons New Specialists**

When flight surgeons came along with the development of aviation during and since the World War, they too, at first, gave most of their attention to those who crashed. Now with their confreres, general and special practitioners, they are preaching prevention. They have proved that from the very first pilot test, preventive hygiene means a great reduction of danger to man and plane. They have found that people who walk the earth untroubled by minor variations from the normal encounter aggravated conditions in rarefied air and rapidly changing temperatures.
five chances to succeed in aviation.

A flier does not have to go into the air to learn what the pilot testers call his reaction times or how his coordination is affected by overwork, loss of sleep, exposure, digestive disturbances and alcohol.

Lindbergh, the pioneer, learned much about his remarkable physical machine by trying it out on his mail route, but many a good man has crashed to his death trying to know what could have been told on the ground after a few physiological and psychological tests. Medical officers would have us get over calling those “heroes” who unnecessarily expose themselves to mortal danger.

The hypersensitive individual is easily confused by rapid changes in position in respect to his environment. The tested pilot becomes immunized to rapid changes in motion. He is able to interpret his sensations so that he shows little reaction to rotation or other rapid changes in position. An apparatus was developed during the war known as the Ruggles orientator. Some one wrote in to the army asking for a picture of “that whirling bat tub.” And that is what it looks like. An experiment is being conducted now in the Navy Bureau of Aeronautics, which predicts even more accurate success for this orientator. Attached to the Ruggles “tub” is an instrument, operated electrically, which will make a graphic record of the testee’s reaction times. Eight different pens are set to make the graphs on paper marked off in tenths of seconds. The resulting graphic demonstration shows the automaticity of the man being tested.

Aviation medicine is practiced in three directions: the selection, the classification, and the care of the flyer. As a result of this specialization in the Army and Navy, the percentage of aviation accidents due to physical causes has decreased in a surprising manner. Since we have had well trained flight surgeons and soundly based and conducted examinations, the fatalities per flying hour have been reduced in a period of four years from one fatality to every 950 hours to one for every 3,400 hours.

Visual Judgment Necessary

According to Comm. Robert G. Davis, Medical Corps, U. S. Navy, the eyes are the most important factor of flying physical requirements. The flyer must see out sideways when he is looking straight ahead.

Visual acuity alone will not suffice as there must be a perfect balance of each extrinsic muscle allowing the maximum of binocular vision with no tendencies to diplopia or nystagmus. Dust, oil, wind and glare are prone to produce congestion of the lids and conjunctivae, which if allowed to progress may greatly impair visual judgment in depth perception for landings or formations in the air.

Everyone who has learned to drive even the slow old automobile knows how important visual judgment is. It may be impaired by an attack of influenza, prolonged application of the eyes to close technical problems and by general staleness.

A typical stale flyer complains of having lost some of his keenness and flying judgment. He is discouraged, not sure of him-
self in the air, has lost his appetite and dreams of unpleasant flying experiences. He is irritable, short of breath and attributes his condition to trivial causes. If his condition becomes worse he must be permanently grounded. His symptoms are those of neurocirculatory asthenia or effort syndrome.

Edward C. Schneider, of Wesleyan University, Middletown, Conn., who years ago made experiments on Pike's Peak in a study of altitude, is one of the authoritative physiologists who have been researching in aviation medicine. He defines staleness as "a neural condition founded on chemical changes within the body."

Ear Considered Less Important

The inner ear was originally considered most important in this country, but not according to the present theory. Equilibrium is important, but it is a function of vision, deep muscle sense, sensations from bones, joints and tendons, gravity effects, and tactile sensations as well as the inner ear.

However, the ears of the flyer demand constant attention. The necessity of equal air pressure on each side of the drum is thoroughly appreciated by the aviator. Equalization of pressure can be obtained in a measure by swallowing. Experienced flyers carry out the practice on rapid descents. Unless the eustachian tubes are easily opened the flyer should be kept out of the air. Marked unequal drum pressures produce severe pains and probable perforation. Scarred or congested drums are disqualifying for aviators.

(Continued on page 37)

Lightning's Odd Trick

One of the few recorded instances in which a person was within a few feet of a lightning flash without being killed or rendered instantly unconscious has been described by the victim herself to Mr. F. M. Delano, of Paris. About noon of July 12, 1927, a thunderstorm crossed Paris. One bolt fell in a small park near the Bon Marche department store. Striking the flagstones of a small court yard, the bolt broke one of these and disappeared.

Miss Ella Dodt, a Danish woman, was less than ten feet from the landing place of the bolt. Her description of the event is that she saw the flash, which was defaced by the noise and showered with fragments of stone and masses of soil. She began to run, being perfectly conscious and unhurt. Within a few yards, however, she began to feel weak and collapsed, still without losing consciousness. Later symptoms included nausea, violent headache and a tingling sensation in the hands and feet, which lasted for over two days.

It is probable, physiologists report, that the fortunate woman was not affected by the lightning at all, the bolt passing instantly into the ground. The weakness and other symptoms were probably due to the effect of terror on the gland system, not to any electric force. Miss Dodt reports, also, that her face, hands and clothing were covered instantly with a coating of fine black dust. This dust was not analyzed but may have been powdered stone from flagstones disintegrated by the bolt.

The Romance of Cotton

Copyright by Keystone View Co.

Cotton! The very word brings to mind pictures of many centuries and countries: India, land of gorgeous potentates and many religions, where the white and yellow flowers and snow-white bolls of the cotton plant have colored the landscape for fifty or sixty or seventy centuries; Egypt, home of the finest cotton in the world; ancient America, land of Aztecs and Incas and of tobacco, potatoes, sunflowers—and cotton.

Cotton scenes of today are no less scattered. The sunny land of negroes, sunshine and song calls it king. Thousands of spindles and looms hum in New England, New York, Pennsylvania and in Southern states, transforming it into yarn and goods. Ships ply along our Atlantic coast and cross the seas to England carrying bales of the fluffy down. Ships set sail from Egyptian and British Indian coast towns for England and America laden with this fruit of their soil. And from our country and from

Photo by COOVERT

Above—Typical scene in Southern cotton field. Circle—Men waiting their turn at the cotton gin.

England other ships with finished cotton cloths and goods clear port bound for all places that ships go.

This great movement of cotton and cotton goods received its first impetus in 1733, when an Englishman, John Kay, invented a flying shuttle. This machine enabled the weavers to turn out goods faster than the spinners could make the yarn. Hargreaves then came to the relief of the spinners and invented the spinning jenny. This made the mill race even, but created a demand for a supply of raw cotton greater than the growers could meet.

This time an American came to the rescue, and with the invention of Eli Whitney's cotton gin in 1793, cotton became the poor man's as well as the rich man's cloth. Under old methods one man was able to free sufficient lint from seed to produce one bale of cotton every two days. Now a cotton gin produces fifteen bales in a day.

As to its uses today—they are as numerous as stars on a summer's night.

(Continued on page 26)
DISTANCE—Here is the receiver for the man who wants the most powerful and sensitive set it is possible to build. Many claim to have received far distant stations once or twice, but Mr. Scott with his World’s Record Super proved his claims to record honors by bringing in consistently, night after night, stations distant six thousand miles or more. The new World’s Record Super 10, in actual comparative tests with the original receiver on which the records were made, has proved that it is even more powerful and brings in the far distant stations with almost unbelievable volume.

No other receiver has approached the marvelous DX records that the World’s Record Super has established, and it is safe to say none will for years to come.

REMARKABLE SELECTIVITY—Here is a receiver for today’s conditions. In Chicago, where there are about forty broadcasting stations, the New World’s Record Super 10 cuts through with the greatest of ease. It brings in distant stations only a few meters apart with such volume that you think you have a local station until you hear the call letters and find you are listening to a station hundreds of miles away.

NATURAL TONE QUALITY—A receiver may have great DX ability and wonderful selectivity, but what good is it if the tone is raspy or distorted? When you hear the New World’s Record Super 10, you will realize that here at last is a receiver that it is a pleasure to listen to.

EASY TO BUILD—With the parts here listed, any one can build an exact duplicate of the New World’s Record Super 10. The only tools required are a screwdriver, pliers, and soldering iron. The building instructions and full size blue prints show exactly where to place each part and how to run every connection, and are so simple and easy to follow that any one, even without previous experience in building a radio receiver, can duplicate this marvelous receiver and own the finest radio set available today.

--- LIST OF PARTS ---

1 Formica panel drilled and engraved 8x7 1/4... $6.70
2 Formica sub panel drilled 20x7 1/4... 7.00
3 Remier 5-three condenser No. 623 00003... 15.00
4 Remier condenser No. 623 00005... 15.00
5 Remier drum dials No. 110... 9.00
6 Remier R.F. choke coil No. 35... 1.80
7 Thorndarson audio transformers R250... 16.00
8 Thorndarson output transformer No. 76... 6.00
9 Selectone L.W. transformers No. 3250... 12.00
10 Selectone L.W. transformers No. 3570... 12.00
11 Selectone R.F. transformers No. 328... 10.00
12 Selectone Antenna coupler No. 520... 5.00
13 Selectone Oscillator coupler No. 540... 5.00
14 10 Benjamin sockets No. 9044... 5.00
15 1 pr. Benjamin brackets No. 6807... .75
16 1 Carter Imp. rheostat 1R-15S ohms... 1.50
17 1 S.M. balancing condenser No. 349... 1.50
18 1 Carter power rheostat MW-1 ohm... 1.75
19 1 Carter Imp. pot. 1R-400 ohms... 1.25
20 1 Carter fixed condenser 60005... 5.00
21 1 with grid clips... 5.00
22 1 Carter fixed condenser 60002... 5.00
23 1 pr. No. 10 Carter pin jacks... .95
24 1 Jewel Voltmeter 6V Pat. 135... 7.00
25 4 Tobe Bypass condensers 1 Mfd... 3.60
26 1 Tobe grid leak... .50
27 1 Jones 1-contact mini-plug and... 3.30
28 1 ft. cable type BM... .25
29 40 Kelling soldering lugs... 3.00
30 30 ft. rubber covered hook-up wire... 5.00

Here’s your chance to build a radio set that will give you all that radio has to give—distance, selectivity, clear and natural tone. Experience is not required, for full instructions will be sent you by Mr. Scott himself. Don’t hesitate—don’t delay. Send now for full details. Then you can’t forget it, and you’ll never regret it.
Greatest "DX" Receiver
World's Record
Super 10

Selectone Transformers cut through the local stations with ease; and their tremendous amplification brings in the distant stations with great volume. They are supplied in perfectly matched sets, insuring maximum amplification and the finest tone quality.

The new Remler Three-in-Line Condenser with the Remler Drum Dial represents the last word in gang condenser construction. Balancing condensers are integral with the main unit, and are easily and quickly adjusted. A special staggered connection of plates makes it self-shielding, preventing interstage coupling. All insulation is of genuine Bakelite.

Thordarson Amplifying Transformers were used in the original World's Record Super, designed by Mr. Scott. Because of the unusual tone quality obtained Thordarson apparatus is again selected. Two Thordarson R-200 Amplifying Transformers and one R-76 Output Transformer are used in this receiver. If you enjoy good music, insist on Thordarson amplification.

The famous Benjamin Spring Cushioned Shock Absorbing Socket was the choice of Mr. E. H. Scott in his original World's Record Super. Mr. Scott has paid the very highest tribute to the efficiency of Benjamin Shock Absorbing Sockets by again selecting them for this newest and greatest of radio receivers.

Tobe Condensers. Only the highest grade parts were selected by Mr. Scott for the World's Record Super 10, and the fact that Tobe parts are specified is one more proof of their claim for leadership in the condenser field.

Here Are the Verified Records

The authenticity of the startling achievements of the World's Record Super (as listed below) is based upon hundreds of verifications by leading Broadcasting Stations and Publications from Coast to Coast.

1. On March 17th established new World's Record for loop aerial reception — 8,375 miles with Loud Speaker Volume.

2. On the night of March 29th established new World's Record with the reception of six foreign stations distant 6,000 miles or more.

3. Established new World's Record for greatest number of broadcasting stations heard that are located 6,000 or more miles away.

4. Established new World's Record for most consistent reception, night after night, of Stations 6,000 miles or more distant — 117 programmes from 19 different Foreign Stations, heard between December 27th and April 10th.

In the careful selection of parts and accessories for the new World's Record Super 19, it is quite natural that a Jewett Pattern No. 138 Radio Voltmeter should be chosen. The black enameled case encloses a fine, D'Arsonval, moving coil type movement having silvered parts and equipped with a zero adjuster. The scale is silver etched with black characters. A special mounting arrangement makes it easy to mount in a radio panel. It is the ideal instrument for filament control.

Jones Ten Contact Multi-plug and 4 ft. Cable enable all batteries to be placed out of sight and simplify wiring. Now used on over one million receivers; endorsed by leading radio engineers.

Carter Rheostats are so designed that they are self-cooling and contact arm shaped so that it provides smooth contact with constant pressure at all times, making control of filaments noiseless.

Send Coupon for Full Details

Mr. E. H. SCOTT
25 East 32nd Street, New York

Dear Mr. Scott:

The article in your paper https://www.radiomuseum.org/encyclopedia/Record_Super_1927 states that the World's Record Super 10 received stations 6,000 miles away.

Please send me details of your new receiver.

Sincerely yours,

[Name]

[Address]
ROMANCE OF COTTON
(Continued from page 23)

One, however, might be singled out as being rather unusually ingenious. That is the use of cotton in the cords attached to telephones. These cords present an unsolved problem. Copper has to be used to carry the current. But copper wire breaks when bent, and these cords, of course, are bent many times in the course of a busy day of telephoning. In manufacturing these cords the Western Electric Company, the largest manufacturer of telephones, winds flat ribbons of copper no thicker than a hair spirally around a cotton thread. In this way they make cotton threads give strength to copper wires.

Other present-day uses involve the cotton seed and the waste from the gin, which formerly were thrown away. From the cotton seed is made cotton seed oil, substitutes for lard, oil cake and oil meal.

Tiniest Motor

A motor so small its rotor could be wrapped in a postage stamp is used by the Westinghouse Electric and Manufacturing Company, for timing the 0.000001 watt/hour meter demand register. It is the smallest synchronous motor ever manufactured for practical use. Four million of these complete motors, together with their reduction gears, would be required.

Flyweight motor held between the fingers of a man, showing minute construction as compared to that of the human hand.

to balance a large 8,000 hp. motor recently built in the Westinghouse shops. The diameters of their shafts are in the ratio of 12 to 1. The rotors are still smaller in proportion as 37 million are required to equal the weight of the large one. While two men, one on the other’s shoulders, could stand upright in the circular opening for the rotor in the 8,000 hp. motor, the rotor of this motor could be worn, set in a ring, on a man’s little finger.

Fine Measuring

In the manufacture of certain telephone parts, machinery of an almost unbelievable accuracy is required. One piece in operation in the works of the Western Electric Company is a measuring machine that is capable of measurements within one-one-hundred-thousandth of an inch.

Learn to Fly by Radio

Here is an absolutely new wrinkle in radio programs—a broadcast of practical lessons in airplane flying!

KOA, the Rocky Mountain broadcasting station at Denver, Colo., is to put them on the air. Cloyd Clevenger, World War ace and now pilot at the Alexander Airport, is to give them.

Clevenger has had great success as a test flyer and instructor in flying. There is much that a student pilot must learn before he takes his first flight, Clevenger says. It is this preliminary instruction he will give his radio flying class.

Lessons began Sept. 9. They will be continued for 10 weeks, going on the air each Friday night from 8 to 8:15 p.m., mountain standard time.

Clevenger’s student flyers will sit in their own homes with perhaps electric fans blowing wind in their faces. They can set a broomstick between their knees to take the place of a “joy stick.” A genuine airplane motor will be set up in the KOA studio to add greater realism to the lessons. See picture on page 11.
LOOK for Venus in the daytime! Ordinarily, the only astronomical body that we are privileged to observe during daylight is the nearest of all the stars, the sun. Sometimes, when the moon is near first or last quarter we see it, in the former case in the afternoon, in the latter in the morning.

But to these two this month is added the planet Venus. Brightest of all the planets when it is brightest, the brilliancy of Venus this month is inferior only to the sun and moon. On October 17, it attains its greatest magnitude, and for perhaps a week or more either side of that date it will be easily visible in the morning sky, if you know where to look for it.

One way of finding it in the day time would be to get up before sunrise. Then it will be blazing in the east, and there will be no doubt of its identity. By watching it carefully until the sun rises, you can easily see it in day light. But a simpler method, and one not requiring such early rising, is to use the celestial guide, the moon, on October 21.

On that date the moon and Venus are in conjunction. That means that they will be as close together as they will get on this particular circuit of the moon around its orbit. At 8:00 a.m., eastern standard time, Venus will be about seven and a half degrees south of the moon. The moon itself is about half a degree in diameter, so if you find the moon in the south on the morning of the twenty-first, and then look about fifteen times its diameter to the south, there you will see Venus. On the 15th of the month, Venus will be directly south at 9:17 a.m. local time, so that will also help you to find it.

Invisible Light Shows Star in Day

Of course, Venus is not a star. It is a planet. The only star that can be seen in the day, as was said before, is the sun. But with the aid of the photographic plate and invisible light, the stars can be photographed in full daylight.

If we were on the moon, the stars would all be visible even if the sun were above the horizon. The sky would look black, either at day or night. The reason why the earth’s sky doesn’t look black is because, unlike the moon, we are surrounded by a gaseous atmosphere. It is the atmosphere that reflects the short waves of light, the blue ones, and makes the sky look blue.

All day, the stars are in the sky above us, just as at night. If you look to the north, about 40 degrees above the horizon, you are looking at the pole star just as when you look at the same part of the sky at night. But in the daytime, the blue light from the sky enters your eye also. It is much more intense than the light from Polaris. The star is therefore invisible.

But the sky light consists predominantly of the short waves of light—the blue, and ultraviolet ones. The light from the star contains these rays, but it also contains a large proportion of longer waves, the wave that we call the infra red. These are invisible, because the retina of the human eye is not affected by their relatively slow vibrations, but a photographic plate can be treated so that it will record their impressions. And a dyed filter can be made that

(Continued on page 30)
3,000 MILES
THOMPSON

Power—Selectivity—Distance—Volume—Overtone amplification
You'll be amazed at the results that this receiver will give you. Hallidorson Precision long wave transformers and Overtone audio transformers are the heart of the Thompson Super Seven. Because they are built like the finest watches they will give you results that you never dreamed possible.

The ability to detect and reproduce weak signals is so acute that the set has unlimited range. Overtones that give depth and life to all music are brought to the foreground with a richness that is astonishing. The selectivity is so marked that powerful local stations can be tuned out and distance brought through with ease.

Get your parts today, a few hours work and your set is ready to be initiated in the realms of distant stations, and you'll be surprised at the low cost of the complete parts for so efficient a receiver.

The HALLDORSON CO., 223 W. Jackson, Chicago, Ill.

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SM Vernier Drum Dials
 Beautify the Thompson Super Seven

S-M 805 vernier drum dial of extremely pleasing appearance is already tremendously popular and its worth is thoroughly proven through its use in such receivers as the Improved Laboratory Model, Aero "Four," "Six" and "Seven," the new Hardness creation, the Bodine Eight, and now lends beauty and commercial air to the Thompson Super Seven. Furnished with attractive oxidized brass panel window and universal 0-100, 100-a, and 100-e block on gold drum scale. Simple in installation, suitable for any type standard shaft condenser for panel or sub-panel mounting, or both and universal for either right hand or left hand position. The dial readings are vernier controlled by a panel knob and may be illuminated by means of 10c. Price $3.00.

If you want the story of true super-quality amplification, full data on use of new A. C. tubes in any set, and the low-down of the first light socket operated six tube shielded T. R. F. set—the new Improved Shielded Six with A. C. tubes—just send in your name and 10c to cover postage.

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855 W. JACKSON BLVD.
CHICAGO, U. S. A.

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Setbuilders Supply Co.
[500H So. Peoria Street
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FREE
Write at once for complete data on: How to Build the Wonderful
Thompson Super Seven

We can make immediate shipment of all parts as specified by the engineers

Complete Parts
$78.55

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YAXLEY
Chosen Again
for the
Thompson Super

Through pure merit alone
Yaxley Approved Radio Products have gained for themselves a place in the new Thompson Super.

Their correct design and superior construction guarantee faultless operation.

1. Yaxley Filament Lamp.......... $ .50
2. Yaxley Pup Jacks........... .25
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1 - 36 Ohm Rheostat............ $1.81

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FREE

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Set Builder
Needs This Book

Every live dealer and set builder in radio sets, parts accessories, supplies, etc., should have a copy of this
bargain catalog. You will be amazed at the thousands of money saving radio items illustrated and listed in this storehouse of everything you could possibly need in radio.

The GUIDE BOOK to Bigger RADIO PROFITS FOR YOU

The book contains all the latest and most popular hits—all the famous nationally known radio parts, including the latest developments in radio tubes and designs of table cabinets and consists of everything at prices that mean bigger profits for you.

Short Wave Section

Our catalog contains a section devoted to a showing of the highest grade short wave receiving and transmitting apparatus. Also the latest electrical appliance for use in the home.

THOMPSON SUPER SEVEN
All Parts in Stock. Retail Price $78.55. Setbuilders: Write for dealers prices.

Dealers
Make More Money!

Make your position the envy of your neighbors and get the highest quality radio parts at the lowest possible prices and 18% satisfactory service. Our wholesale list pocket price list and discount sheet and catalog will be sent to you on request.

BUT WRITE QUICKLY
SHURE RADIO COMPANY
337 G Madison Street
Chicago, Illinois
Camfield Equatune Condensers

SPECIFIED FOR THOMPSON SUPER 7

THEY ARE MANUFACTURED IN ALL POPULAR CAPACITIES AND IN UNITS OF ONE TO FIVE GANGS.

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A Universal Condenser designed to give better operation in any radio set

CAMFIELD CONDENSERS UNEQUALED FOR ACCURACY, MECHANICAL DESIGN, ELECTRICAL EFFICIENCY, WORKMANSHIP APPEARANCE AND GENERAL UTILITY.

WRITE FOR LITERATURE ON COMPLETE LINE OF CAMFIELD RADIO PRODUCTS.

FOR BEST RESULTS

With the Thompson Super-Heterodyne use the Bodine Deluxe Loop

The characteristics of this loop meet perfectly the requirements of the Thompson hookup described in this issue, and all other super-heterodyne sets. It has remarkable pickup ability, high tuning efficiency, and surprising volume. The Bodine Deluxe Loop is only 26 inches high, with a turning radius of 6 inches. Its superbly balanced frame of hand-rubbed walnut adds to the beauty of the most attractively furnished room. The exclusive plug and jack mounting eliminates trailing wires and a unique device keeps the wires taut.

Order model L-500 for .0005 mfd., and L-500 for .0005 mfd. condensers. Either model $12.00.

MAIL THIS COUPON!

BODINE ELECTRIC COMPANY
2258 W. Ohio St., Chicago
Send me full information on the Bodine Deluxe Loop for super-heterodyne sets.

Name ____________________________
Address __________________________

Immediate Delivery of Complete Parts

For the New THOMPSON SUPER SEVEN

Write Today

For your cost on this receiver and a copy of our latest big radio catalog. Listing everything in radio at big savings.

WESTERN RADIO MFG. CO.
128 W. Lake St., Chicago, Ill.
"Dept. A"

Exclusively Specified For the Thompson Super Seven

TOBE CONDENSERS

The smallest details in Tobe Condensers have been studied to make them the choice of every engineer. If you want to be sure you are getting the best use Tobe Condensers.

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Give that last ounce of efficiency. Write for data on all Ellis "D" Coils.

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Write for circulars covering all Halldorson products

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Halldorson Overtone Audio Transformers $6.00
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Halldorson Precision Long Wave Transformers Type 540 J. G. 6.00
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Full size blue prints covering construction of THOMPSON SUPER SEVEN complete set 1.00

All technical letters regarding the Thompson Super Seven will be forwarded to Mr. Thompson for his personal attention. He will be glad to tell you about the receiver and to assist you in obtaining the maximum results from your set. He will also send free to those who enclose 2 cents return postage a complete constructional booklet with all drawings for the easy building of this wonderful receiver.

THE HALLDORSON CO.
Chicago, Ill.

4745 N. Western Ave.
Sales Office

THE SUPER SEVEN

J Fitzgerald, Chicago, Ill., writes:

On Monday night August 30 I listened to 25 stations in two hours and the next night when all powerful local stations were off the air I tuned in 14 of the same stations. The THOMPSON SUPER SEVEN is still receiver.

Henry Stuerz, Chicago, Ill., Says:

I have owned many superb but the Thompson Super Seven for tonal quality and distance has everything beat. I can cover the country from coast to coast almost every evening. The tonal quality and volume at distance stations is uncanny. Precision built apparatus sure make a big difference.

And now on top of all the good news comes still more praise, Louis Buck, Winnipeg, Canada, adds the final proof.

Have had the THOMPSON SUPER SEVEN working now for about 3 weeks and have had stations over three thousand miles regular. Can set the dials 1000 miles (either Coast Pacific Time) and KFI comes through with sufficient volume to dance to. Can always pick up P.W.X. Havana, Cuba, when they are on the air and have also had C.T.X. Mexico City, two or three times. Even up here where reception is fairly good I have never heard a receiver perform the way this one will.

Halldorson Precision Long Wave Transformers each $6.00

35 E. Wacker Drive, Chicago
Electricity For Colds

A new way of curing colds by applying electric heat to the inflamed interior of the nose is advocated by Dr. H. Bordier, of Lyons, France. The method is credited to a physician of Athens, Greece, Dr. Tsionoukas, but Dr. Bordier has improved and perfected it and has subjected it, he reports, to extensive trial. The method depends upon the electric treatment called diathermy. This is really the application of heat, not of electricity, but electricity is used to generate the heat. High-frequency electric currents, not unlike the currents used in radio, are sent through the body or parts of it and are so controlled that a part of their electric energy is converted into heat just where the physician wishes that heat to be applied. A hot poultice or a hot water bottle applies the heat chiefly at the surface of the skin. Interior tissues are heated only by inward conduction of the heat. The diathermic methods, on the other hand, can apply internal heat without heating the outer skin at all. In Dr. Bordier’s method of treating colds metal plates are applied at either side of the nose and the diathermic current is sent between them so that the inner membranes of the nose, not the skin, receive the major part of the heat produced. The Lyons physician reports remarkable successes from a few minutes of such treatment. As might be expected, the treatment is more successful when a cold is just beginning than after it is well on its way. Physicians now regard the common cold as one of the most dangerous diseases, because of the more serious troubles for which it may open the way. The new treatment will probably be tried widely and soon.

In the blue print section of the September issue, page 19, the circuit diagram of the Radio Age 6-Tube A C Receiver does not show the grid returns connecting to negative B lead. The correction is illustrated in the accompanying section of the original circuit lay-out.

VENUS NOW VISIBLE IN DAYLIGHT

(Continued from page 23)

will stop the blue waves, but will pass the slow infra red ones.

This gives the means of photographing stars in full sunlight. A photographic telescope, which is nothing but a huge camera, is employed. At the end opposite the lens is placed a plate sensitized to the infra red. Over the plate is placed a filter that stops all the sky light. Then the star’s light, or at least a large part of it, gets through, and leaves its impression on the sensitive emulsion.

At best, however, infra red plates are not very sensitive compared to ordinary plates, and so long exposures are required to record even the brightest stars. During this exposure, the telescope is driven by clockwork to follow their motion. Print stars can hardly be recorded at all, so the method of photographing stars in the daytime is principally of interest as an interesting stunt. As long as we have dark nights, astronomers will continue to take most of their star pictures between sunset and sunrise.

Jupiter Also Visible

Jupiter, largest of the planets, is also visible this month, but in the evening sky, as it has been for many weeks. It is directly south about ten o’clock. If one were to watch it might by night, it moves among the stars, and note its position carefully, a peculiar feature of its motion would be apparent. Jupiter, like all the planets, moves around the sun from west to east. But this month it seems to move from east to west. It is in the constellation of Pisces, and at the end of the month it will be about three and a half degrees to the west of its position at the beginning of the month. Yet a few months ago, it could have been seen moving from west to east, and in November it will seem to turn around and start moving east again.

Is this? Formerly it was, and for two thousand years previously, it was interpreted as an actual change in the motion of the planet. According to the Ptolemaic theory, which was then universally accepted, Jupiter moved in a small circle. This was called the epicycle, and its center moved in a larger circle around the earth. Though the motion of the center of the epicycle was always from west to east, the motion of the planet itself was sometimes in the opposite direction.

Explained by Copernicus

In 1543, with the publication of the theory of Copernicus that the sun was at the center of the solar system, and that the earth, like the other planets, revolved around it, a new explanation was offered. This is the one which we now know to be true.

Copernicus showed that we do not observe Jupiter from a stationary object. The earth, and we with it, are moving. The cause of the apparent motion of the earth is that the motion of Jupiter is to be blamed for the backsiding of that orb. Anyone who has been on a train in a station when another came in on the adjoining track can appreciate the situation. Often, it is impossible to tell whether the train we are on, or the other one, is moving. Frequently we are greatly surprised, when we have been quite sure that our journey had started, to look out the other side, and find ourselves still in the station.

The situation with Jupiter is the same. This month Jupiter, as always, is moving from west to east. So is the earth. But really we are greatly surprised, when we have been quite sure that our journey had started, to look out the other side, and find ourselves still in the station.

Square in Pegasus Conspicuous

As for the stars this month, the “Great Square” in Pegasus is conspicuous and is indicated on the map. This figure is one of the most familiar in the autumn and early winter sky. Over to the west, the “Northern Cross,” or Cygnus, the swan, is now magnificent in its upright position, with the brilliant Deneb at the top.

Below Deneb, and to the North, is the bright Vega, in Lyra, the lyre. To the south of this is Altair, in Aquila, the eagle. Like the great square, the triangle formed by Deneb, Altair and Vega, is a useful guidepost in finding stellar objects. Low in the east there appears the ruddy Aldebaran, the eye of Taurus, the Bull, which in the coming months will be a prominent constellation in the evening sky.
All Electric
Or Battery Operation

AGAIN Marwood is a year ahead—with the Radio sensation of 1928—at a low price! No other Radio is better built or better sounding. Here's the sensation they're all talking about—the marvelous 8 Tube Single Control Marwood for BATTERY or ALL ELECTRIC operation. Direct from the factory for only $69.00 retail price—a price far below that of smaller, less powerful Radios. Big discount to Agents from this price. You can't beat this wonderful new Marwood and you can't touch this low price. Why pay more for less quality? To prove that Marwood can't be beat we let you try it on 30 Days Free Trial in your own home. Test it in every way. Compare it with any Radio for tone, quality, volume, distance, selectivity, beauty; if you don't say that it is a wonder, return it to us. We take the risk.

New Exclusive Features
Do you want coast to coast with volume enough to fill a theatre? Do you want amazing distance that only super-power Radios like the Marwood can get? Do you want ultra-selectivity to cut out interference? Then you must test this Marwood on 30 Days Free Trial. An amazing surprise awaits you. A flip of your finger makes it ultra-selective—or broad—just as you want it. Every Marwood is perfectly BALANCED—a real laboratory job. Its simple one drum control gets ALL the stations on the wave band with ease. A beautiful, guaranteed, super-efficient Radio, in handsome walnut cabinets and consoles. A radio really worth double our low price.

Buy From Factory—Save 1/2

Why pay profits to several middlemen? A Marwood in any retail store would cost practically three times our low direct-from-the-factory price. Our policy is highest quality plus small profit and enormous sales. You get the benefit. Marwood is a pioneer, responsible Radio, with a good reputation to build. We insist on the best, and we charge the least. If you want next year's improvements NOW, you must get a Marwood and the Radio that a year ahead.

Agents

Make Big Spare-Time Money

Get your own Radio at wholesale price. It's easy to get orders for the Marwood from your friends and nabors. Folks buy radios when they compare Marwood quality and low prices. Do not let this opportunity to earn extra money slip away. Concentrate on Marwood—no other Radio is equalled in performance, beauty and dependability. We are making the biggest sale of the year in the Marwood line. This is the time to get in. Free literature, personal coaching, 10% commission, plus many other agents' benefits. No experience, no capital needed. Write today.

Rush for Free Trial

Send Agents' Confidential Prices, 30 Days Free Trial, Radio, Sentry and Agents' New Money Making Plan. No obligations on your part.

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MARWOOD RADIO CORPORATION
5315 Ravenswood Ave., Dept. A-3, Chicago, Ill.
Uncle Sam Needs More Radio Reports from Ships to Aid Fliers

Toward the end of April, when preparations were started for transatlantic flights by airplane, the number of ocean weather reports received by the Weather Bureau of the United States Department of Agriculture from ships flying the north Atlantic steamer lanes took a jump. It increased from four or five a day to twenty-five or thirty when interest in the flight projects was at its height. As a result, it was possible to keep the flyers well advised as to the winds, storms and fogs they would be likely to encounter.

This weather service, without which the hazards of the flights would have been enormously increased, was made possible largely by the voluntary co-operation of shipmasters and of the radio companies, which collected ocean weather information twice daily and delivered it to the Weather Bureau for charting and analysis. In future transatlantic flying, such voluntary co-operation will hardly be as readily forthcoming, since the novelty of the enterprise will be gone and public interest in it less keen.

Officials of the Weather Bureau are accordingly figuring out what can be done to stimulate interest in ocean weather reports, which are valuable in forecasting weather conditions on land as well as in adding to the safety of flying and of navigation. It is their hope that shipmasters who have been sending out weather reports in the last two months will have formed the habit and will continue the work when the present flying season is over. Nevertheless, something more permanent is essential.

One obstacle is the cost of taking observations and making them available by radio and telegraph to the weather forecasters. This cost has to be met by someone, even if it is voluntarily assumed and widely distributed as it was during the period in which weather service was maintained for the transatlantic flyers. The Weather Bureau's funds do not suffice for payment of observer, services and radio tolls from all ships.

That a more complete and extensive organization of ship service is necessary is shown by the fact that on some days while the flyers were waiting for favorable conditions the Weather Bureau did not get a single ship report from areas a thousand miles wide in the Atlantic. Even on May 18, two days before Lindbergh made his successful flight, no report was received from any ship between longitude 40 west and the Irish coast. It was not until he had started that weather reports from ships became nearly adequate. When Chamberlin made his flight the amount of information coming in was more abundant than in any previous period and continued so even after his successful landing in Germany.

Although the cost of getting ocean weather reports is a difficulty, perhaps a greater one is the fact that often there are no ships in areas where dangerous conditions exist. Moreover, when ships are warned of storm areas they avoid them. The hurricane that struck Florida last year, for example, was forecast by the Weather Bureau, and ships in the hurricane area were advised of its approach. They got out of the way so promptly that for twenty-four hours before the storm struck the coast not a single weather report was received from a ship in the hurricane area, for the good reason that none were there. Another difficulty is heavy competition for the use of Atlantic radio facilities. Ships on the regular traffic lanes in the Pacific much more commonly and regularly send weather reports than those on the New York to Europe routes in the Atlantic.

Apparently, moreover, the value of weather forecasts to Atlantic shipmasters is not a sufficient inducement to them to make regular weather reports, since most ocean liners are well able to cope with ordinary storm conditions. Nevertheless, information of big blows would be of value to ocean liners. Eventually, when funds and facilities permit, the Weather Bureau hopes to get reports twice daily from all the ships in
Radio's Acute Ear

The superiority of modern radio apparatus to the human ear, considered as a listening device, was demonstrated recently in England during an attempt to broadcast the song of that seldom-heard bird, the nightingale. A feathered songster far off in the distance burst into song while the experiment was going on. The engineers at the microphone heard nothing. The distant song was too faint and the engineers were trying to hear and to broadcast the song of another bird, believed to be near at hand but silent. However, the distant song, missed by the human ears that were on the spot, was picked up by the specially sensitive microphone that was being used and was broadcast, without the knowledge of the engineers directing the experiment. Radio listeners many miles away heard it perfectly, although the sounds themselves seem to have been quite inaudible to the nearby ears. Modern radio apparatus can act as a magnifier for sounds, much as a microscope can magnify objects too small to be visible to the naked eye.

Radio's Record Order

The largest order for radio sets ever written was recently given to John L. Limes, assistant sales manager of the Crosley Radio Corporation, by R. B. Austrian and R. B. Rose of the R. B. Rose Company, New York City. The order called for $1,000,000 worth of Crosley radio sets to be sold through radio departments operated by the Rose Company in stores throughout the country. Forty-eight radio departments were included in the contract in twenty-eight large cities extending from coast to coast.

According to Limes, in taking this order the Crosley Radio Corporation acted only as agent for its distributors. The sets will be delivered to the Rose retail departments by local Crosley distributors and the orders handled through them.

We Carry a Complete Line of Parts for the Following Circuits:

Worlds Record Super Ten

Thompson Super Seven

1928 Infradyne

Melo-Heald Fourteen Tubes
Electrically Operated T. R. F. Receiver
St. James Super
A Portable "B" Eliminator Tester
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CHICAGO ILLINOIS
Independent Radio Manufacturers Start Battle

By OSWALD F. SCHUETTE, Executive Secretary, Radio Protective Association

The case of the so-called "independent" radio manufacturers against the Radio Corporation of America rests upon a vital and fundamental principle that is important to all American industry. Ever since the Sherman Anti-Trust law passed in 1890, attempts have been made to evade its purpose by private corporations, under the pretext of patent ownership. The fundamental social doctrine of the United States, guarded zealously by its statutes and its courts, is that monopoly destroys both industry and democracy.

There is voluminous evidence in the archives of Congress and in such text compilations as Vaughan's "Economics of our Patent System" (MacMillan, 1925) that the concentration of control over an industry under one balance sheet stifles and suppresses the life of the industry. Developments which threaten to make existing assets obsolete are placed on the shelf and inventors find it useless to deal with the one existing customer.

Under the Constitution of the United States, the patent laws are written to promote the progress of science and the useful arts. The patent statutes are designed to stimulate invention and the use of patents to obtain a contrary effect is a perversion of these laws. Furthermore, the courts have held that patents do not give a license to any one to escape the prohibitions of the Sherman and Clayton Anti-Trust statutes, and have held therefore that the pooling of competing patents, resulting in the restraint of trade, is illegal.

In this light, let us examine the position of the Radio Corporation of America and the independent radio manufacturers. Almost a year after the Armistice, in the turmoil still existing in the Washington departments of the government, the Radio Corporation of America came into being, and now the Radio Corporation claims it was created "at the request of the government." As a matter of fact, the report of the Federal Trade Commission on the Radio Industry, made in 1923 (page 16) reveals that Secretary Daniels refused to sanction the Radio Corporation plan, stating that he believed in government ownership of radio and that only Congress could sanction such a move. Apparently the officials of the War Department also refused to sanction it.

According to this report, when the formation of the Radio Corporation of America was first discussed with navy officials in the spring of 1919 it was planned only to authorize the General Electric Company to buy existing Marconi patents and pool them with the General Electric Company's inventions. This was actually accomplished in October, 1919, and the Radio Corporation was incorporated. It was not until July, 1920, that the patents of the American Telephone and Telegraph Company and its subsidiary, the Western Electric Company were put into the pool, and another year—in June, 1921—that the patents of the Westinghouse Electric and Manufacturing Company and its subsidiary, the International Radio Telegraph Company, were absorbed under a series of agreements which practically divided the ownership and control of the Radio Corporation among the General Electric Company, the Westinghouse Company and the American Telephone and Telegraph Company.

As a result, there were pooled in the hands of the Radio Corporation approximately 1,000 radio patents and the parent companies entered into a series of agreements with the Radio Corporation and with each other that are of the greatest significance and importance to the radio industry, which we will refer, in detail, hereafter.

With reference to whether the patents so pooled were competing patents, let us consider here only a few radio circuit patents. The alleged superheterodyne, the tuned radio frequency, and the regenerative patents were among those pooled. David A. Sarnoff, Vice President of the Radio Corporation of America, in referring to the superheterodyne sets in a public statement declared that "it is the one element of our line that most distinguishes it from competitors' radio equipment. Judge Thacher, in the Atwater Kent case, in supporting the contention of the Radio Corporation, held that the Westinghouse Company's Armstrong circuit, alleged to cover regeneration, was "utterly different" from the Alexanderson patent, owned by the General Electric Company, alleged to cover tuned radio frequency.

It certainly should not be difficult for radio engineers to conclude that among 1,000 patents there must be a number of similarly interesting examples of competitive inventions.

As conclusive evidence of the total disregard by the Radio Corporation of America and its parent companies of this fundamental and far-reaching principle of our anti-trust laws, we point to the clause recurring with startling and significant emphasis in all the agreements between the R. C. A. and the parent companies and between the parent companies themselves, providing for the pooling of "all future inventions." It is hard to imagine any future radio invention which would not be competitive with what has already been developed.

Another important detail in these agreements was the careful division in the activities of the parent companies, whereby the R. C. A. pooled among themselves. To the General Electric Company was apportioned 60 per cent of all the manufacture of commercial receiving apparatus, including tubes. To the Westinghouse Company was allotted 40 per cent. The American Telephone and Telegraph Company was given the exclusive right to all commercial activity in wireless telephony. What does this promise for the development of wireless telephony in the United States? We are still using telephone apparatus developed thirty years ago. Although improvements have been made in the art, there have been limitations in use in Europe. Wireless telephone service is already installed on fast German trains for the use of passengers.

Now, after all these steps toward a monopoly, we find the Radio Corporation, according to many, has created "licensing competitors under patents necessary for the type and character of set upon which they (the competitors) have built their business." Mr. Sarnoff has announced also that "it is the policy of the American Corporation to encourage legitimate competition."

Mr. Sarnoff says that the terms of the licensing agreement are well known to the radio trade. What are they? In substance, a licensee agrees to pay a royalty of 7½ per cent of his invoice price of radio sets, including cabinets, speakers, socket power equipment or batteries, and other accessories, with a minimum guarantee of $100,000 for a period of four and one-half years; this, for the privilege only—and this is of the utmost importance—of making tuned radio frequency receivers. They are licensed to use only their present manufacturing facilities and the license agreement cannot inure to the benefit of assigns, successors or legal representatives of the licensee without the written consent of the R. C. A. In other words, consolidation and amalgamation by a licensee are at the option of the R. C. A. Mr. Sarnoff has said he intends to control the entrance of any new aggregation of capital into the radio business, and that is the meaning of this particular particular paragraph.

The licensees, further, must license the Radio Corporation of America, or any of the parent companies, under any patents they may have or may obtain, in any field, during the term of agreement, at a reasonable price. And it cannot be stated "licensing competitors under patents necessary for the type and character of set upon which they (the competitors) have built their business." Mr. Sarnoff has announced also that "it is the policy of the American Corporation to encourage legitimate competition."

Another clause requires the licensee to purchase sufficient tubes from the Radio Corporation of America initially to actuate all the sets made by the licensee. In defending this clause, Mr. Sarnoff points out the importance of tubes in the operation of sets and adds that "the tube is the neck of the bottle in the modern radio set." Mr. Sarnoff's metaphor is a particularly happy one. No bottle can rise higher than its neck! Under this clause, the license agreement, the Radio Corporation of America will control the type and efficiency of the sets manufactured by the licensee. Under this clause, the development and engineering of the sets of the
licensors will be dictated by the R. C. A. Furthermore, although Mr. Sarnoff concedes, undoubtedly by advice of counsel, the right to other manufacturers "not infringing patents" to compete for the replacement market, it needs no argument in a magazine read by the radio trade to prove that this clause is intended to assure to the Radio Corporation a complete monopoly of the tube business.

Mr. Sarnoff may claim that this is fostering "legitimate competition," and it is probably true that this fostering has been carefully guided by his legal department because it is obviously designed to give the Radio Corporation control of its competitors and to keep them in subservience. How many radio manufacturers in the past three years could have met an additional 3½ per cent cash outlay at the end of each radio season? How many could have paid the $100,000 a year minimum? Each year the ranks would have decreased. All the commercial uncertainties of the past are still with us, and now the licensors have the additional one of making the public pay the increased price necessitated by these royalties. No one knows better than Mr. Sarnoff the financial vicissitudes.

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**1928 Infaradyne**

At the San Francisco Exposition the new 1928 Infaradyne "stole the show." It proved that the real radio enthusiasts want something better, something that will out-perform all competition. Of course, interest focused on the Infaradyne. Here is a circuit—built in a few hours—easy to operate—which will roam the ether and pick out station after station which no one else can get. And yet its ability to snare stations thousands of miles away means no sacrifice of selectivity or tone purity. This is 1930 radio today, "for the man who looks and thinks ahead."

The following Remler units, plus a few incidental parts, will give you a complete Infaradyne.

- Remler Foundation Kit No. 750.................................................. $52.00
- Remler Infaradyne Cabinet, No. 760.......................................... 15.00
- Remler R. F. Amplifier, No. 710................................................ 55.00
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We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed the best hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

March, 1926
- Improving the Browning-Drake.
- Rhythimless Tubes in a Set.
- How to Make a Wave-meter—Blueprint.

May, 1926
- Short Wave Transmitter—Blueprint.
- Simplifying Battery Charging.
- Protecting Your Inventions.

June, 1926
- Simple Crystal Set.
- Golden Rule Receiver—Blueprint.

August, 1926
- Receiver, Transmitter and Wave-meter.
- Beginners 200 mile Crystal Set.
- Changing to Single Control.

September, 1926
- How to Make a Grid Meter Driver.
- Short Wave Wave-meter.
- Power Amplifier for Quality (Blueprint)

October, 1926
- Crystal Control Low Power Transmitter (Blueprint).
- Raytheon Design for A B C Elimination.
- What Type Loud Speaker to Use.
- Nine Tube Super Brings Back Faith.

November, 1926
- Blueprints of the Henry-Lyford.
- World Record Super With Large Tubes.
- How to Use a Power Tube in Your Set.

December, 1926
- Starting Radio with Crystal Set.
- Rheostatless Shielded Receiver.
- Types of Rectifiers Discussed.

January, 1927
- Full Data on World Record Set.
- Dual TC Receiver.
- Clough Super Design.

February, 1927
- Building the Hammarlund-Roberts.
- Making a 90 Inch Cone Speaker.
- Browning Drake Power Operated.

March, 1927
- Ideal Model Worlds Record Super.
- Building the Hammarlund-Roberts.
- Riddling Super of Repeat Points.
- Loop and Four Tubes.

April, 1927
- Inexpensive B. Eliminator.
- One Spot Superhet.

May-June, 1927
- Complete Trouble Shooter for Supers.
- 9 Tube for Worlds Record Super.

July-August, 1927
- Building Vacuum Tube Voltmeter.
- Low Power Crystal Control Transmitter.

September, 1927
- New A. C. Tubes in a Six-Tube R. F. Receiver
(blu prints.)

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Radio Age, Inc., 500-510 N. Dearborn St., Chicago
of the manufacture of radio sets. He must therefore know of the power which the patent is a monopoly of America, that gain over the radio industry by its position as a creditor under these license agreements with its competitors.

In other words, how can the Radio Corporation of America claim that it is fostering competition by placing its competitors in a frame of mind where they may be even conscious that they have to meet a fixed cash liability of 7½ per cent of their billings with $100,000 as the annual minimum; that their engineering must be built around the R. C. A. tube characteristics and their production around R. C. A. tube deliveries; that if they desire to consider their business as a realizable or negotiable asset they must keep themselves in good standing with the Radio Corporation of America?

And at all times, every signatory of one of these licensing agreements must have before him the possibility that new inventions may destroy the commercial value of the ruined radio frequency circuit. But the $100,000 a year minimum would remain in force. Even the R. C. A. might embarrass its licensees by such an invention or it might put the invention on the shelf and become its own income, in another evidence of the power which a monopoly has to throttle the development of an industry.

So we have the picture of three of America’s greatest corporations in the electrical field pooling their patents to build a radio monopoly. That is the Colliot when independent manufacture is called upon to meet. It has licensed such as it chooses among its competitors, and if it can carry out its program it will condemn to death by far the largest majority numerically of the manufacturers of receiving sets, as well as 75 per cent of the manufacturers of tubes, accessories and parts. And the few it permits to remain will be compelled to live in the same subservience which it now imposes by its license agreements upon those of its competitors who pay their royalty into the treasury. If the Radio Corporation is allowed to carry out these plans, the independent dealer will be forced to go the same way as the independent manufacturer, for it is the history monopoly that the destruction of competition makes for the few dealers that remain mere hired salesmen of the trust.

So far as the listening public is concerned, the consummation of this monopoly will mean higher prices for sets. Under the battle-cry of “stabilization” there will be stagnation in the development of the radio industry; under the pretext of the patent laws there will be a stifled art; in defiance of the anti-trust laws, there will be the destruction of competition.

The future of radio is still untouched. Before us there opens a broad vista of partially explored fields of radio science—telephony, telegraphy, broadcasting of power, the breaking down and building up of the electrons in food, the transmission of the life-giving ultra-violet rays, and the many ramifications that lead from these. Yet in all of these there is to be no commercial basis for independent or competitive development.

It was to meet this crisis in the radio industry that the Radio Protective Association was formed by outstanding representatives among the independent manufacturers to secure the protection of the laws for this great and growing industry; to mobilize the public opinion on behalf of a free art; to appeal to Congress and the other federal authorities at Washington as well as the courts against the menace which threatens them. The Federal Trade Commission is already investigating the Radio Corporation of America and actions are pending in the Senate to investigate the great aggregations of capital in holding companies in the electrical industry and it will not be difficult to broaden these to cover the power which such an aggregation of capital could obtain, through monopoly of the radio industry, over the welfare, and even the politics of the American people.

Sandstorms Affect Aerials

That the sandstorms which occasionally annoy the residents of western Texas are remarkably good generators of electricity as well as of discomfort was announced to the recent meeting of the American Physical Society in Reno, Nevada, by Messrs. E. F. George, W. M. Young and Harry Hill, of the Texas Technological College, at Lubbock, Texas. Persons caught in these storms have frequently experienced, the Texas physicists report, severe electric shocks. The shocks may be felt from radio antennas, fence wires or other metal objects. The electric ignition systems of automobiles sometimes refuse to work while such a storm is going on. Using the antenna wire of a large radio station, the three scientists have made actual measurements of the amounts of electricity involved. Voltages as high as 40,000 volts have been observed; amply high enough to cause death if the amount of current obtained were sufficient. Occasionally, the current discharged by the storm is such that a single wire is too small, in most cases at least, to be dangerous to life, although it may reach a hundred million times the electric current normally present in the atmosphere. The source of the electricity generated by sandstorms is supposed to be the friction between the flying grains of sand in the air and between these sand grains and stationary objects. The air of western Texas is usually so dry that this frictional electricity is not dissipated, as it would be in moist air.

Independents Organize

The battle against radio monopoly in the United States has been brought nearer to a crisis by the organization of the Radio Protective Association, with headquarters in Chicago. That conflict promises to be of decisive importance to the future of the entire radio industry—not only to manufacturers and dealers, but to the listening public as well.

Representatives of about thirty manufacturers, from all parts of the country, took the initial steps in the formation of this anti-trust organization early in August by obtaining a charter of incorporation from the Secretary of State of the State of Illinois following the purpose of the association to be “to promote the progress of science and the useful arts insofar as they apply to radio and to preserve the freedom of said science and useful arts.

The following were named as the original board of directors:

- Fred S. Armstrong, Vesta Battery Company, Chicago, Ill.
- Fred A. Atlee, Joy-Kelsey Corporation, Chicago, Ill.
- Allen G. Messick, Indiana Manufacturing and Electric Company, Marion, Ind.
- Harry Sparks, Sparks-Withington Company, Jackson, Mich.
- Oswald F. Schuette of Chicago was elected executive secretary and offices have been opened at 134 South LaSalle Street, Chicago, as the headquarters for the fighting.

Organized opposition to all efforts to create a radio monopoly under the pretext of an alleged patent situation will be carried on vigorously and in all quarters, say sponsors for the new organization. The battle is to be taken to Congress, to the Department of Justice, and to the Courts. The Radio Corporation of America and the testimony which it is taking promises startling revelations when it is made public.

As one of the first steps in the progress of the Radio Protective Association, it has carried the fight direct to the 33,000 radio dealers throughout the country and dealers occupy a vital position in the coming battlefield for they must stand between the radio manufacturers and the purchasing public. Anything that increases the price of radio sets will be reflected in the business of these dealers, declare the independent leaders. And anything which destroys competition in the industry by eliminating independent manufacturers will destroy the business lives of the independent dealers as well, and leave those who survive at the mercy of the monopoly.

British Invent Radio Game

A new outdoor sport for radio fans enlivened the recent field day of the Golders Green and Hendon Radio Society, in England. Instead of hunt-the-button it was hunt the radio set. A small radio broadcasting station was set up in secret in the grounds of a fashionable house. When this station, sent out radio signals. Members of the Society mobilized in the neighborhood and attempted to find the secret station, much as radio scouts in wartime might hunt for the secret radio transmitter of a spy. Mr. Maurice Child, using an apparatus to detect the direction from which radio waves were arriving, made three readings of this direction at different points a few miles apart combined these on a map according to the well-known surveyor’s method of “triangulation,” and was thus enabled to locate the hidden station winning a prize offered by the British radio magazine, the Wireless World. Four other contestants succeeded in finding the secret station within the time limit set by the rules.
New Aero Circuits

The Improved Aero-Dyne 6 and the Aero 7 and Aero 4 are destined to be intensely popular this season!

Here are three new Aero circuits of unusual merit. Each is constructed around a set of improved Aero Universal Cores—the finest and most attractive inducances ever offered. Learn more about this feature if you are interested in securing finest selectivity, greatest range and power, finest tone quality and best advanced radio reception.

AERO UNIVERSAL
TUNED RADIO FREQUENCY KIT
Especially designed for the Improved AERO Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 301-A, 199, 112, and the new 240 and A. C. tubes. Tuning range below 200 to above 500 meters. This kit will enable you to circuit better in selectivity, and the right circuit innate losses and give the greatest

Are You Fit to Be an Aviator?
(Continued from page 23)

aviators have found protection in a powder puff sewed in each flap of the helmet.

Sound Nervous System Necessary
Defects of nerves constitute the commonest causes of accidents and removal from flying status. Army and Navy fliers are subjected to a psychoanalytic test. By a complete study of the personality and a review of the history, the tendencies, resistances and potentialities of the nervous system can be determined.

Therefore, when you go for your examination a conversation like this will be in order:

“What is the first, the very first memory you have?”

“I remember falling off the garden fence,” answers the would-be aviator.

“Heavens, do you think of falling when you are on high places?” asks the examiner anxiously to follow up and unearth a possible complex.

“No, never.”

“Well, how about your early life in school? Did you enter into all games? Did you engage in fist fights with your playmates?”

So the questions go. The trends and reactions to stresses in the past life form the basis of a prophecy of the probable reactions to the stresses of flying.

Much has been written about the abstinent, non-drinking, non-smoking life of Lindbergh. His cool-headedness was proved long before he hopped the Atlantic by no less than four parachute jumps from unmanageable planes. Such quick reaction is essential in a flyer. There is often a situation where almost automatic reaction is necessary. Reaction involves coordination of complicated arm and leg movements.

Chilling Must Be Prevented
It is necessary to prevent body chilling. Clothing is a most essential consideration. It varies according to the flight undertaken. ALTITUDE, weather conditions and the degree of protection afforded by the type of plane are all to be considered. The temperature drops five degrees Fahrenheit for 1,000 feet of altitude. At thirty to forty thousand feet a temperature of seventy below zero is encountered. The body must be kept surrounded with warm layers of air between several layers of loose-fitting wool or silk. The mesh and not thickness prevents heat loss. Freedom of movement is essential and ready removability must be insured by a metallic rip arrangement. A thin layer of cold cream on the face is a marked protection.

Adequate physical exercise is necessary for every one and indispensable for fliers. During the war physical trainers were attached to all aviation units and sports and games were part of the daily routine. A good athlete of muscle toward becoming a good aviator. Eye and limb coordination mental alertness, high efficiency in respiration and circulation and morale are all to be gained by enjoyable exercise. The tone of thoracic and abdominal muscles is increased and metabolic activity of the tissues stimulated by swimming, rowing, golf,
tennis, handball and other favorite recreations. A body kept hard by outdoor life, covered with loose clothing and given sufficient opportunities has the greatest known preventive against a tendency to circulatory asthma. Before making a flight dietary indiscretions must be avoided and liquids limited to reduce kidney stimulation from cold.

Poisoning by dope presents a health hazard. Amyl and butyl acetate, gasoline, de-natured alcohol and cellulose make up the standard dope used on the surface of fabrics, covering the wings and bodies of air-planes. These are dangerous chemicals. Their concentrated fumes produce head-aches and nausea. Death may occur sud-denly with symptoms of vertigo. Soluble dope reaching the bowels is best eliminated by a persistent milk diet.

Another recent addition to aviation haz-ards has resulted from the employment of ethyl fluid which has as its base tetraethyl lead. Danger of lead poisoning requires the usual precautions taken by the lead traders. Aeronautics in its progress is incorporat-ing the modern equipment of technology and psychology, as well as preventive medical principles. The flight surgeon should keep him men physically and mentally fit to fly. He should know his men intimately and the quick to recognize any condition which the flyer himself may not think important.

Length of Flying Life
Every aviator should be examined every six months and after every illness. This will greatly prolong his usefulness. The English found during the early part of the war that stress of work at the front meant a limited amount of work in the air; that the limit of every flyer was approximately 150 to 300 hours. At the end of the war these figures were greatly improved and now they are better still. Lindbergh has spent around 2,000 hours in the air.

The International Medical Requirements for Air Navigation have been adopted by practically all countries except the United States. The requirements of our Army and Navy are along the same lines. The medi- cal requirements are stricter for pilots engaged in public transport. They are all re-quired to be examined every six months.

The civil flight surgeon is the man of to-morrow. Aviation medicine is a specialty and only those with special training are qualified to make special examinations. With civilian transport companies carrying both passengers and freight; with the air full of commuters, the civilian physician will need to know aviation medicine. There are opportunities now for him.

There is no doubt that we shall all want to fly. Ernest L. Smith, Emory B. Bronte and Lieuts. Lester J. Maitland and Albert F. Hegenberger tested the radio beacon as a guide to a diminutive goal in the sea to prove that we can fly anywhere. The trans-Atlantic fliers were tested engine-endur ance to prove it. Lieut. Al Williams is trying to show how fast we can do it, and Lieut. James Doolittle, by his amazing out-side loop, has shown how sportively we can fly.

The world is moving on at a great rate toward our getting up over the traffic-

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THORDARSON POWER SUPPLY TRANSFORMERS

Here is a power unit that will satisfy the ever increasing demand for improved quality of reception. A split secondary 550 volts either side of center, makes possible full wave rectification, using two 216-B or two 281 tubes. Current capacity, 150 milli-amperes. The lower secondary, 7½ volts, will supply two UX-210 power tubes, enabling the use of push-pull amplification in the last audio stage.

The Double Choke Unit 2099 is designed for this power unit. Contains two individual chokes of 30 henries, 130 milli-amperes capacity.

T-2098 Transformer, $20.00
3½" x 5½" x 8¼" List Price $14.00

The new R. C. A. and Cunningham A. C. filament tubes will be very popular with the home experimenter this season. The Thordarson Transformer T-2445 is designed especially for these tubes. Three separate filament windings are pro-vided.

Sec. No. 1, 1½ volts, will supply six UX-226 amplifier tubes.
Sec. No. 2, 3½ volts, will supply two UX-227 detector tubes.
Sec. No. 3, 5 volts, will supply two 5-volt power tubes.

In addition to the above, this transformer is equipped with a receptacle for the B-supply input plug. Supplied with six-foot cord and separable plug for attachment to the light circuit. Transformer in compound filled, crackle-finished case. Dimensions: 2¾" x 5½" x 4¾".

A. C. Tube Supply, $10.00
T-2445, List Price $20.00

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choked streets, where there is more room. Our children are going to consider travel by air as safe, perhaps safer, than travel on foot. Moreover, health, airships and flying samoritans are going to be felt.

The Telephone's Progeny

The telephone, most widely used of communication devices, has become the forerunner of an illustrious family of communication instruments. These include the Vitaphone which furnishes a voice to the motion picture screen; an audiometer to test hearing; an audioplane to aid the hard of hearing; an electrical stethoscope which amplifies the faintest heart sounds; a public address system which carries a speaker's voice to crowds of thousands and tens of thousands; and the microphone—the heart of the radio.

Electric Darts

A tree trunk actually blown to bits by lighting, as though by a dynamite bomb placed inside it, is described by Dr. N. Ernest Dorsey, of Washington, D. C., in a recent issue of the Monthly Weather Review. It was a typical presentation of the United States Weather Bureau. The tree was struck by a lightning bolt in Jacksonville, Illinois, on the afternoon of April 13, 1927. Photographs made immediately were submitted to Dr. Dorsey by Mr. Frank P. Norbury, a cooperative observer of the Weather Bureau at Jacksonville. The lighting did not strip off the bark or knock off a limb or two; it literally blew the tree to bits. The incident supplies, Dr. Dorsey believes, support for his theory that lightning does not consist of ordinary electric sparks but of "darts" of concentrated electricity, shot down from the clouds like bullets from a gun. Ordinary electric sparks would merely follow the outside of the tree into the ground. The imagined dart of lightning, on the other hand, might penetrate the ground as a bullet would do. Inside the wet wood this electric bullet would cause a powerful steam explosion, disrupting the trunk exactly as it did happen in this instance.

Airplanes of the Future

That the airplane of the future will be large enough to carry a hundred passengers; able to land virtually, so that any field will serve for emergency landings; capable of taking off or landing on the roofs of city buildings; fireproof, and equipped for flying at a speed of three hundred miles an hour and at a height of 30,000 feet above the ground, are predictions made by Professor Alexander Klemin, head of the Daniel Guggenheim School of Aeronautics, in a statement issued by New York University.

Air planes as large as ocean liners, Professor Klemin considers improbable, as the theory of the support of aircraft in the air calls for a limit of size at about the height of the 50-foot machine with the hundred-passenger capacity. The higher speed at high altitudes will be attained by the super-charger, a device already in use to compress the air before supplying it to the engine.

Standard "ENSCO" Kit

$10.00 With Hardwood Wall Frame, $11.00

It contains "Enson", Direct-drive unit, designed and patented by Clyde T. Enterc. Beautifully decorated Alphonse FOR-OK-TEN Cone Material; Metal Answer Extension Pin and Electromagnetic Switches. Use in any assembly of any of styles of Cone or Roll Shape, Wall, Pedestal or Console Speaker, sizes 30 to 50 inches. You can build it in less than five hours. Static maturity reduced—winter results all summer.

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Enjoy your radio to the utmost by having at all times the exact volume your mood and taste desires. This is easy if you install "Tonatrol". "Tonatrol" controls volume from a whisper to the most powerful tones—quietly—instantly. A fine addition to any set. Radio experts endorse it.

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Tonatrol—Type W. S. (with filament switch attached) List price $2.00.

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The "SELF-ADJUSTING" Rheostat
Announcement

In making a report on tests of a new seven-tube super-heterodyne which has been developed in the Radio Age laboratories our technical department brought in such good news about the circuit that we decided to pass it on to our readers. Full instructions on how to build the set, with illustrations, including blueprints, will be published exclusively in the November issue of this magazine.

The Quadrode (Four Element) Superheterodyne does not merely present something new and different in the arrangement of parts. It is not merely a modification of the reflex. It is not a reflex. It introduces an element into superheterodyne construction that has never before been used. This new method makes it possible to obtain power, selectivity and tonal quality equal to those of the best eight-tube sets. The fans will readily recognize the economy in time and effort and money in this elimination of one tube.

The editors believe that this circuit will arouse the interest and eventually the enthusiasm of fans everywhere. Simplicity, compactness, excellent performance—those are characteristics sufficient to make the Quadrode popular, but it has that new feature which makes it an outstanding phase of this season's radio development.

Do not miss this illustrated article in the November Radio Age. If you are unable to obtain it at the newsstands send 30 cents in stamps and we will mail a copy direct. The November issue will be on the stands Nov. 1.
Radio Industry Standards

H. B. Richmond, of the engineering division of the Radio Manufacturers Association sends the following interesting information on standardization of radio products:

"Much confusion has formerly existed in the radio industry, because of two separate technical standards set up by two organizations within the industry. Each of these standards had been set up in good faith, and represented the accepted practice of its particular group.

"Radio has been phenomenal in its growth. It is, therefore, only natural that organizations within the trade should show a similar growth. Within a period of a few years the Radio Manufacturers Association, which is the leading trade association of the industry, has grown from a dozen to three hundred members. It now has ten times the membership of any other manufacturers' trade association within the industry.

"As a result, the agreement now is so nearly 100% representative of the entire industry, it feels that any standardization work it may do will be truly representative of the industry. Under the direction of the Engineering Division, meetings are being held, at which not only are members welcome, but all interested manufacturers are invited. At these meetings all previous standards, regardless of their origin, are being reconsidered. Out of this previous duplication of effort, the RMA is drawing up, a new set of standards which, while sponsored by the RMA, will no longer be known simply as the RMA standards, but will be designated 'The Radio Industry Standards.'"

Chicago Radio Show

The sixth annual Chicago Radio Show, one of the most important milestones in the progress of the radio industry, will take place in the Coliseum from Monday, October 10, to Sunday, October 16, being open to the public each afternoon and evening. Jobbers and dealers will have special hours from 11 a.m. to 1 p.m. The show will have an especial appeal to the public this year for several reasons. The Trade Show in Chicago last June gave the manufacturer the opportunity to get into contact with his distributors and the dealers. Now he can bend his every effort to make a display which will be primary for the benefit of the general public. Coming so soon after the Dempsey-Tunney fight, when radio will reach such a height in public interest, the show will be doubly interesting to the fan.

This year, too, the display of radio apparatus staged by the manufacturers will be backed up by the "Theater of Wireless Wonders" in which will be displayed the latest achievements in scientific research. These exhibits, or at least many of them, had their first public demonstration at the Radio World Fair in New York. The exhibits, which will be grouped on the balcony of the main exposition hall, will include devices by which the infinitesimal atom can be measured, seen and even heard. Amplifiers which build up sound to millions of times its original volume will make flowers "talk" and other devices will touch them with a wireless ray which will instantly freeze them into brittleness.

Cold heat will be transmitted through the air and a cake of ice burned up before the eyes of the spectators. Another machine using 350,000 volts of electricity will send a ray at the speed of 150,000 miles an hour. Scientists will show how they measure one-millionth of an inch.

J. Elliott Jenkins, radio engineer, is installing a model broadcasting station in the balcony of the annex from which nearly a score of Chicago stations will give special programs for the benefit of their millions of listeners. Jack Nelson, pioneer announcer and station manager, has been placed in charge of arranging the programs to be given at the show and in co-ordinating the work of the stations taking part in the hook-up.

Mayor William Hale Thompson of Chicago and Lieutenant Governor Fred Sterling of Illinois will take part in the opening exercises at the show. Miss Lois Delander, who went to Atlantic City as "Miss Illinois" and came back to her home at Joliet as "Miss America," is expected as a specially honored guest one evening during the show.

U. J. Herrmann, who started the Chicago radio show when there weren't enough sets in the entire community to fill the Coliseum, is again managing the director of the exposition, and G. Clayton Irvin, Jr., is general manager.

Many jobbers in the middle west are planning to attend the Chicago show to see what developments have been achieved since the R. M. A. trade show held in Chicago in June.

SEE NOVEMBER ISSUE FOR SUPERHET CIRCUIT WITH NEW FEATURES
### Radio Stations and Broadcasters

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### November Styles in Supers

The next issue of Radio Age will present a new group of constructional articles on superheterodyne circuits. Full details on how to assemble, drawings, photographs and a specially interesting blueprint feature.

**How to build a super for A. C. tubes.**

**How to make a seven-tube circuit (involving an entirely new method)**

**How to make the Camfield 9-tube super.**

**Other technical information of timely value.**

**Complete corrected list of stations.**

**Everyday Mechanics and Current Science.**

Readers of Radio Age write to us every day praising our “bright little magazine” and reporting that they have built sets from our instructions with happy results. The November issue will be on the stands about Nov. 1, or send 30 cents in stamps to insure getting one.
The problem of high cost gasoline has apparently been solved by a mysterious little device that can be installed in a few minutes on any car. With this device installed the saving in gasoline effected will be so great that the cost of gas, as compared with previous cost, will be even less than 11c. It is estimated that if every car were equipped with this invention, millions and millions of dollars would be saved a year. Autoists also report an immediate increase in power and pick-up when this device is installed. Instant starting is also noticed.

Motor Runs Much Smoother
Carbon forming disappears. The inventor claims that this is the outstanding automobile invention of the decade and has grounds for his claim. Thousands of motorists have already equipped their cars. They report mileage tests that seem almost unbelievable. Thirty, forty and more miles on a gallon is nothing unusual. Motorists who have not already equipped their cars with this gas saver should get one as soon as possible so that this season their gasoline bills will not worry them.

FREE SAMPLE
To sell the Whirlwind, you have to have one of the devices to show. We have arranged a plan that supplies you with this device free so that you can get out and take orders right off the jump. If you have a car, you can equip your own car and make the experiment first. Your experiment will make you so enthusiastic that it will make you a doubly successful salesman. If you have no car, just carry it with you.

A newly invented device has actually made it possible for automobile owners to ride on 11c gas. This device, by utilizing air, cuts down the gas consumption amazingly. 11c gas is really a conservative estimate, as in many cases bona-fide reports have been received on cars running as high as

60 Miles on a Gallon of Gas

With the high cost of gasoline, this new Whirlwind device is the greatest thing of its kind ever discovered for auto owners. It is not an experiment, but the outcome of years of accurate tests. Car after car equipped with this marvelous device has shown amazing mileage tests.

This little device is worth its weight in gold, yet costs such a minimum sum that it pays for itself in just a short time in the gasoline it saves alone, not counting the more pleasing driving it produces.

$100 a Week Territory Open

When you sell a device that actually saves gasoline, you overcome the one big point that makes selling difficult—that is, sales resistance.

Every auto owner wants to save gasoline. The Whirlwind is so practical, so easily explained, that it does not require a high-pressure, experienced salesman to make big money introducing it. On the contrary, the less sales talk used, the more sales you make. The literature we supply and the device itself do the selling. All you do is to take the orders. Word-of-mouth advertising brings you tremendous repeat business. For those who can devote full time, this is a knock-out proposition. It means a sure road to independence with an ever increasing future. Auto registration shows the number of cars is increasing daily. Every new car in your territory is a prospect for you. We stand back of you 100% and supply constant sales helps to increase your business. When you get big enough to handle it, we then forward to you business in your territory that comes to us direct.

Even if you are not in a position to devote full time, the Whirlwind agency offers big possibilities to you. It is easily possible to make as high as $20.00 in an hour with this device. It sounds like a lot of money, but it has been done and it can be done by you if you will just push it as actively as other salesmen have done.

Big opportunities wait for no man, and this is a big opportunity. You have to decide, now, if you want to make some real money yourself supplying the demands for the live agency item of the year. Here is your chance. Just fill in the coupon and mail it today.

Whirlwind Carburetor Co., 999-495-E. Third Street, Milwaukee, Wisconsin
CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don’t overlook RADIO AGE’s classified advertisements.

The classified advertising rates are but four cents per word for a single insertion. Liberal discounts are allowed on six and twelve-time insertions, making rate of 3 and 2 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for November issue must be sent in by Sept. 25.

AGENTS


AIRPLANES

SEND FOR free illustrations and plans of our won- derful new Radio Motor glider, the smallest, lightest, highest flying plane ever built. Send name and address. Approved by the American Radio Club, Remington Radio Co., Detroit, Michigan. Guaranteed to do what they say.

BOOKS AND MAGAZINES

Pitkin's '25, 50, 75, 100 cents, 35, 25, 15, 10, 5 cents, 1 cent. Write for list. The Oliver Test Pressing Co., 36 W. Chicago Ave., Chicago, Ill.

BOYS


RADIO SET FREE, farm magazine clubs. Club list free from Spenser Agency, Los Angeles, Calif.

BUSINESS OPPORTUNITIES


MAKE RADIO PANEL LAMPS, inventor can supply numbers, etc. Easily assembled. Also complete kits on top of radio cabinet. Light, efficient. Free sample. Lamp $1.25. Paid prep. Robert Stevens, Lebanon, Ohio.

LAND FREE if planted to bananas. Bananas bear a full crop the second year. 10.00 monthly will plant five acres, which should pay 1,300 profit annually. Reliable Companies will cultivate and market your bananas for $1.00 per ton. Write today.

FOR SALE—Papaya on Florida map and duster. I have party offered to take five hundred dozen per month. Lester Doss, McMinnville, Tennessee.

DOGS

BEAUTIFUL REGISTERED BULL PUPS $15. Bulldog, 501 Rockwood, Dallas, Texas.

ELECTRICAL

ELECTRIC FUN! Seventy aunts, 110 volts, $1. Cecot- ing, Campell, Calif.

FORMULAS


MISCELLANEOUS

NEUROSYNDES AND HETEROXYNE ARE GOOD AS FAR AS THEY GO. THE BEST ONE TUBE SET 30.00. EXCLUSIVE! GUARANTEE ON MACHINES! FIFTY CENT TUBES BY MAIL, IODINE PRODUCTS COMPANY, Laureau, Mbk. 35.

"MUSIC Composed" to words. Elaura Brose, formerly of Shoe's Band. Oshkosh, Wis.

GILLETTE STYLE Razor with 10 Blades 60c Premium. Lead Sparkler 35c. Sparkler Unit 90c premium. Trans- former 50c, Male Station A, New Haven, Conn.

PANEL ENGRAVING

SINGLE PANEL and medium quantity engraving of highest quality. Also panel drilling, meter engraving and machine engraving on small parts. Careful attention to detail. Send plans and specifications. A. L. Woody, 19 S. Wells Street, Chicago.

PERSONAL

LONELY HEARTS: Exchange letters; meet interesting new friends in our Jelly shk. Particulars free. Eva Moore, Box 805, Jacksonville, Florida.

RADIO

EXTRA HEAVY Autumn wire 7 ft. No. 18 $1.50 100 feet, 17 No. 22 braided 3/8" with $2.00 100 feet all pre- paid. George Sloan, Canton, Michigan.


SHILON Transformer Steel cut to order .014", 10 lbs. 20 cents, 8 lbs. 30 cents, less than 8 lbs. 35 cents per lb. 4 tables on four pages. We charge $1.25 per lb. postage extra. At least 10,000 feet with each order—balance C. 0. & D. Geo. Bealz, Calu- met, Michigan. Guaranteed.

PURE aluminium and lead rectifier elements, bolt drilled, with brass sleeves and nuts per pair 1.19", 1.0", 0.8", 0.6". Send for price list. Bealz, Calumet, Michigan.

SALESMEN WANTED


STAMPS

1000 different $1.00, 500 different 30c. French colonial- ies 100. Kohler, 604 Milwaukee St., Dayton, Ohio. 100 foreign stamps & hinges free to approved appli- cants. Postage four cents. Bidle, 1133 River St., Dayton, Ohio.

TYPEWRITERS

TELEGRAPHIC, all standard makes, $10.00. Full details for COMPLETE list. Northwestern Telegraph Exchange, 121 N. Francisco Ave., Chicago.

WANTED TO BUY

Full value paid for old BOLD Jewelry, silver or plat- num. Packages returned if our offer not satisfactory. Palme Rare Coin Company, 353 Ave. G, Fort Worth, Texas.
In this standardized black shielding are housed the famous 220 audio and 231 output transformers, 222 output, 330 transformer input, 331 push-pull output, 332 mount, 332A and 230 power transformers, 331 Dose Rugs and 322 transformer bank. A new super-power full wave ABO supply transformer is on the way—type 328, at $10.00, for one or two 216S or 281 tubes.

Silver-Marshall now offers two smaller size audio transformers for replacement work in old sets, wherever price and size is a consideration. Type 36B audio transformer is equal or superior in the majority of high-grade audio transformers, but does not reproduce frequencies below 20 cycles to the extent that the famous 220 does. Its single-stage amplifier curve is shown above—two stages, the 242's afford practically the same 5000 cycle cut-off as the 220. Its frequency compensation curve is also shown above. 234 output transformer offers the same low frequency compensation as type 221 and 222. Due to their small size, these transformers will fit in almost any size of the older receivers, and once installed, will work wonders in tone quality improvement, for their performance nearly equals that of 220's and 222's. Size 3-3/8" high, 2-1/4" wide, 2-9/16" deep, weight 2 lbs. 4 oz. each. Price, 240 audio, 40.00, 244 output $4.00.

Lawrence Cochraney, for the preferred audio amplifier for the LC-26 receiver, uses two 240's and a 241 with an S-M power supply.

440 JEWELERS TIME SIGNAL AMPLIFIER

The S-M 440 Amplifier is a three-stage tuned R.F. amplifier and detector completely wired and sealed in a compact and attractive case. Tuned to 112 K., C., the 2677 meter wavelength of the U.S. Naval Observatory Station at Arlington, (N.A.A.).

Each of the four circuits of the amplifier is serially shielded. The selectivity is so great that interference from other wavelengths is impossible, while large low resistance tuned air core transformers, hermetically sealed, the amplification is tremendously higher than that of any 3-stage long wave amplifier that can be constructed from standard parts today. The 440 amplifier receiver construction and eliminates all pass work in transformer matching. Price $35.00.

SILVER-MARSHALL INC.
850 West Jackson Boulevard
CHICAGO, U.S.A.

The New Shielded Six Is Ready!
The Improved Shielded Six is ready, the very latest model of this excellent receiver which has over a year of successful and satisfying performance to its credit. The Improved model has vastly increased selectivity, greater distance getting ability, and the same fine tone that has made almost every builder say of the original "That's the finest set I've ever heard!"

This year the Six offers the additional possibilities of push-pull amplification with 210 tubes for the man who wants the utmost. All in all, the Six deserves the reputation as the finest tuned R.F. kit you can buy, equalled only by $200 to $400 factory built sets. Yet it's priced at but $59.00 for the complete kit, or $142.00 assembled, in cabinet, and guaranteed to satisfy you. S-M will be glad to tell owners how last year's model can be converted to the Improved Six, or push-pull 210 amplification installed with simple changes.

87% at 30 Cycles!

At 30 cycles, an S-M 220 audio transformer in a standard amplifier circuit gives 87% of the amplification obtained at 1000 cycles, while its curve is substantially flat from 100 to 1000 cycles. Above 2000 cycles, the curve for a single stage falls off gradually, while in a standard two stage amplifier circuit, the curve is substantially flat up to 5000 cycles above which frequency it falls off rapidly to keep static, heterodyne squeals and "set noise" at a minimum.

The above paragraph sums up at once the desirable characteristics of an audio amplifier for realistic recreation of broadcast programs, and the actual performance of S-M audio transformers. It is just this fact that has made 220's the choice of over half of the designers of the new 1927-28 circuits, for engineers know that the short cut to the finest of quality is to use S-M audios. Experienced fans know this too, as is proven by the fact that 220's have outsold every other transformer in their class by a wide margin for over a year. And S-M audios are signalized by being used in more broadcasting stations than any other types. WCAE, WBHM, WEBH, WTAQ, KGDJ, WLBF and many others. WCPY, the "Voice of Labor," checks quality on all programs with them. Nathaniel Baldwin, Inc., famous speaker experts, test with 220's and 221's.

Your guarantee of quality is to use S-M 220's and 221's in every circuit you build, and you'll find that over the popular 1927 and 1928 circuits will give you just this same guarantee of quality. But S-M promises unconditionally that you can improve any set by using 220's and 221's, and backs the promise by the offer of your money back if 220's and 221's don't give you more satisfactory quality than you've ever heard before.

The 220 audio is the biggest value on the market, and its performance measures up to its 4 pound size. It contains more steel and copper than any other transformer—the measure of transformer merit. Price $8.00.

221 output transformer not only protects load speakers against power tube plate currents, but compensates low frequencies for all loud speakers. Price $7.50, or with cord and tip jacks, No. 222, $8.00.

230 push-pull input and 231 push-pull output transformers are priced at $10.00 each.

COPPER SHOWS TRANSMISSION OF SILVER-MARSHALL TRANSFORMERS WHEN Operating OUT A TUBE HAVING A PLATE RESISTANCE OF 10,300 OHMS.
The BANDBOX
A 6 Tube Receiver of unmatchable quality at

$55

Many features of this set have been found here-tofore only in the most expensive radio. Since Crosley is licensed to manufacture under nearly all important radio patents, this combination with Crosley leadership and experience naturally produced an amazing radio, the remarkable value of which can be judged by the following features incorporated and by seeing it and hearing it at your dealers.

1. Completely shielded coils, condensers and wiring.
2. Acornizers for sharper tuning.
3. Completely balanced genuine nctrodynes.
4. Volume control.
5. Single tuning knob.
6. Illuminated dial.
7. Single cable outside connections.
8. Designed for easy installation in consoles.

AC model using new R.C.A. AC tubes and working directly from electric light socket through Crosley Power Converter is $65. Power Converter $60 extra. Hear this wonderful new contribution to the enjoyment of radio. If you cannot find one of the 16,000 Crosley dealers near you, write Dept. 63 for his name and literature.

Crosley is licensed to manufacture under patents of the Radio Corporation of America and associate companies. Also The Hallicrafters Corporation and Lamir Corporation.

The Crosley Radio Corporation, 9400 mt., Prosp. Cincinnati, Ohio

Crosley Radio is licensed only for Radio Amateur, Experimental and Broadcast Reception

Prices slightly higher west of
the Rocky Mountains

Shielding is necessary in a modern radio receiver. The more sensitive the set, the more you need it. Some sets are merely housed in a metal case. This helps to keep strong local signals from breaking through, but it is even more important to keep them where they belong after you get them the proper way from the antenna.

A set has tubes, condensers and coils. Here is the coil. The lines around it are the magnetic field. You know the earth's magnetic field will work a compass down in a mine, or up in a plane (it certainly worked for Liebergher) and the fields around unshielded coils get all mixed up and the set howls and squawks and has to be choked off by turning down the filaments in the tubes.

Now if the coils are housed in copper shields the fields can't mix each other up, and the tubes can do a real job of amplifying.

The coils in Crosley sets have these copper shields, and there isn't anything better.

Then there are the condensers, and if it wasn't for the shield around them, the fields would act like those in the coils, and the results would be just as bad, or worse.

It isn't enough to shield the coils and the condensers, because even the wiring of the set has fields around it. This too is shielded, as it is in all really high grade sets. Of course, it's all in knowing how to do it, and that's why Crosley sets can be as good as the best without costing half as much.
In This Issue
Quadrode Superheterodyne (With Blueprints)
Radio Age Short Wave Receiver
1928 "Nine-in-Line"
Aero-Seven
Camfield Super-Ten

Complete List of Broadcasting Stations
All Electric Radio

**The Randolph**

**7 Tubes-Single Control**

Just plug this Randolph Radio into the electric light socket—and tune in. A powerful, selective radio that gives dependable coast to coast reception. No batteries, chargers, eliminators, acids or liquids. Here is complete radio satisfaction whenever you want it. The easy tuning with one control brings on all stations. Illuminated drum allows you to operate the radio in the dark and has space for logging stations. Every detail of the Randolph is modern and perfected—it is the utmost in radio—unsurpassed regardless of price. It is this wonderful radio that you test and try for 30 days FREE before you buy. Listen to it in your own home. When it convinces you by actual performance it is the ideal radio—the one you have always hoped for—you can buy it direct at factory prices. Be sure you write for free descriptive literature today.

**Beautiful Ampliphonic Console**

Illustrated here is one of the beautiful Randolph Seven Console Models—made of the finest carefully selected heavy solid walnut, hand-rubbed and with burl finish. Has built-in genuine large cone speaker that compares with any on the market. Assures unlimited reception of high notes and low notes clear as a bell. Completely electric—uses no batteries of any kind. Be sure you send for fully illustrated, full color folder giving complete details.

**Genuine Walnut Cabinets**

The finest of heavy, genuine, solid burl finish walnut is used in the making of all Randolph cabinets. No picture can do them justice. You must see them to appreciate them.

**6-Tube Radio**

New, modern, single-control, six-tube radio. No other compares with it. Two-dial, six-tube sets selling for about the same price. The Randolph 1928 Senior SIX has been tested and approved by the leading radio engineers. Comes in beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated drum with space for logging. Absolutely dependable and very selective. Send for 30 days free trial. You test it before you buy.

**All Sets Guaranteed**


**USE THIS COUPON TODAY!**

Randolph Radio Corporation
711 West Lake Street, Dept. 236
Chicago, Illinois

Send me full particulars about the RANDOLPH Six and Seven-Tube Electric and Battery Table and Console Sets with details of your 30 Day FREE Trial Offer.

Name: __________________________
Address: ________________________
City: ____________________________ State: ________________

Mark here □ if interested in Agent's proposition.
If you want to get into the Radio Profession, or if you’re in it and want to get ahead—

Read This Announcement!

Here’s a message of importance to every man who hopes to better himself along the lines of Radio. Never before has there been a Radio training course that could be made to fit the needs of all—both experienced men who wish to better themselves and inexperienced men who wish to start from the beginning. There is one now: I am prepared to help the beginner start in Radio from the very beginning. And I am prepared to help the radio dealer, the experienced Radio operator, the Radio service man, the college engineering student, the graduate engineer, or the Radio fan, the “ham,” the factory or broadcast man who wants to get a more responsible job.

An old, established system of Radio home-study training has now been developed, improved, tested, and enlarged in scope so that now it not only will help anyone who wants to get into the Radio profession, but more, can be adapted to help almost any man now engaged in Radio (Radio engineers of experience and standing excepted).

If you want to get into Radio, or if you’re already in it and want to add to your knowledge and get ahead, let me send you my free 64-page book of information about this new and greater Radio training system.

The Good Jobs Pay $50, $75, up to $200 a Week—Some Pay More

If you’re earning a penny less than $50 a week, you’re not earning what you should be able to get out of Radio. Thoroughly-trained Radio men—men whose knowledge of Radio is practical and completely rounded out on every point—earn up to $200 and $250 a week. Radio is a new industry with plenty of fine positions unfilled. There are countless opportunities in Radio for a man to earn a splendid salary. But these are not opportunities as far as you are concerned, unless you are fully qualified for them. The only way to qualify is through knowledge—training—practical, complete training that fits you to get and to hold a better position in the Radio field.

For the beginner, I have a complete training that will take him from beginning to end. To the Radio dealer I’ll give the technical and practical knowledge he has to have. I will train him and bring him up to date the experienced Radio operator’s knowledge. I can take a Radio service man who has a pretty good idea of the “how” but very little idea of the “why” and give him the practical and theoretical knowledge he must have before he can hope to climb higher on the Radio ladder.

I can take the college engineering student, or the graduate engineer, who wishes to specialize in Radio, and give him what he needs.

What other line offers such an opportunity as Radio? From $1,000,000 a year in 1920 to $300,000,000 a year in 1926; from 1,000 persons engaged in Radio in 1920 to 300,000 in 1926. That’s its record. The accomplishment of television and the many other inventions constantly being made the same promise of the same boom for the future.

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My free 64-page book is filled with facts and photos relative to Radio and its opportunities, and tells all about my new and greater system of Radio training. Under my practical methods, you can study at home in your spare minutes, and get a thorough, clear, practical and expert knowledge of Radio in from 4 to 12 months. The time required depends on your previous knowledge, your ability, and the time you can spare for study. You keep right on with the job you have—no necessity for your leaving home or living on expense.

This proposition is open to anybody who is not satisfied with his job, his prospects, or his Radio knowledge. Regardless of how much you know already (or if you don’t know the first thing about Radio technically) I’ll fit my methods to suit your needs. No particular amount of general education is needed to start—many men I’ve trained didn’t even finish the grade schools.

If you want to enter into any correspondence about your own situation, anything you write will come directly to me and will be held strictly confidential. Send the coupon at the right, or write me a letter today.

Address: J. E. SMITH, President
National Radio Institute
“Oldest and Largest Radio Home-Study School in the World”
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Employment Service to all Graduates

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BRIEF articles on further organization of the Radio
Protective Association; Court Decision, Favors
A. R. R. L.; Survey of Radio Dealers' Stock made by
Government.

FOLLOWING our announcement in
the October issue we are publishing
this month the description of a super-
heterodyne circuit which presents
absolutely new features. But aside
from the unique phases of the receiver
it has qualities which will be sure to
make it popular. Mr. Freimann's arti-
cle on this Quadrode Superheterodyne
tells of the superior performance of the
set when carefully tested in our labora-
tory and makes it clear, also, that here
is an outfit that, despite its simplicity
of construction and operation, meas-
ures up to the best results obtained by
the more complicated superheterodynes.
Set builders who have hesitated to
tackle superheterodyne construction but
who have wished to do so, will find this
simplified super a dish to their taste.

* * *

Interest in set building and in kits
is maintained at a mark that scarcely
would have been predicted a year ago.
It appears that the anticipated falling
off in "how-to-make" radio has not de-
veloped. On the other hand there are
general signs of increased interest.

One sure register of technical radio
interest is to be found in our corre-
spondence from fans. They are more
enlightened as to what they want than
they were two or three years ago but
they are just as enthusiastic. It had
been a rather commonly heard predic-
tion that interest in technical radio
would slump off sharply after the first
glow of enthusiasm, just as interest in
automotive engineering and interest in
talking machine mechanics died away.
But it is now apparent that there will
remain indefinitely a large number of
fans who will not be satisfied unless
they can make their own.
Radio is better with Battery Power

NOT because they are new in themselves, but because they make possible modern perfection of radio reception, batteries are the modern source of radio power.

Today's radio sets were produced not merely to make something new, but to give you new enjoyment. That they will do. New pleasures await you; more especially if you use Battery Power. Never were receivers so sensitive, loud-speakers so faithful; never has the need been so imperative for pure DC, Direct Current, that batteries provide. You must operate your set with current that is smooth, uniform, steady. Only such current is noiseless, free from disturbing sounds and false tonal effects. And only from batteries can such current be had.

So batteries are needful if you would bring to your home the best that radio has to offer. Choose the Eveready Layerbilt “B” Battery No. 486, modern in construction, developed exclusively by Eveready to bring new life and vigor to an old principle—actually the best and longest-lasting Eveready Battery ever built. It gives you Battery Power for such a long time that you will find the cost and effort of infrequent replacement small indeed beside the modern perfection of reception that Battery Power makes possible.

NATIONAL CARBON CO., INC.
New York San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night
—9 P. M., Eastern Standard Time

WEAE—New York WOC—Davenport
WJAR—Providence WVOO—St. Paul
WEZ—Boston WAKR—St. Louis
WFB—Philadelphia WGR—Buffalo
WCAE—Pittsburgh WRC—Washington
WSAI—Cincinnati WGY—Schenectady
WANT—Cleveland WHAS—Louisville
WWJ—Detroit WSB—Atlanta
WGN—Chicago WSM—Nashville
WMC—Memphis

Pacific Coast Stations—
9 P. M., Pacific Standard Time
KPO—KGO—San Francisco KFI—Los Angeles
KFOA—KOMO—Seattle KGW—Portland

Here is the Eveready Layerbilt “B” Battery No. 486, Eveready’s longest-lasting provider of Battery Power.

The air is full of things you shouldn’t miss
SIXTEEN REMLER REASONS WHY!

1. Readily changeable, white cardboard indicator strips. Supplied for clock-wise or counter-clock-wise reading.
2. Large, easily read figures.
3. Space provided for call letters.
4. Attractive bronze escutcheon plate.
5. Station Settings spread over 15 inches of space.
6. Heavy brass bracket supports condenser; rigid construction.
8. Vernier control; Special shaft cannot bind in bushing.
9. Round hole for escutcheon plate; no special tools necessary.
10. Right or left hand control.

REMLER Drum Dial

1. 360° rotation of shaft and reduction drive give vernier control.
2. Proper placing of insulating material minimizes resistance to radio frequency currents.
3. Complete insulation of plates from dial and dial shaft and provision for grounding dial and shaft give absolute freedom from body capacity effects.
4. Plates carefully aligned by hand and soldered rigidly in position at three points.
6. Shape of plates permits attainment of very low minimum capacity and wide tuning range.

REMLER Twin-Rotor Condenser

REMLER Gang CONDENSERS—both 2-in-line and 3-in-line—incorporate all the advantages of the Twin-Rotor Condenser. No common rotor. Balancing condensers provided.

NINE YEARS OF RADIO EXPERIENCE
The Radio Age Short Wave Receiver

This instrument was designed and built in the laboratory of the Radio Age testing station, 9BRE

THERE is as much room below 100 meters as there is above, and in fact, a lot more. To the average person this territory is so much wilderness infested by wild Hams and kindred parasites. In other words, a refuge for those who don't dare go anywhere else. Maybe so. Then, why is it that the mightiest radio interests in the world are fighting for a slice of this useless ether for their individual employment? The answer is simple; the short waves are the most valuable of all the channels. Phenomenal distances are covered with ease, it takes only hundredth as much power to bridge a gap as on 300 meters, tuning is so sharp there is practically no interference.

Here may be found powerful transatlantic stations which keep a twenty-four hour schedule, amateurs in all parts of the world, KDKA and twenty other short wave phone broadcasters, as well as numerous foreign phone stations, the Navy and private interests.

It should not be understood that the short wave receiver belongs merely to the amateur who can read code. Broadcast listeners who have not the slightest knowledge of dots and dashes have new and wonderful fields of entertainment opened to them by the short wave set. Not only may the broadcast listener enjoy delightful programs on the low waves (not possible to get on ordinary receivers) but they can bring in these programs from a distance in the daylight hours and under adverse weather conditions that would possibly prevent reception on the higher waves.

Just recently the Puget Sound tug boats were equipped with short wave radiophones. Any one is free to listen who so desires. The broadcasters run some excellent programs, and there is no jamming and interference as on the higher channels. World history has been made on short waves. When Byrd flew over the North Pole he informed the world of the fact on short waves, and again while he crossed the Atlantic. The only clinch to the fate of several flyers was received on short waves. Most all airplanes that have radio use short waves. Numerous expeditions in the remotest corners of the world keep in touch with the home office on short waves. The famous Catalina
Channel swim was scooped on short waves before other mediums could function. All this is free to him who has a short wave receiver.

The only requisite is a knowledge of the code. This is easy to master. Conscientious endeavor will familiarize one to such an extent the funny buzzes cease to be static and become letters spelling words, connected together into sentences. It is a great thrill to hear a mess of dots and dashes slowly evolve into a serious statement that an expedition has just discovered something new, or a great catastrophe has befallen someone. Those of us who heard the Dallas Spirit fall know this only too well. The results are worth the effort.

Before any signals may be heard a receiver must be built, so let us roll up our sleeves and get busy. The parts selected are those which have proved their worth time and again. They are all standard and may be obtained on the open market. We chose them carefully, picking those which performed best in the combination of the finished receiver.

Now that all the parts contained in the list are on hand we will lay out our panel and baseboard. This should always be done before a single hole is drilled. Quite often it will be found that a certain instrument must be moved a fraction of an inch to make room for another. If it is already mounted this cannot be done without leaving unsightly holes. The only correct way to lay out a panel is by using a square and a pair of dividers. It is slow and often tedious but the results are accurate. We have already done this, and the readers may avail themselves of our efforts by obtaining the drilling templets supplied by the service department of this publication at a cost of twenty-five cents. Paste this templet to the panel and with a centerpunch and hammer make an indentation for every hole. Care must be used, both to make sure the impression is in the correct spot, and also that a light enough blow is struck not to crack the panel. The correct size drill is indicated, as well as countersunk holes.

Rubber is used for panel and baseboard because it is the best dielectric obtainable in workable form, and it is far easier to handle than other insulating materials.

The instruments to be mounted on the panel are the two tuning condensers, the rheostat and cord tip jacks. Next we will fasten the two brackets to the panel, and in turn subpanel to them. The chassis is now complete, ready for the instruments to be mounted.

It will be noted that the coil jacks are removed from the supporting strip furnished by the manufacturer and placed directly in the subpanel. This shortens the leads considerably, makes a neater set and allows all the connections to be made on the under side.

The grid condenser and leak are mounted on the under side of the subpanel, placing them in a position where the leads will be shortest. Mounting screws are furnished with the condenser, as well as clips to contain the grid leak.

Surface mounting sockets are used, for as many leads are above the subpanel as below and it is just as easy to have the leads going down as it is to have them coming up.

In wiring, about five lengths of square wire is used. (Continued on page 36)
The Aero-Seven Receiver

The design of the Aero-Seven receiver is one of distinction in the radio field. It claims several new features as follows: A special feature eliminating the objectionable detuning of the first stage of radio frequency amplification by the antenna, a common defect in many so-called single dial sets; the use of Aero Universal Coils, which are tapped in such a way as to allow the use of the new high-mu tubes for radio frequency amplifiers, with a considerable gain both in the sensitivity and the selectivity of the receiver; the use of these tubes in a perfectly balanced resistance coupled amplifier to produce exceptional tone quality and volume; and the embodiment of a special foundation unit consisting of drilled and decorated panels, with mounting brackets so that the construction of the receiver is simplified to an assembly operation. A front view of the completed receiver, Figure 1, shows the workmanlike appearance of the receiver that may be constructed by the home builder.

Many of the present-day single control receivers have the first radio frequency transformer tuned by one of the units of the gang condenser. In spite of any care in matching of the coils and condensers there is no provision made against the detuning of the first stage by antennas of different electrical characteristics. This effect is not noted in the succeeding stages as the other transformers each operate out of the plate circuits of similar tubes and hence similar impedances. A very simple means has been resorted to in the design of the Aero-Seven in order to eliminate this defect. As will be seen in the circuit diagram, Figure 2, the antenna is connected across the 1,000-ohm resistor in the grid circuit of the first radio frequency tube, thereby allowing the first R. F. transformer to operate out of the impedance of a tube in similar manner to the rest of the transformers in the receiver. The size of this resistor has been carefully chosen so as to permit the voltages set up in the antenna to be effectively transferred to the grid of the first amplifier tube.

As will be seen from the circuit diagram, the remainder of the radio frequency features are the tried and tested standards of the past, with the exception of the employment of high-mu tubes as radio frequency amplifiers. This feature is made possible by the design of the Aero Universal Coil. This coil is an arrangement of an exceptionally efficient, secondary construction that has been on the market for several years, with a primary arrangement so as to get the most effective coupling coefficient to the secondary and tapped so as to produce primary impedances of widely varying values on the different taps. The highest of these values is secured by the use of tap No. 1 as the plate and the No. 4 tap as the B battery connection, as shown in the circuit diagram. When employed in this connection the impedance is of such a value as to perform very effectively with the high-mu tubes now on the market, such as the UX240 and the CX240. At the plate potential used (90 volts), these tubes on the average show a figure of merit, as generally accepted in engineering work, of 1.6 times the figure of merit for the usual 201A type of construction. This figure of merit may be realized in the design of a practical receiver either in selectivity or in amplification, or partially in both. In the design of the Aero Universal Coil the primary impedance was so proportioned as to conform to the latter possibility. The result is an extremely sensitive receiver of extreme selectivity.

An innovation in the matching of the radio frequency stages has been employed by matching the Aero coils in kits of three at two widely separated frequencies in the broadcast band. It has been found after considerable investigation of the subject that if two or more coils match at one wavelength they will not necessarily match at another wavelength at the other end of the broadcast band. In order to prevent the receiver from falling out of tune at one end of the dial and in at other points of the dials, the Aero coils are matched at the factory at 250 meters and also at 500 meters. It has been found that by matching the coils in this manner that they will be sure of maintaining the same inductance over the whole broadcast band. The Ameco gang condenser used to tune these coils is one of exceptional accuracy and is provided with small compensating capacities to adjust for small differences in the wiring and tube capacities of the various stages. This adjustment will be described later.

Preliminary to constructing the AERO-SEVEN, a word about the Aero Nokskip No. 60 choke coil used in the set. It has two nuts at the mounting end, the outer one of which is the only one supposed to be removed by the set constructor. The remaining one is intended to hold the engraved bakelite disc at the same end in place, and should not be removed. The Aero Nokskip No. 60 choke coil is made of very fine wire, of especial design, and we caution you against substituting other chokes in circuits where it is recommended. Furthermore, we like to tell you not to tamper with it on the inside because of the very fine wire. Each one is tested at the factory, and is mechanically and electrically

Figure 1—Front panel view of the Aero-Seven Receiver

Figure 2—Schematic diagram of the Aero-Seven.
trically without defects. If, however, regard-
less of the above instructions, the choke is taken apart, be careful of
the very fine wire in putting it together
again.
If, in the latter event, your set fails to
function, you have broken the very fine
wire in this choke. In which case, you
should have it repaired or purchase a new
one.
In the assembly of the receiver the sub-
panel is the best starting point, as most
of the work may be done on it without
putting on the front panel, thus allowing
the work to progress unhindered. Look-
ing at Figure 3, we see the back of the
assembly. The first radio frequency tube
socket is partially hidden behind the first
radio frequency coil, but is mounted with
one screw so that the grid and plate ter-
minals are nearest the first Aero coil.
Across the back of the panel are mounted
the second two radio frequency tube sock-
ets in the same direction as the one pre-
vious. This places the grid and plate con-
nections closest to the points to which
they are to connect. Next, closer to the
front panel side and in succession, are
mounted the Amsco cushion detector socket
and the three audio sockets. If these lat-
ter are mounted with the grid and plate
terminals toward the binding post holes
and the Amsco resistor couplers directly
behind, a practically direct connection is
secured to the plate and grid terminals.
In the blank space in front of the radio
frequency coils and sockets is mounted the
Amsco triplet condenser. Four brackets
are supplied with this condenser, which
may be secured by carefully removing the
nuts at the corner bracing rods, one at a
time, and placing the long side of the
bracket over the stud and replacing the
nut firmly. The brackets should be
mounted on the side opposite the small
adjustment condensers, so that in mount-
ing these adjustments will be perfectly ac-
cessible. The condenser is then bolted
down to the subpanel with the shaft ex-
tending near the center of the receiver.
The panel brackets should now be put
on so as to support the subpanel while
working. All the minor accessories, such
as binding posts, condensers, etc., may
now be put on before the receiver is wired.
These accessories are better shown in the
bottom view, Figure 4. Holes are provided
for all these fittings and in some cases
holes which were used to hold objects to
the top of the panel are used for one or
both ends of another object on the bottom.
Looking at Figure 3, we have from right
to left, the 1,000-ohm Carter resistor used
in the antenna input circuit, the Carter
$1/2$-mf. bypass used across the potentiom-
eter, another across the 90-volt B sup-
ply, the Amsco resistor mounting with
grid leak, the .001 bypass across the plate
and filament of the detector tube, and the
Carter 1-ohm resistor for the "A" circuit.
After all these have been mounted the
subpanel is ready to wire in accordance
with the circuit diagram, Figure 2. The
wiring is so simple that most of it can be
followed out from the photographs. It
should be noted that in most cases where
a circuit is to pass through the subpanel
that a hole has been provided in the drill-
ing of the foundation unit, and where no
hole is provided the lead is intended to
pass through the panel by use of the near-
est mounting screw of that piece of ap-
paratus.
The bracket from the Silver-Marshall
drum dial should now be mounted under
single hole mount nut of the condenser
and the front panel prepared. The dial
plate should be mounted on the panel with
the Carter 200-ohm potentiometer at the
left, the rheostat at the right, and the
battery switch below, the connection screws
of both pointing downward. This done,
the panel may be screwed to the assembly
by means of the panel bracket holes and
the holes in the drum dial bracket. Care
should be taken that the shaft and collar
assembly of the drum dial are in place be-
fore putting on the panel. Now, by put-
ting on the drum and with a screw driver
inserted in the lips of the shaft mechanism
the drum may be slid along the condenser
shaft and into the aperture of the drive
shaft and released. At the same time the
dial should read 100 degrees with the con-
denser plates full in and the set screw is
then locked on the condenser shaft.
The remainder of the wiring to the po-
tentiometer and rheostat may now be com-
pleted and the receiver is ready to set up.‌

(Continued on page 28)
1928 Nine-in-Line Super-Heterodyne

Figure 4—Schematic diagram of the Nine-in-Line.

The H F L Nine-in-Line Super-Heterodyne certainly needs no introduction to radio fans since in the past two years it has been one of the leading receivers. This receiver delighted thousands of radio DX fans in its remarkable ability to extract stations in remote and distant corners of the United States—and even foreign stations—through the conglomeration of powerful local broadcasters in congested areas such as represented here in Chicago. No doubt many who built the set last year feel that it couldn’t be improved upon.

There are refinements in the 1928 receiver which will attract the man who has already built the set and the new prospect for a receiver capable of getting distance under the present conditions and still preserve the fine qualities of music and speech as they are presented from the broadcasting stations. The outstanding refinements are the new audio transformers which have the characteristic of reproducing all the notes with uniform intensity so that an orchestra, for instance, will sound like the orchestra playing in the ballroom of a large hotel and not like an orchestra playing the same melody yet distinctively different from the original. That is, the low notes, mediocre notes and high notes are relatively the same as they burst forth from the loud speaker. The new Remler drum dials are here incorporated giving the set a snappy finished appearance and making the tuning easier.

The simplicity of assembling and wiring the set, which has been in the past one of the outstanding features, is well retained. All the leads are extremely short and direct which also adds to the electrical efficiency of the receiver. As can be readily observed from the name Nine-in-Line, nine tubes are used in the receiver. A first detector, four intermediate stages of amplification (using three iron core untuned transformers and two sharply peaked transformers), one oscillator, one second detector and the conventional two stages of audio frequency.

The receiver built in the laboratory of the RADIO AGE a few weeks previous to the writing of this article produced very gratifying results. The first night it was tried, a Sunday night, stations from coast to coast were easily tuned in. KFI, the west coast criterion, was brought in with ample volume to fill a room with music. It being Sunday night there were, of course, not quite as many local stations on the air as on an ordinary week day night. The tone quality is very good. The set tunes smoothly without breaking into annoying oscillations and was as a whole very easy to operate. A very

Figure 1—Photograph of complete set.
smooth volume control is provided to afford signals that can be heard a block away or in just a whisper.

Assembling and wiring the set was an interesting operation. All the parts coordinated perfectly. There is available on the market a front and sub-panel already drilled for the parts to be mounted thereto. As the parts are taken out of the boxes they are screwed down to the sub-panel in the proper places as indicated in Figure 2. Soldering lugs should be inserted on all the machine screws holding the transformers to the panel and also on all the filament terminals of the tube sockets, for electrical connections. Most of the lugs from the plate grid terminal of the transformers should be soldered directly to the tube sockets making practically no leads. Solid bus bar wire can be conveniently used in wiring up the set and the lugs bent so that the wires will be straight or at an angle. This gives the set a very neat and commercial appearance. Spring washers beneath all nuts are a great advantage as they prevent the nuts from loosening and making a poor electrical connection.

Assembling the new drum dial and condenser is probably a novel experience but as the fittings are quite obvious there is no difficulty. On the right hand dial, however, slight changes may have to be made so that the condenser will be mounted the opposite way from the left hand condenser. This is simply a changing of the position of the shaft and putting on another gear provided for that purpose with (Continued on page 32)
Radio is, and as it is most progressing, and we have before us today the Campfield Super-Selective Ten, which combines a Tuned Radio Frequency circuit and the Super-Heterodyne.

This remarkable receiver functions best when used with an aerial and ground. It is well known that even the most diminutive of aerials picks up more current than a loop. The only reason aerials and supers were not used together long ago was that the super refused to differentiate between stations. It could not handle all the power collected by the antenna.

By consulting the diagram one will readily see how this trick is possible. Three stages of radio frequency amplification are placed ahead of the detector, one untuned, the others governed by a three gang condenser.

The untuned stage acts as a ballast, stabilizing the circuit and greatly retarding unwanted oscillation. This receiver positively will not squeal nor howl when being tuned.

Tuning is extremely sharp, due to the employment of a new device on the market, a 10 Kilocycle Band Pass Filter. This device prevents stray waves from visiting the second detector. Only the frequency to which the first detector is tuned is allowed to pass. This is quite desirable for use in metropolitan districts for it enables one to tune right through the high powered ether paralyzer next door and drag in the favorite back in the old home town. The Campfield Super-Selective Ten is the first receiver to make use of a filter circuit of this sort, and by the way it works it will not be long till there are plenty of others.

Tone quality is perfect. Sharply peaked intermediates are avoided and the filter allows a sufficient breadth of channel to let the overtones and musical side bands pass undisturbed. This means that the full musical scale is faithfully reproduced, from the deepest growl to the highest squeak.

Now that we have made an appeal both to the man who hates QRM and the lover of fine music we will also include the midnight prowler who is satisfied with nothing short of Manila or Cape Town. This receiver is sensitive, very much so. There are three stages of radio frequency amplification ahead of the first detector. No matter how many tubes after this first detector, signals are heard no farther than it is able to detect. There is a minimum point of audibility, below which no sound is heard. With the additional radio frequency tubes ahead, this point of audibility may be considerably lowered giving phenomenal range. D. X. is a matter of selection of tubes, batteries, aerial and ground, coupled with patience and skill on the part of the operator. Many new trans-Atlantic records will be made this winter with the Campfield Super-Selective Ten.

There are only two tuning controls, because most of us have but two hands. That is all that is needed anyway for they do the work to perfection.

The three T. R. F. condensers must be

---

**The Campfield Super-Selective Ten**
LIST OF PARTS

1 251 Camfield .00025 mfd. Variable Condenser
2 351 Camfield .00035 mfd. Variable Condenser
1 10 inch Camfield Steel Shaft
4 pair Camfield Condenser Support Brackets
1 Camfield Kit of 3 Camfield Type 44 Duoformers
1 620 Camfield Oscillator Coupler
1 10KC Rusco Band Pass Filter
2 95KC Rusco Transformers
1 Carter .001 mfd. Fixed Condenser
1—IR400 Carter 400 ohm Potentiometer
1—MW2000 Carter 2000 ohm Potentiometer
2 105 Carter .5 mfd. By-Pass Condensers
2 Carter .00025 mfd. Grid Condensers with Clips
2 Lynch 2 Meg ohm Grid Leaks
2 330 Tyman Audio Transformers
1 Tyman Double Vernier Drum Dial
1 10 Carter Battery Switch
1 6 Carter Jack Switch
2 Carter 750 ohm Resistances
2 Carter Tip Jacks
10 9044 Benjamin Sockets
3 Karas Sub-Panel Brackets
2 Engraved Eby Binding Posts
1 PM Jones Multiplug
2 4A Amperites
1 3A Amperites
1 Celeron 7" x 30" x 3/16" Drilled and Engraved Front Panel
1 Celeron 10" x 29" x 3/16" Drilled Sub-Panel
40 Feet Acme Celatsite Wire

Graphic chart of the Camfield Super-Selective Ten

synchronized down to a hairs breadth, or
the set won't work. This sounds formidable, but it is simple. Tune in a station
and then disengage the set screw for two
of the condensers and adjust till in resonance
with the third. An hour is plenty of time for this.

One advantage in building this receiver
is that it may be constructed in two sections if desired. One will notice by con-
sulting the diagram that the receiver may be
either a six tube T. R. F. or a ten tube super, at the throw of a switch. The
switch connects the first detector tube di-
rectly to the audio amplifier in one posi-
tion, and when thrown to the other, lights
the super tubes and connects the oscillator, inter-
mediates and second detector. A more
desirable arrangement than this cannot be
found.

The super has been considered the most
satisfactory circuit for use under condi-
tions formerly prevailing. But broadcasters
have increased power and crowded to-
gether till the overlapping of harmonics
has become a serious matter. In fact it is
so bad in certain localities the beat note
of one station may be used as a heterodyne
for another, making it possible to remove
the oscillator tube from the socket and still have perfect reception, if such cir-
cumstances may be called perfect.

A super designed to function on an in-
termediate frequency of 50 kilocycles or
thereabouts will pick up the local sta-
tions regardless of the oscillator dial set-
ting if there happens to be another station
on the air in the neighborhood having a
frequency either 50 kilocycles above or
below the one intended to be heard. Need-
less to say, results are far from gratifying.

In the Super Ten this condition is en-
tirely eliminated as intermediate frequency
transformers, peaked at 95 kilocycles, are
used. There are no stations in the United
States that are exactly 95 kilocycles apart.
This frequency coupled with the three
stages of T. R. F. spells freedom from
harmonic interference.

The filter used in this receiver has been
designed to pass a band of frequencies 10
kilocycles wide between 90 and 100 kilo-
cycles. All frequencies lying within this
range are amplified equally by the inter-
mediate stages. The filter is designed to
cut off very sharply on both sides of this
band, and the circuit, therefore, has ex-
cellent selectivity.

It must be remembered that the fre-
quency of a broadcasting station at any
given wavelength is not absolutely con-
stant. It is modulated by the frequency
of the voice or music being transmitted
and therefore varies within 5 kilocycles of
the rated frequency, either above or below.
If a circuit is not designed to give prac-
tically uniform amplification over a band
of frequencies 5 kilocycles above or below
that of the incoming wave, some of the
voice or music frequencies will not be
(Continued on page 28)

Bottom View of Camfield Super-Selective Ten
We are bringing to our readers a new super-heterodyne which we know will be met with enthusiasm. We have long been wondering why the Quadrode Vacuum Tube (four electrode) was not adapted to the many possibilities which this interesting tube affords. A month ago we started working towards a super-heterodyne of a highly efficient nature which would be simple enough to attract the man who, because of its complicated character, has been afraid to build a super-heterodyne. We planned a super-heterodyne simple enough in construction to be built by one who has had little or even no experience with radio receivers and yet a super-heterodyne as generally efficient as the most complicated of receivers we know today. And here the Quadrode Vacuum tube immediately presented itself as the solution for a simple mixer circuit.

Fortunately we already have on the market a highly efficient intermediate frequency amplifier which we immediately decided to use in our new receiver, due to its simplicity and high amplifying ability. The amplifier was described in the October issue of RADIO AGE and is already familiar to the radio experimenter as the S-M 440 Jewelers Time Signal receiver, manufactured by Silver-Marshall, Inc. This instrument itself reduces the complications of the super-heterodyne many fold. Instead of having a series of transformers to wire up into an intermediate amplifier—complications which entail dozens of connections, not to mention the worries as to whether or not the transformers are matched—the S-M 440 amplifier merely has eight connections to be made to the associated parts of the receiver.

The one tube mixer, the S-M catacomb, and a simple two-stage audio amplifier constitute the unique Quadrode Super-heterodyne shown in the photograph, Figure 1.

The special tube which serves the dual purpose of detector and oscillator more efficiently than the conventional two-tube circuit, needs perhaps some description as very little publicity has been given this very excellent tube in this country. In foreign countries its merits are more fully recognized and the tube is more commonly in use, whereas here in America there has been no such device developed and made available until this late date.

The Voltron Quadrode we are here employing is the development of the K & H Electrical Corporation, and consists of a very substantial filament, two grids, one on each side of the filament, and a common plate. The characteristics of each side of the tube is practically identical, that is, the inter-electrode impedance and capacity is the same. Double grid tubes that have previously made their debut on the market are the type having one grid within the other. A tube of this kind has two decidedly different characteristics, one equivalent to a High Mu (high amplification and very high plate resistance) and the other a Low Mu; therefore the tube does not lend itself to all purposes. The Voltron Quadrode looks externally exactly like any other tube of the more common type except for the base, which has five points instead of four, so spaced that the tube can be plugged into a socket designed for a five prong type of tube.

The connections on the socket can be followed according to the way the socket is marked except the cathode connection (the extra connection) which is the additional grid. The plate resistance of the tube is about 20,000 ohms.

The Quadrode Super-heterodyne is not only simple in construction but easy in tuning as well, since there are no regeneration controls and since there is no possibility for the detector circuit to oscillate; yet regeneration is always present in the detector circuit, thus increasing the sensitivity and selectivity of the set. The two dials run together over the whole wave length range with a deviation of less than five points. This makes the set particularly easy to tune because one knows that the dials are in resonance as long as the numbers on the dials correspond.

The set can be used on either an inside loop aerial or a short outside aerial. Most of the experiments were conducted with a wire connected through a small condenser to the house lighting system as an antenna. In this manner KFI was received with enough volume for good loud
Power Amplification With Tone

The Jewelers Time Signal Amplifier

The Silver-Marshall 440 Jewelers Time Signal Amplifier is a three stage R. F. amplifier and detector completely wired and sealed in a copper and brass catacomb and tuned exactly to 112 K. C., the 2677 meter wavelength of the U. S. Naval Observatory Station at Arlington (NAA).

Each of the four circuits of the amplifier is sectionally shielded. The selectivity is so great that interference from other wavelengths is impossible. The amplification is tremendous—higher than that of any 8-stage long wave amplifier that can be constructed from standard parts today. Thousands have been sold, for it's the best long wave amplifier ever developed. The 440 simplifies construction and eliminates all guesswork. Price $35.00.

New S-M Transformers

Two new S-M audio transformers are now available and chosen for the Quadrode Receiver. Type 240, 3:1 ratio audio provides practically the same characteristics as the famous S-M 220, the largest selling high grade audio transformer, except for slightly less accentuation of notes below 80 to 100 cycles. Type 241 output protects speaker windings and boosts low note reproduction. Used together, a pair of 240's and a 241 provide an ideal audio amplifier in small space, at low cost, and with low power consumption—and they provide the 5000 cycle cut-off so necessary under present broadcast conditions to keep heterodyne squeals and noise at a minimum. Due to their small size, these transformers will fit in almost any of the older receivers, and once installed, will work wonders in tone quality improvement. Size 3 7-16 inches high, 2 1-4 inches wide, 2 5-8 inches deep, weight 2 lbs. 4 oz. each. Price, 240 audio, $6.00; 241 output $5.00.

S-M audio transformers hold the record again this season—for the largest sales in their class—and again for specification for more circuits than any other type!

Do you know that no matter what kind of a set you have, by adding an S-M Unipac you can eliminate all B and C batteries and add power amplification that will give you tone quality obtainable by no other method—not even with the most expensive of the new sets?

The 660-210 push-pull Unipac is a light socket-push-pull 210 power amplifier stage (and receiver B supply) far superior to any other power pack you can buy. It will give from five to fifteen or more times the power you can get from any other 210 power pack—in fact, it is the finest amplifier ever offered. It is priced at $83.25 for the kit.

Then there's the new 660-171A Unipac, a similar model for 112 or 171 tubes that will far outperform ordinary 210 packs, and it also supplies ABC power for any receiver at all using A. C. tubes. It is priced at $66.00.

The 660-240 Unipac, a two stage amplifier and B supply for any set at all, is the choice of L. M. Cockaday for his LC-28 set, and of Glen Browning for the new two tube Browning-Drake. It is priced at $81.25 for the kit, and uses one 210 amplifier, one 226 A. C. amplifier, two 216B or 281 rectifiers and one 874 ballast tube.

SILVER-MARSHALL, INC.
850 West Jackson Blvd. Chicago, Ill.
speaker operation. The set was equally sensitive when using a loop for the pick-up. Due to the high amplification of the intermediate frequency amplifier a large antenna was found unnecessary. Ten kilocycle separation between stations is very practical. Only when too close to a powerful station is a separation of more than ten to twenty kilocycles necessary to bring in distant stations. Due to the splendid characteristics of the new S-M 240 audio frequency transformers which are employed in this receiver, very accurate reproduction of the distant music and voice is realized. There is no drummy sound to the music even when stations from a great distance are received. All in all the quality is beautiful.

The highest grade materials available on the market are used in the make-up of this receiver, yet the set can be built for about $90.00 which is within reach of many builders who have found the more expensive super-heterodynes restricted because of the cost in building. This set is unusually compact. With the present tendency towards receiving twenty-six inches and longer, the Quadrode Super-heterodyne is a delightful contrast, being only twenty-one inches long, seven inches high and ten inches deep. Nevertheless the parts are not so crowded as to hamper greatest efficiency in operation. This set indeed has a portable feature.

Seven tubes are used, one Voltron double grid tube, five Voltron 201A tubes and one Voltron 171 power tube. The Quadrode in the mixer circuit, four 201A’s in the S-M Oscillator, 1,201 in the first stage of audio—and the power tube, of course, in the last stage. A Yaency cable plug and connector for the batteries is used making the connecting and disconnecting of the set a matter of seconds.

The schematic wiring diagram is shown in the blue-print, Figure 2. The mixer circuit of all Quadrodes, the antenna coupling U99 and its tuning condenser C1. This is the in-put circuit to the tube. Four binding posts are used so that either a wire antenna or loop can be used. If the antenna is used, the ground is connected to G-post and the antenna to A-post while the other two binding posts are connected together by a piece of wire completing the circuit from the secondary of the coil to the grid condenser. When a loop is used, the terminals are connected to the two outside binding posts, with the connector between the shorted binding posts is removed thus connecting the loop directly across the tuning condenser C1. If the wire between the upper two posts is not removed, the secondary of the coil will be connected across the loop and interfere with its operation. U100 is the oscillator coupling and C2 its tuning condenser. As can be observed, the plate of the tube is common to both the in-put circuit (detector circuit), the oscillator circuit, and the first intermediate transformer. In other words, there are three frequencies in this one circuit, the frequency of the station which is desired, the frequency to which the oscillator is tuned, and the beat frequency which is the difference in frequency between the station frequency and the oscillator frequency. The beat frequency is that to which the intermediate frequency amplifier is tuned, namely 112 kilocycles. The pickup coil is entirely eliminated. It is apparent that there is no need for the pick-up coil since all three frequencies are already in the plate circuit of the mixer tube.

To illustrate this we will suppose that WMAQ is desired and condenser C1 is tuned so that the secondary circuit of the antenna coupler will be in resonance with 670 kilocycles (448 meters) than the oscillator condenser C2 must be tuned to 568 kilocycles. These two frequencies combined net a frequency difference of 112 kilocycles which will be amplified to a very large value by the intermediate frequency amplifier, then rectified by the second detector which is incorporated in the S-M 440, and then amplified to any desired volume by the two audio frequency stages. The oscillator condenser is always tuned to a frequency lower by 112 kilocycles than that of the desired broadcasting station frequency. The .001 mfd condenser in series with the oscillator tuning condenser straightens the tuning characteristics of this circuit so that the dial readings on the in-put, or antenna, and oscillator circuit will always be alike. Only on stations lower than 350 meters is it possible to use the "upper setting" or the frequency higher by 112 kilocycles than that of the station frequency, thus preventing repeating of the low wave stations on the upper part of the dial to a marked degree.

The S-M Jewelers Time Signal receiver designed to receive the time signals from NAA on 112 kilocycles works at an ideal frequency for a super-heterodyne amplifier because the two oscillator settings are so wide apart (224 kilocycles). When the oscillator is set to the lower setting and the local station should be 224 kilocycles lower, the possibility of interference is very much reduced because of the great percentage of difference in frequency from that of the station which is desired. If the intermediate amplifier was tuned to half that frequency or about 55 kilocycles, the percentage of interference would be twice as great. Thus the advantage of working on a high intermediate frequency is readily apparent. Each stage of the S-M 440 amplifier is carefully shielded so that no energy is fed from one stage back to another due to coupling between stages and this makes a much higher gain per stage possible than with the usual transformers mounted in a row. Accurately tuned air-core transformers are in each stage. These transformers are all identical so that each stage is tuned to the same frequency making a perfect frequency band pass about ten kilocycles wide.

Amplification and oscillation in the S-M 440 is controlled with a 200 ohm potentiometer which is connected across the filament terminals of the mixer tube. The terminal to the right, number 3, should be connected to the negative lead, and the left hand terminal, number 1, should be connected to the positive lead. When the knob of the potentiometer is turned to the right, the grid of the tubes become less positive in potential and the amplification is increased. When the knob is turned to the left, the potential on the grid is more positive and the amplification is increased. When the knob is turned to maximum—the extreme right—no positive potential will be impressed on the grids of the intermediate frequency tubes and oscillation in the amplifier will likely result. The maximum amplification is at the point just below which the tubes start going into oscillation. As the amplification is increased by making the grids less positive, the selectivity is also slightly increased, and as the amplification is decreased due to an increased positive potential on the grids, the selectivity of the amplifier diminishes. This is a very desirable characteristic since the quality on local stations will be better when the intermediate amplifier is a little broader. As the amplification is increased to receive distant stations, the selectivity of the amplifier automatically increases, which is very advantageous in cutting through the locals.

By-pass condensers C5 and C6 are quite essential, especially when the set is operated on a "B" battery eliminator. One condenser is connected from terminal B, where the 45 volt lead terminates from the detectors, to the amplifier case, and the other condenser is connected from N on the S-M 440 amplifier to the case. The copper housing is already connected to the negative A terminal inside the amplifier. The second detector in the amplifier is biased by 4½ volts negative. This is used in preference to a grid condenser and leak because with this method a larger out-put from the intermediate frequency stages can be handled without distortion of the music. The out-put of the detector is connected to the two stage audio amplifier.

The new S-M 240 audio transformers which are in no small way responsible for the fine quality obtainable from this
Bottom view of Quadrode Superheterodyne

Parts for Quadrode Super-Heterodyne

1—Aero Antenna coupler No. U-96
2—Camfield .0005 S. L. F. condensers
3—Kuras-Kaschen vernier dials
4—S-M 440 amplifier
5—S-M 240 audio transformers
6—S-M 511 sockets
7—S-M 512 socket
8—S-M 540 bracket (pair)
9—Frost 200,000 ohm potentiometer
10—Frost 200 ohm potentiometer
11—Yaxley cable plug and connector
12—Yaxley on-off switch
13—X-L binding posts (antenna, ground and two loops)
14—SA Amperite
15—SA Amperite
16—Carter .00025 condenser with clips
17—Carter .0002 fixed condenser
18—2 meg. Polymet leak
19—1 Carter mfd condenser
20—10 x 20 x 3/16" sub panel
21—7 x 21 x 3/16" front panel
22—Sangamo .001 condenser

Accessories

1—Voltron 171 tube
2—Yaxley grid tube
3—Voltron 201A tubes
4—Loop aerial
5—Wire or aerial—Luxem and Davis

Batteries

National Carbon Co.

1—Lead-In-Electrod

wired first with leads coming up through the proper holes for the S-M 440 and the two audio transformers before these last parts are mounted. This leaves more room to work in. The long wires beneath the panel may be cabled or run directly from one hole to another. In the accompanying diagrams the wires were run parallel to make a neat appearance.

Soldering lugs are not necessary except on the variable condensers. Tinned No. 20 cotton covered wire as is used by the telephone company for cabling, makes the wiring job very easy. This wire can be obtained in radio stores and in a variety of colors. The ends of the wires should be skinned and the wires twisted around the screwed terminals then screwed down tightly. Small spring washers beneath all will insure permanent connections. Soldering lugs may be used if preferred to this type of connections. The filament circuits and B and C battery wires leading from the Yaxley battery connector should be wired first leaving the terminals free of the panel to be connected to the S-M 440 amplifier and to the audio transformers. Be sure to wire up the 200 ohm potentiometer so that the right hand side is the negative terminal, making the volume increase as the knob is turned to the right as has already been explained. If the out terminals are reversed, the action will be backwards.

The mixer circuit should be wired next. The binding post closest to the front panel should be connected through the hole made for that purpose to terminals 4 and 5 on the U96 coil and from there to the right hand side of the potentiometer (positive terminal); also terminal 5 should connect to frame of condenser. The wire from the second binding post should be run up through the same hole and connected to No. 3 terminal. The third binding post can be connected directly to No. 6 terminal from the bottom of the panel through provided hole.

It is immaterial as to which grid is used for the in-circuit or the oscillator circuit. The grid condenser should be mounted on one grid terminal by bending one end of lug on the condenser and screwing same onto grid terminal. The wire from the fourth binding post should be brought up through the hole beneath the grid and all, and connected to the stator plates of the left hand condenser and from there to the top terminal of the grid leak. The .001 series condenser can be connected directly to the stationary plate of the oscillator tuning condenser so that it is in a vertical position and the wire connected from the bottom of the fixed condenser to No. 6 terminal of U100 coil and from there through the hole in the panel and underneath the panel to the other grid terminal of the mixer tube. The top terminal of the condenser (rotary plate) is connected to No. 5 terminal and from there to the negative terminal of one of the tube sockets. A wire from No. 1 terminal of U100 is run through the hole provided near this terminal along the bottom of the panel and up through the hole near the plate terminal of the mixer tube, to P.

A wire is run underneath the panel from No. 2 terminal of the oscillator coil and brought up through the hole provided for P connection to the S-M 440 amplifier. The .00025 is connected from No. 1 terminal to negative filament. The center tap of the 200 ohm potentiometer is connected (through the hole directly beneath the terminals) to the N terminal to which it is also connected one end of the ½ mfd by-pass condenser.

A lead is connected from the blue terminal of the battery connector (No. 4) through the large hole near the receptacle along the bottom of the panel to terminal on right side of S-M 440 amplifier. The wire should come up through the same (Continued on page 20)

The transformers are mounted almost directly against one another without any bad effects due to coupling between transformers. The grid return of the first audio amplifier is connected to the negative side of using a C battery instead of using a C battery since this tube is not handling any large volume of power. A one volt bias is impressed on the grid by virtue of the voltage drop across the 3A Amperite. The grid of the power tube is connected to minus 45 volts for C bias since this tube handles much more power.

The 200,000 ohm potentiometer is connected across the secondary of the first audio transformer to serve as a volume control. This considerably has a stabilizing effect on the audio amplifier. The left terminal of the potentiometer, number 3, is connected to the filament terminal of the secondary, the right hand terminal, number 1, is connected to the grid terminal of the secondary while the grid of the tube is connected to the middle terminal of the potentiometer. In this way the volume is increased as the knob of the potentiometer is turned towards the right and decreased as it is turned to the left, the filament voltage of all is reduced to five volts by the two Amperites 5A and 3A. The four tubes in the S-M 440 amplifier and the double grid tube are governed by the 5A Amperite and the two audio tubes are governed by the 3A Amperite. Filament rheostats were found unnecessary.

Figure 3 in the blue print section shows the dimensions for drilling the front and sub-panels. The panels should be first accurately laid out, marked with the center punch and then drilled with a small drill so that the holes will line up perfectly. The condensers and two potentiometers, battery switch and dials should be mounted on the front panel first. The 200 ohm Frost potentiometer to the left side, and the 200,000 ohm Frost potentiometer on the right side. The sockets, coils and fixed condensers, cord tip jacks, binding posts and battery plug receptacle should be mounted on the sub-panel before the audio transformers and the S-M 440 amplifier are mounted. The U99 Aero antenna coupler is mounted on the right side and the U100 Aero oscillator coupler is mounted on the left side. The U96 coil should be mounted so that the terminals 3 and 4 face the panel to permit the antenna and ground wires to go through the holes which are available for this purpose in the sub-panel. This will line up the other holes for wires automatically. The U100 coil should be mounted so that the terminals 1 and 2 (plate coil) face the front panel and the hole through which the wires are to pass. The parts already mounted should be the receiver are worthy of some comment here. These transformers have just been placed on the market and we find them especially fine for the use with a super-heterodyne, or any other extremely selective receiver, due to the characteristic of amplifying the very high notes which are to some degree reduced when passing through a very sharply tuned radio amplifier. The higher notes are restored to normal proportions after they are amplified by these two audio stages. The transformers are of the type with plates with leads from outlet to outlet which makes the connections very simple.
(Continued from page 17) hole as P wire. To this terminal is also connected one end of the other 1½ mfd by-pass condenser. The other ends of the two by-pass condensers are connected together and to a screw in one corner of the amplifier which holds the metal box to the sub panel. A wire is run in the same manner from the 90 terminal of the amplifier to the grey terminal (plus 90) of the battery connection. Two short wires should also be soldered to these two battery and connection terminals, the other ends of which are to be later connected to the audio transformers. The 90 volt wire is brought up on the amplifier end through the same holes as the N wire. From the 4½ terminal of the Yaxley connection (brown) run the wire along the bottom of the panel and up through hole on the out-put side (right side) of S-M 440 and connect to 4½ volt C terminal.

A wire is connected from the green terminal of the battery connector to terminal No. 4 on the second audio transformer. A wire is run from the yellow terminal to one of the loud speaker cord tip jacks, the wire from the other jack to the plate of the last tube. The wires terminating at the transformer soldering lugs are clearly shown in the diagram of figure 2 and can be easily followed without detailed description here as to how they should be run.

The terminal on the right side of the 200,000 ohm Frost potentiometer should be connected to the negative A battery lead which terminates at the Amperites near the front of the panel. On the left side of the potentiometer (looking at the potentiometer from the front of the set) a wire should be run to No. 3 terminal on the first audio transformer. A wire from the center terminal of the potentiometer should run directly across the top of the panel to the first tube socket and connect to the grid terminal. The first audio tube and audio transformer is towards the back of the sub panel. The filament wiring is quite obvious.

As can be judged from the photographs, the finished set looks very neat and business like. When mounted in an attractive cabinet of either a console or table model type, it will hold it's own with the handsomest of receivers and in performance do even more. Any good B battery eliminator will work well. An A eliminator appliance can also be used if preferred to the conventional storage battery. The results obtained from the Quadrode Super-heterodyne are quite satisfactory and no more. We are sure this receiver will delight thousands of radio fans who undertake to build it. Accurate blue-print and templets for the Quadrode Super-heterodyne are available through the RADIO AGE office at the price of 25 cents per blue print.

Tuning Up

"Pardon me a moment, please," said the dentist to the victim, "but before beginning this work I must have my drill."

"Good gracious, man!" exclaimed the patient, "can't you pull a tooth without a rehearsal?"

QUADRODE

BLUEPRINTS

Readers who desire blueprints of the Quadrode Superheterodyne Circuit may obtain them from Radio Age. They include:

Panel Templet—Exact Size
Sub-panel templet Exact Size Wiring diagram.

The price is 25 cents each or 75 cents for set of three. Send stamps, money order or coin.

Address:

RADIO AGE
500 North Dearborn Street

VOLTRON TUBES

The "Heart" of the Quadrode

The double grid Voltron is the only tube of its kind on the market. With two grids and a common plate the single Voltron replaces what would ordinarily be the first detector and oscillator. The merits of this principle are proven—it marks a most startling advance in tubes and opens possibilities in receiver design never before realized. It makes seven tubes do the work of eight—it makes for increased efficiency in any super circuit.

Voltron tubes are known for their uniformity of manufacture for the absence of the ordinary tube noise—for their handling capacity and for their clarity of tone. Voltrons in any set will make a good set better.

Complete Quadrode Kits

A complete tube set exactly as specified for the Quadrode is neatly packed in kit form and may be purchased from your dealer. The tubes included in the Quadrode kit are:

1 Voltron Quadrode tube ........................................... 4.50
1 Voltron 171 power amplifier ..................................... 4.50
5 Voltron super-sensitive 201A amplifiers $1.25. ........... 6.25

$15.25

Voltron tubes are available in all standard types, Oxide filament, 210 super power amplifiers, 216B high power rectifier, Voltron A. C. tubes, types 226 and 227, are guaranteed to give you results that are superior to the battery tubes that you are now using in your set.

Although Voltron tubes are better—standard prices prevail.

K and H ELECTRICAL CORPORATION
68 Springfield Ave., Newark, N. J.
These are the AERO Universal Coils

That Make Possible the Fine Performance of the QUADRODE Superheterodyne Receiver Described Elsewhere in This Issue

Of course you’ll want to build the Quadrode Superheterodyne Receiver featured in this issue of Radio Age. It’s a mighty good set—powerful, selective, and possessing wonderful tone qualities.

The AERO Universal Coils used in this circuit are responsible, to a great extent, for the splendid efficiency and fine performance of this receiver. These super-sensitive inductance units are twice-matched, and are adaptable to 201-A, 199, 112, and the new 240 and A. C. tubes.

Patented construction features eliminate losses to the greatest possible degree. You’ll find these coils the finest inductances thus far produced.

When ordering parts for the Quadrode Superheterodyne from your dealer, order these AERO Universal Coils by code number.

No. 100 AERO Universal Coil (Code U-100) . . . . . . Price $4.00
AERO Universal Antenna Coupler (Code U-96) . . . . Price $4.00

Other AERO Kits Employing Supersensitive AERO Universal Coils

AERO Universal Tuned Radio Frequency Kit

Important Notice — A New Service

We have arranged to furnish the home set builder with complete Foundation Units for the Improved Aero-Dyne 6, the Aero T, and for the Chicago Daily News 4- Tube Receiver and the Aero Transmitter Set, drilled and engraved on Westinghouse Micarta. Detailed blueprints and wiring diagram for each circuit included in foundation units free. Write for information and prices.

AERO SEVEN Tuned Radio Frequency Kit

Also especially designed for the Aero T. Kit consists of 2 twice-matched units. Coils are wound on Bakelite skeleton forms, assuring a 95% air di- electric. Tuning range from below 200 to above 500 metres. Adaptable to 201-A, 199, 112, and the new 240 and A. C. tubes.

Sale Price $12.00

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

AERO PRODUCTS, Inc.
Dept. 106
1772 Wilson Ave., Chicago, Ill.
Radio’s Newest Receiver

The Quadrode Super

Complete Parts List

1—Aero Antenna coupler U96 $4.00
1—Aero Universal Oscillator coil U100 4.00
2—Camfield .0005 S. L. F. condensers 12.00
2—Kurz-Kasch Vernier dials 4.00
1—S-M 440 amplifier 35.00
2—S-M 240 audio transformers 12.00
2—S-M 511 sockets 1.00
1—S-M 512 socket .75
1—S-M 540 Bracket (pair) .70
1—Frost 200,000 ohm potentiometer 1.75
1—Frost 2000 ohm potentiometer 1.25
1—Xyaxley on-off switch .50
1—Xyaxley .X.L binding posts (antenna, ground and 2 loops). .60
1—5A Amperite................. 1.10
1—3A Amperite................. 1.10
1—Carter .00025 condenser with clips .50
1—2 meg. Polymet leak .25
2—1 mfd. condensers, Carter 2.50
1—10x20/3/16 in. sub panel 4.50
1—7x21/3/16 in. front panel 3.44
1—Sangamo .001 condenser .50
1—Carter .0002 fixed condenser .45

$92.39

Accessories

1—Voltron Quadrode tube 4.50
1—Voltron 171 power amplifier 4.50
5—Voltron super-sensitive 201A amplifiers at $1.25 6.25

$15.25

Substantial discounts to professional set builders and the trade.
A full line of standard parts and accessories carried.

From us you can get all parts for the new Quadrode Super-radio's latest development—which is described in detail in this issue of Radio Age. Each and every part is most carefully inspected and checked—no substitutions anywhere—each and every item exactly as specified by the designer. It goes without saying that you want to own the Quadrode Super, the first receiving set which makes use of the new double grid tube—seven tubes doing the work of eight and in a more efficient manner.

Orders can be filled on the complete list of parts, complete tube kits and all accessories. All carry the guarantee of Setbuilders Supply Company. Or if you need but an individual part your order will be taken care of in the same prompt, efficient manner.

Our stock and adequate shipping facilities enable us to make immediate shipment either on complete kits or on individual units. Send your order to us or ask us to send you our complete literature.

The Improved Laboratory Super

The sensation of the shows, the set that everyone is talking about. The super in the three to five hundred dollar price class, with tone incomparable, that will bring in distance just as if every night was ‘silent night.’ The Improved Laboratory Super will bring in distant stations with loud speaker volume that are barely audible with other receivers. Its selectivity allows the separation of distant stations within ten kilocycles of powerful locals—not occasionally but regularly. No matter where you live the Improved Laboratory Super is the finest set you can build or buy. This set has been endorsed and approved by Radio Broadcast, Citizens Radio Call Book, Radio Review, Popular Radio—in fact, by every prominent authority. Complete parts, including walnut metal panel and pierced steel sub-base, complete $89.45. Send for literature.

SETBUILDERS SUPPLY COMPANY
516 South Peoria Street
Chicago, Ill.
Camfield Super-Selective "10"

Camfield has again come to the front with a 10-tube super-selective circuit of exceptional merit, possessing many features never before incorporated in a radio receiving set. It is a simplified receiver, having two easily operated drum-dial controls. Another feature is that it may be operated as a six-tube radio frequency set, or as a ten-tube super-selective receiver by the simple turn of a switch on the front panel.

Again the famous Rusco Band Pass Filter in the intermediate frequency amplifier comes to the fore as one of the most remarkable things in radio. This Filter is designed to pass a band of frequencies 10 kilocycles wide. The amplification over this band is uniform and the cutoff on either side is extremely sharp. The result is perfect selectivity between wave bands of only 10-kilocycle separation in the frequency. The uniform amplification over the band maintains perfect tone quality. The selectivity of this device is so perfect that it permits the use of radio frequency amplification ahead of the super and the operation of the set on an antenna, making it one of the most sensitive receivers ever developed. This makes possible the simultaneous increasing of both sensitivity and selectivity to a degree heretofore unknown.

This new circuit embodies all the latest improvements—simplified control by means of two Tyman Drum Dials, Tyman Audio Transformers, Camfield Condensers, Rusco Band Pass Filters and especially selected parts to make a perfectly balanced receiver of the highest quality yet available at a very modest price. It is easy to construct and simple to operate and will outperform any radio set you have ever used.

"A Tribute to a Leader"

Camfield Equitable Condensers are the unanimous choice of discriminating manufacturers, jobbers, dealers and radio builders. There is proof of this in the fact that they are being officially specified in the following circuits for the 1927-28 season:

- Camfield Super-Selective 9 and 10.
- The Tyman Ten.
- Madison Moore Super.
- Frequency Circuit.
- Citizen Super 8.
- Camfield Duoformer 7.

On actual demonstration the Camfield Super-Selective 9 will out-perform any other receiver. Its exclusive features mean real service and satisfaction to the man who builds his own. Do not pass up this wonderful opportunity. Set Builders in all parts of the country who have built the Camfield Super-Selective 9 are enthusiastic.

We stand back of this circuit and are ready to help you in every way. If you have any special questions regarding this circuit we will welcome a personal call or a letter from you. Either will receive our immediate attention.

Write for free booklet, "Wherever You Require Quality" or get complete parts from your jobber or dealer.

THE FOLLOWING FEATURES OF THE CAMFIELD EQUITABLE CONDENSERS ARE NOT TO BE FOUND IN ANY OTHER CONDENSER ON THE MARKET:

1. To facilitate sharp tuning and perfect balancing in sets of the well-constructed type, condensers are adjustable, which makes possible the perfect equalization of all circuits after the receiver has been completely wired. This eliminates the use of error or trimmer condensers. Complete instructions and a special tool for making adjustment are packed with each double and three-gang condenser.

2. The shaft may be shortened or lengthened or entirely removed without affecting the adjustment of the rotor plates. This provides a simple means for connecting several units together with a single shaft and any where from one to six condenser units may be operated with one dial.

3. May be mounted from either end by reversing the shaft cap out and the panel mounting nut. After shaft cap nut has been removed, shaft may be extended from opposite end of condenser by loosening set screws on rotor hub.

4. A variable spring tension is provided and the rotor is mounted on ball bearings which insure extremely smooth running over a long period.

5. Beautifully Finished. Rotor and stator plates are of bright! signed brass. All other parts are hand buffed and anodised plated.

6. A pair of special brackets for mounting condensers on base-board or sub-panel furnished at a slight additional cost. The use of these brackets, several single condensers may be mounted in a row on a base-board or sub-panel and all operated with a single shaft.

CAMFIELD RADIO MANUFACTURING CO.
35 E. Wacker Drive, Dept. RA, Chicago, U. S. A.
Shielded Grid Tube Announced

The Radio Corporation of America has finally announced the coming of the shielded grid tube developed some time ago by Doctor A. W. Hull of the General Electric Company. Although the tube was developed almost two years ago, there has been much secrecy about it and it has been kept off the market until now, for some unknown reason. We have been hearing rumors of this wonderful Aladdin’s Lamp for some time, and here and there appeared unofficial information regarding same, in various publications, some of them proclaiming this wonder of wonders as “revolutionary.” It is true that much can be expected from this really remarkable invention which was originally discovered several years ago by the German scientist Doctor A. W. Hull. However, the tube was never developed to its full scope until a few years ago by Dr. Hull.

According to an article by Dr. Hull which appeared some time ago in the Physical Review, the effect of inter-electrode capacities within the tube are practically entirely eliminated by virtue of the additional grid, and shield, which shields the usual grid from the plate—or plate from the grid if you so prefer to put it. The parasite and bugbear of the radio frequency amplifier, mainly oscillation, which limit the amplification to a low value and cause instability and squealing, with which we are familiar. Where now the amplification for (at broadcast frequency) is from 6 to 16 per stage, and the latter only in cases of well shielded and balanced circuits, the new tube affords an amplification from 20 to 35 per stage, depending upon the efficiency of the tuned plate circuit. With the detrimental capacity removed the tube becomes a true oneway repeater with all the complications of balancing out capacities removed. Doctor Hull in the new tube has found unlimited and unparalleled amplification available with properly shielded stages.

He states that stage after stage of amplification can be effectively added until the amplification is so great that the minute tube noises or “short effect” saturate the last tube. In his experiments with five tubes an amplification of about 2,000,000 was attained. Just imagine, with three stages of amplification at a gain of 30 per stage the total amplification is 18,000, where with the best balanced and shielded three-stage amplifier the gain is less than 3,500; the ordinary three-stage neutrodyne or unamplified amplifier yields a gain from 1,000 to 1,500. In a super-heterodyne intermediate amplifier, tuned to about 50 kilocycles, an amplification of 75 per stage is quite feasible, Dr. Hull says.

At broadcast frequencies the same number of tuned circuits will still be necessary, that is, three or four to get the selectivity required to cut through local stations in the same band. The use of shielded tubes in the radio frequency amplifier will not be decreased but the sensitivity will increase many fold with absolute freedom from oscillation. If no great amount of amplification is desired, however, a number of tuned circuits may be used in parallel and fewer tubes used in the amplifier. The super-heterodyne should still reign supreme because of the greater possibility in selectivity and the greater gain per stage.

The new tube will most certainly be food for the experimenter, and of the most delicious variety. The Radio Corporation announces that the tube will be on the market at the end of the present year. The new Radiotron will be known as UX-222. It has a filament, a plate and two grids, in place of the usual three element employed in our present tube. The second grid is responsible for its high amplification and freedom from oscillation. It is intended primarily for radio frequency amplification (without neutralization or stabilizing resistance) in circuits especially designed for it.

Radiotron UX-222 may also be used as a “space charge grid” tube in audio frequency circuits. It is also useful in other experimental circuits, where a double grid, four element tube can be used.

Quoting Mr. Bucher, assistant vice president of the Radio Corporation of America: “It should be realized, however, that this tube will not bring about any revolutionary developments in the radio industry, nor will it render obsolete the type of sets now in use or being sold. It must be remembered that all of these tubes give greater radio frequency amplification per tube than former type, nevertheless, a certain number of tuned circuits must be used under present day broadcasting conditions to obtain adequate selectivity; therefore, all things considered, the new Radiotron will not necessarily reduce the number of tubes required in a given broadcasting receiver.”

The new Radiotron has a standard four-prong UX base and differs in external appearance from the ordinary tube by the addition by a small metal cap at the top of the glass bulb, which indicates connection to the controlled grid, or shield. The filament terminal voltage for this tube is 3.3 volts and the filament current consumption is .132 amperes. A filament resistor makes it usable with a six-volt storage battery. The recommended plate voltage is 135 volts. The shielding grid is connected to the 60-volt tap of the B battery. Instead of transformer coupling direct coupling through a condenser and tuned plate circuit, is used between tubes.

Switching Tubes

In times gone by, the efficiency of a multi-tube receiver could often be greatly increased by switching the tubes around. Some tubes functioned better as R. F. amplifiers while others gave better results as detectors or A. F. amplifiers. By trying each tube for each different function in a receiver the most efficient arrangement was readily found. Improved manufacturing methods have now made such switching of tubes unnecessary.

Announce New System

An announcement is made by the DeForest Radio Company, Jersey City, N. J., of the development and perfection of a “fundamentally new system of radio reception.” This new system is the conception of and the result of long research by Dr. George A. Somersalo, well known Finnish physicist and former Research Director of the DeForest Company. In an interview, an official of the DeForest Co. stated: “It is frequently claimed that all fundamental patents relating to radio receiving are owned or controlled by a group of large interests. That this contention is without foundation has been fully demonstrated by the advent of Dr. Somersalo’s system.

The Somersalo system, which is controlled by Arthur D. Lord, Receiver-in-Equity of the DeForest Radio Company, provides a fundamentally new method of obtaining radio frequency amplification without infringing any existing patents.

“For those who are technically inclined, it may be stated that the DeForest system is essentially self-regulating and the only variable or adjustable apparatus or values being the rheostats if such method of controlling the filament supply be used.

“Many attempts have been made to construct an efficient and at the same time a selective filter system. These earlier attempts failed because efficiency had been sacrificed at the expense of selectivity. A proper solution seemed impossible until Somersalo made his discovery, making use of a peculiar arrangement of coils in the filter system, which in itself is quite simple. In his system, the signal passes through a series of tubeless filters without any voltage reduction whatsoever, and is later amplified by tubes.

“An extremely important feature is that the need of neutralization is practically eliminated. It is, of course, necessary to reduce the indicated current of the tube by one of the various well-known methods, not to prevent squealing, however, since there is hardly a tendency towards squealing, but in order to sharpen the tuning if such be necessary. With regard to the other tubes, nothing is needed to suppress oscillations, as there is no oscillation present. This is a very important point of design which eliminates one of the greatest difficulties in set construction.”

Automatic Safeguard

Where a rheostat is used to control the filament current to a group of radio-frequency tubes, and thus to function as a volume control, it is a good plan to use an automatic filament control unit in series with the rheostat. The automatic control unit should be the same as would be used in the instrument feeding the circuit. Thus if the rheostat is turned up all the way the tubes will be burning only at their normal temperature and the filaments cannot be overloaded by careless operation of the rheostat.
The Aero-Seventy Receiver, which is being featured in the prominent radio magazines and newspapers, is a new tried and tested tube R.F. circuit, incorporating the most modern radio improvements at a popular price. It is a distinct innovation in a tuned R.F. receiver, utilizing three stages of R.F. and three stages of regeneration. It is a very simple circuit built around the famous improved Aero Universal Coils, with improved Ameco 3.5 tuning 3-gang condenser, S.M. single-control drum dial and the tried and tested parts of other famous manufacturers. Such names as Carter, L.L., Westinghouse, Aero, Amesco and Silver-Marshall assure you of a circuit that is the final word in perfection.

Distinct features are: the new HI-Mu tube at input and in R.F. stages, potentiometer control, higher amplification, 10-kilicycle selectivity and true single control.

The Aero-Seventy has a broadcast range from below 200 meters to over 550 meters (1500-5500 kc) and requires no shielding as with the small Aero coils, direct pick-up is negligible and coupling between coils is the very minimum. The coils are twice-matchd at both high and low frequencies of the broadcast band, thus eliminating many difficulties in single dial control and overcoming some of the principle causes of disappointments.

The adjustable compensators on the Ameco condensers facilitate the equalization of circuits, solving the major problem of random tuning.

The extremely sharp selectivity of the Aero-Seventy circuit is due to the low resistance of the coils. The high voltage gain per stage, due to the extremely low loss construction, assures extreme distant reception and greatest volume and sensitivity is assured through the high efficiency of the coil windings.

New and Unique Hookup
3 Stages of Radio Frequency
3 Stages of Audio Amplification

The Aero-Seventy has a new and unique hook-up that incorporates three stages of R.F. and three stages of Audio. There are two stages of tuned radio frequency and a special singular stage, the secondary function of which is to prevent internal decimation, thereby giving single control which is both theoretically and practically perfect. This independent antenna circuit is of a new design, providing an improvement between the antenna and ground isolation to the first grid circuit. Five CX340's are used in the R.F. circuit, one detector and one in the audio.

In the three audio stages: one 71L4 power tube is used, one 214A tube and the one CX340 tube in the input. The circuit, therefore, is different from the usual 7-tube R.F. circuits, which variations contribute to its separation—especially perfect quality and thrilling volume.

The combination of all the parts, the magnetic coupling of the Aero Universal Coils, together with the Ameco compensating 3-gang condenser, with true single control and potentiometer control, greatly simplifies operation and tuning, while adding efficiency to the circuit.

First Use of New CX340 Tubes—1/6-1/10 Times Better

Utilizing the new CX340 Cunnion tubes in place of the usual CX34A, gives the Aero-Seventy the distinction of being the first circuit using this superior method. CX340 tubes are 1/6-1/10 times more efficient than 34A tubes, having a 300% higher H.F. input and 50% more gain at the output. This characteristic is utilized constantly on the plate for the R.F. circuits, smoothing golden currents and preventing feedback, working out here. It is a High Mu tube, having a high amplification factor (5600) and is used both as a detector and in a radio and audio amplifier. The Aero-Seventy is specially designed to operate with this new and better CX340 tube and the results secured will be a platoing revelation to you. It is surprising what tone and volume is secured with a minimum use of current.

Resistance Coupled Audio Amplification

Resistance coupled audio amplification in the Aero-Seventy is a quality of reproduction unsurpassed in other sets. The tone and volume is consistently achieved by Aero’s 10-kilicycle selectivity.

10 Kilicycle Selectivity Now a Real Fact

Ten kilicycle selectivity is OPTIMUM Selectivity. It means a receiver that times sharply enough to eliminate interference and yet does not time so sharply as to cause distortion. It is the ideal tuning characteristic. "Optimum tuning," says the engineer, when he means a perfect art, "better than anything but the best. Why put up with anything but 10-kilicycle selectivity, as represented in the Aero-Seventy circuit?"

Due to the low-loss construction of the coils and condensers in the Aero-Seventy and the great selectivity introduced into the circuit itself, you are selectivity as sharp that you cannot get two stations at once, under your lowest broadcast resonations, at the same time providing adequate frequency margins to prevent high "rest off" distortion.

It has been demonstrated that this means in perfect radio reception. Selectivity, the ability to time in clearly, sharply, with our fear of interference in getting the station you want whenever you want it—that's something every radio fan has long desired. It is an actuality in the Aero-Seventy— a feature that is necessary in an up-to-date circuit—a feature that you get in the Aero-Seventy when you build it.

New, Modern, Proven Features in Aero-Seventy

10 Kilicycle selectivity.

Resistance coupled amplification.

Silicon stable biasing control instead of 34A.

3 stages of R.F. circuit.

3 stages of audio amplification.

Extreme D-X X reception.

Potentiometer control.

Silver-Max tuning single drum dial.

True single control.

Aero-Cells are twice matched at both high and low frequencies.

Aero adjustable condensers.

Carter resistances.

Type A, B or C.

High quality parts throughout.

Range below 200 to above 550 meters (1500-5500 kc).

Low loss characteristics throughout.

Get the Facts—MAIL NOW->

AERO PRODUCENTS, INC.
1768 Wilson Ave., Dept. 711
Chicago, Ill.


AERO-SEVENTY—10-Kilicycle Selectivity

Utilizing New 340 Tubes

Battery, Electrical or A C Operation

Unique Features

Aero Products

Aero-Products, Inc.
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Dear sir: Enclosed find 10¢ for which please send me assembly diagram, construction, and all the facts in building the new Aero-Seventy Receiver.

Name

Address

Payment enclosed

Printed in U.S.A.
The Aero-Seven
(Continued from page 9)

The antenna and ground are connected to the two posts at the left of the set and battery connections in the manner marked at the right. It will be noted from the circuit diagram that the -A BAT post is used as well for the -B and +C. The +AMP B BAT post should be supplied from a 180-volt battery for the amplifier and power stages, while the C battery on the power stage will be 35 to 40 volts.

The Amsco resistors should be unpacked and inserted in the clips of the Resistocouplers in the order shown in the circuit diagram form, left to right while facing the front panel.

The tubes necessary for the operation of the receiver are as follows: Five UX-240 or CX-340, which are placed in the radio frequency sockets, the detector and the first stage of audio frequency; one UX-201A or CX-301A, for use in the second audio stage; and a UX-171 or CX-371, for use in the last or power stage. Where extra good quality is desired, the second stage should employ a 112 tube rather than the 201A, particularly when receiving loud signals from a nearby station.

In lining up the radio frequency stages, a screw driver should be made from a sliver of wood or bakelite to use on the condenser adjustment. These midget capacities should be screwed all the way out as a preliminary and a station tuned in, preferably on the lower waves. After tuning to maximum volume the dial reading should be decreased ever so slightly. If the signal is a weak one it will disappear by this procedure, while if a strong one it will only be diminished in volume. After this has been done the small condensers are adjusted with the wooden screw driver until the volume is at maximum. In the course of doing this it may be noted that as a perfect adjustment is approached the receiver may oscillate. In this case the potentiometer should be retarded as much as necessary to prevent this and then proceed with the adjustment for maximum volume.

With this adjustment made the receiver is in perfect operating condition over the entire wave band.

Ray: Why do they have most all radio broadcasting stations on top of tall buildings?
Bray: So nobody can throw bricks at the performers.

Independent Directors
Announcement of the permanent board of directors to manage the affairs of the Radio Protective Association—the antitrust organization of the independent manufacturers—was made after a meeting of the membership at the Palmer House, Chicago, during the Chicago Radio Show.

As a result of the growth in the membership, the board was increased from five to eleven members, particularly to give representation to the new members of the association in the West.

The new board of directors follows:
Harry G. Sparks, Sparks-Withington Company, Jackson, Mich.
Fred S. Armstrong, Vesta Battery Corporation, Chicago.
H. R. Rose, Shamrock Manufacturing Co., Newark, N. J.
H. Chirelstein, Sonatron Tube Co., New York, N. Y.
L. Mandel, Metro Electric Co., Chicago.
J. Wiechers, Western Coil & Electrical Co., Racine, Wis.
Arthur D. Lord, DeForest Radio Co., Jersey City, N. J.
Alexander Weiss, Marti Electric Co., West Orange, N. J.
Ernest Kauer, C. E. Manufacturing Co., Providence, R. I.

Mr. Armstrong remains treasurer of the association and Oswald F. Schuette, executive secretary in charge of the headquarters at 134 South LaSalle Street, Chicago.

As the decisive step in the battle of the Radio Protective Association against the radio trust, it was decided that the association is to undertake the defense of any dealer or jobber of a member who may be sued for patent infringement by the Radio Corporation of America, or its constituent companies—the America Telephone & Telegraph Company, the General Electric Company and the Westinghouse Company.

Sixty-six representatives of independent manufacturers at the Chicago Radio Show attended the meeting. At a meeting held at the Hotel Astor in the preceding week, fifty-two were present. The association is only two months old, and its members point to its directorate as proof that as an organization it will have to be reckoned with in shaping the future of the radio industry.

Camfield Super
Selective Ten
(Continued from page 13)

properly amplified and distortion will result.

Building this receiver is a simple task. All parts are laid out with mathematical accuracy in such a fashion that a single centerline passed through a dozen holes. By carefully consulting the diagrams and layouts one cannot go wrong in the assembling.

The wiring is nearly all on the under side of the sub-panel out of sight and out of harm's way. Several small parts as are liable to be in the way and may readily be placed in concealed locations are also put here. All connections are soldered and carefully wiped with a rag saturated with alcohol.

The large hole in the panel for the drum dial requires a bit of painstaking work. It may be either cut out on a drill press with an expansion bit, if one is available, or it may be drilled around the circumference and the plug pushed out. Be careful in doing this, or the panel may break in two. Time spent in careful workmanship is never wasted.

To obtain the best of results good tubes must be used. For the radio, intermediate oscillator and first audio, 201-A tubes are used, the two detectors are 200-A, and the last audio a 112. A total of 135 volts plate current is needed, furnished either by B Batteries or an eliminator. If an A Eliminator is used it must be one that delivers parallel feed, for series feed is useless in a super-heterodyne. Though not included in the original plans, an output filter is most desirable for obtaining the highest quality of reproduction.

Test Your Tubes
It is a good plan to have the tubes in a receiver tested after every three or four hundred hours of service. If a receiver is in use an average of three hours per day for instance, it will be worth while to have a service man test the tubes about once every four months, and to replace any that are found to be wearing out.

This is particularly important where the receiver makes use of rheostats for the adjustment of the tube filament supply because if a single tube starts to wear out there will be a tendency to make up the decreasing volume by turning the other tubes up higher and the usual result is that several tubes are prematurely worn out, whereas replacement of the one poor tube would have saved the others.

And what do you want for Christmas, little boy?
Youngster—Nothing but a three-step polyphase heterodyne regenerative unit and a reflex inductive oscillatory tube for my radio.
Now a World Chain

International rebroadcasting, heretofore a feature limited to stations in the United States to other countries, east, south and west, is now a two-way service.

On successive mornings, Oct. 27 and 28, WGY, the General Electric Company station at Schenectady, N. Y., picked up and rebroadcast station 2FC of Sydney, Australia, 2,700 miles away. Music carried on the late evening program of the Australian station became breakfast hour music for WGY’s audience. The signals started off in the spring-time and reached Schenectady in the fall, but in spite of the difference in seasons WGY’s audience heard the music from 7:50 to 8:30 a.m. Thursday, which Sydney listeners were getting between 10:50 and 11:30 Thursday night.

In May of this year WGY broadcast a series of early morning programs for Australian and New Zealand listeners. These programs were carried on two short wave stations 2XAF and 2XAD. Martin P. Rice, manager of broadcasting for the General Electric Company addressed the far eastern listeners extending to them the greetings of the United States. Five Australian stations picked up the short wave signals and rebroadcast them. Reports indicated that the rebroadcast signal was exceptionally clear and fortunately free from static and fading.

The success of this broadcasting delighted the Australians but left their technical man dissatisfied. The picture couldn’t be complete until the courtesy could be returned. A few weeks ago the chief engineer of Amalgamated Wireless Ltd. of Sydney notified the management of WGY that test programs would be transmitted by 2FC on 28.5 meters and they asked the Schenectady engineers to rebroadcast if possible. Dates for test programs were Oct. 25, 27, and 28. Signals on Oct. 25 and 27 were unsatisfactory, but Oct. 27, voice and music were coming through so well that WGY went on the air with the rebroadcast entertainment for forty minutes. There was some static and the fading surge was present at all times, but the signal, in neither voice or music, was ever lost in indistinctness. Just before the sign-off at 11:30 p. m. Sydney time, a male quartet sang: "There are we together, the merrier will we be," and in that song forecast what may ultimately prove the highest mission of radio, the promotion of international understanding.

In transmitting 2FC, WGY has established an American record in rebroadcasting. Two years ago a station of the British Broadcasting Company was picked up in the United States and rebroadcast by WJZ and WGY, but this is as far as rebroadcast of foreign stations has gone in this country. The signals of the European and other foreign stations were not strong enough for rebroadcasting purposes. Now, however, there is a trend toward the rebroadcasting in other countries. Station PCCJJ of Eindhoven, Holland, is using a short wave station that has reached out well and AGA, a German station working on 14 meters, has been heard occasionally in the United States.

(Continued on page 35)
Transformers

Two additions to last year’s Radio Sensation
The Amazing Achievement in Audio Amplification

Designed to fulfill the exacting requirements of set builders who demand

EFFICIENCY
SENSITIVITY
PRECISION AND
HIGH QUALITY
BEAUTY

The new C-16 and C-26 and C-25 Transformers will work in any circuit and will improve any Radio Set.

H. F. L. C-16 and C-26 Audio Transformers and C-25 output Transformer—New companions of a Great Unit, will work in any circuit and improve any radio set.

H. F. L. Facts
H. F. L. Units have been used, approved and most highly endorsed by Radio News, Citizens’ Call Book, Radio Review, Radio Age, Radio Engineering, Radio Mechanics, Chicago Evening Post, the Daily News and others. Thousands of engineers and fans, who have turned to H. F. L. Units for better reception, hail them as the finest transformers known to Radio—uncalled for Power, Sensitivity and Purity of Tone.

Perfectly matched, skillfully designed, carefully made, rigidly tested—in a word, the H. F. L. transformers are technically correct to the minutest detail.

All H. F. L. transformers are designed for baseboard mounting or invisible subpanel wiring—each unit is enclosed and sealed in a genuine bakelite moulding.

H. F. L. Units are easily connected into the assembly, simplify set construction, and make a beautifully finished job.

H. F. L. Units Give Wonderful Clear Reception

Engineers acclaim H. F. L. C-16 and C-26 a marvellously efficient Audio Transformer. It carries signals at highest volume and lowest amplitude without blazing or developing harmonics. Operates with all power tubes as well as standard tubes. H. F. L. C-25 Output Transformer handles the voltage output of power amplifying tubes, at the same time matches the impedance of the average speaker to tubes. Protects loud speaker unit without reducing plate voltage. Mechanical features of these two transformers are: A coil designed and treated to exclude moisture and withstand heavy electrical surges without breaking down—complete magnetic shielding to avoid interstage coupling—terminals brought out so as to insures short leads.

Endorsed by America’s Leading Engineers—Guaranteed by the Manufacturers

PRICES

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<thead>
<tr>
<th>Model</th>
<th>Price</th>
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<tr>
<td>No. C-25 Output Transformer</td>
<td>$5.00</td>
</tr>
</tbody>
</table>

Set Builders—Dealers
If your jobber cannot supply you with H. F. L. Transformers, write us for name of nearest jobber.

Radio Dealer’s Stocks

According to a survey of radio dealers’ stocks just completed by the Electrical Equipment Division of the Department of Commerce, the first of its kind ever officially undertaken returns from 7,842 dealers out of a total of 31,485 indicate that there was an average of 9 receiving sets and loud speakers per reporting dealer on October 1, 1927. “B” and “C” battery’s stocked showed an average of 31 per reporting dealer, in units of 45 volts, and 7 storage batteries for “A” power, whereas eliminators averaged 5 per dealer. Receiving set tubes, not A. C., averaged 63 per dealer, whereas A. C. ones averaged 4. The survey showed that other types of tubes for rectifying purposes averaged 5 per dealer.

A total of 936 jobbers were localized of which 236 replied. The number of receiving sets per reporting jobber was 373, loud speakers 385, “B” and “C” batteries 1220—45 volt units, Storage batteries 105, eliminators 254, tubes other than A. C. ones 3,140, A. C. tubes 97, and rectifying tubes 171, all per jobber.

Herewith is a table showing combined dealers and jobbers stocks, actually reported:

(1) Receiving Sets

<table>
<thead>
<tr>
<th>No. on Hand</th>
<th>Description</th>
<th>Units</th>
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| A. C. Power 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The FAMOUS HOT SPOT FOURTEEN

A super with actual single point reception

Like a Thermometer—It Registers at One Point.

Razor Edge Selectivity—
No Receiver Harmonics—
No Repeats—Gets Everything

The famous Robertson-Davis HOT SPOT Fourteen Receiver
Fully Illustrated and Described in the Editorial and the
Blue Print Sections of the DECEMBER RADIO AGE

JOBBERS: Get lined up with our new 1927-28 Sales Proposition.
Set Builders, Radio Fans, Dealers: Write for full particulars.

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[Engineers & Manufacturers of Electrical Windings]

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CHICAGO, U. S. A.

Best Hookups—Thirty Cents Each!

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed the best hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired

March, 1926
—Improving the Browning-Drake.
—Rheostatless Tubes in a Set.
—How to Make a Wavemeter—Blueprint.

May, 1926
—Short Wave Transmitter—Blueprint.
—Simplifying Battery Charging.
—Protecting Your Inventions.

June, 1926
—Simple Crystal Set.
—Golden Rule Receiver—Blueprints.

August, 1926
—Receiver, Transmitter and Wavemeter.
—Beginners 200 mile Crystal Set.
—Changing to Single Control.

September, 1926
—How to Make a Grid Meter Driver.
—Short Wave Wavemeter.
—Power Amplifier for Quality (Blueprint)

October, 1926
—Crystal Control Low Power Transmitter (Blueprint).
—Rhythcon Design for A B C Elimination
—What Type Loud Speaker to Use.
—Nine Tube Super Brings Back Faith.

November, 1926
—Blueprints of the Henry-Iyford.
—Worlds Record Super With Large Tubes.
—How to Use a Power Tube in Your Set.

December, 1926
—Starting Radio with Crystal Set.
—Six Tube Shielded Receiver.
—Types of Rectifiers Discussed.

January, 1927
—Full Data on Worlds Record Set.
—Dual TC Receiver.
—Clough Super Design.

February, 1927
—Building the Hammarlund-Roberts.
—Making a 36 Inch Cone Speaker.
—Browning Drake Power Operated.

March, 1927
—Ideal Model Worlds Record Super.
—Building the Hammarlund-Roberts.
—Ridding Supers of Repeat Points.
—Loop and Four Tubes.

April, 1927
—Inexpensive B. Eliminator.
—One Spot Superhet.

May-June, 1927
—Complete Trouble Shooter for Supers.
—Tubes for Worlds Record Super.

July-August, 1927
—Building Vacuum Tube Voltmeter.
—Low Power Crystal Control Transmitter.

September, 1927
—New A. C. Tubes in a Six Tube R. F. Receiver
—blue prints.)

October, 1927
—The Thompson Super-Seven.
—The 1928 Infrafrayne.
—New World’s Record Super-Ten.
1928 Nine-in-Line Super Heterodyne

(Continued from page 11)

every condenser. A Carter 6 ohm rheostat is mounted on the left hand side of the panel. A Carter 6 ohm rheostat with filament switch is mounted in the center, while a 500,000 Hi-ohm is mounted on the extreme right in the position indicated as the "MODIFIER". This completes the assembling of the front panel.

Figure 3 illustrates very clearly the wiring of the various parts while Figure 2 shows the relative positions these parts take on the front panel and sub-panel. Detailed explanation is unnecessary as it is illustrated in these drawings.

Figure 4 shows the schematic diagram of the Improved 1928 Nine-in-Line. The first tube to the left is the oscillator tube and coil L430 and L425 comprise the oscillator circuit. In the completed set the oscillator tube is the seventh tube to the right. The oscillator coupler L430 is between the two variable condensers and the choke coil H425 is mounted between the two audio transformers. The following tube is the first detector.

The first two transformers are of the iron core type H210 designed for the purpose of amplifying only while the third and fifth transformer are of the air core type tuned to about 37 kilocycles. The third, fourth, fifth and sixth tubes in the diagram are the intermediate frequency amplifier tubes. The seventh tube is the second detector. The combination of the iron core and air core transformers yield a comparatively high amplification and allow a frequency band to pass of not more than 10 kilocycles. The eighth and ninth tube are the audio frequency amplifier tubes and C16 transformers are the associated audio frequency transformers. C25 is the out-put transformer which prevents the plate current in the last tube from flowing into the loud speaker and possibly injuring the winding. A 4½ to six volt bias is impressed on the four intermediate stages second detector and first audio frequency amplification stage, while a bias of 4½ volts additional is put on the last tube if it is of the 112 type of tubes with a 135 plate voltage, making the total bias on the last tube about 9 volts. However, if the 171 type of tube is used in the last stage, 180 volts of plate voltage, a 45 volt C battery should be used connecting the positive side of the B battery directly to the negative A battery. This is recommended in preference to the 112 type. The center tap of the loop is
connected to the filament terminal of the first detector tube. No grid condenser and leak is used in the first detector circuit. The oscillator grid return is connected to the positive filament. An Amperite R4 is provided to maintain the filament of the last two tubes at 5 volts.

Twenty-two and ½ volts of B battery are used on the oscillator and first detector, 67 volts on the second detector and 90 volts on the intermediate stages. If the 112 tube is used, 135 volts can be applied to the first stage audio tube as well as the last stage. However, if 180 volts are used for the 171 type of tube this should be impressed on the last tube only and 90 volts or 135 volts on the first audio tube.

Some of the by-pass condensers in this set are of more importance than they may appear at a glance at the circuit diagram. The .0005 mfd fixed condenser connecting from the plate terminal of the detector tube to the minus filament terminal, for instance, is quite necessary. This condenser changes the impedance in the plate circuit of the first detector tube so that the detector tube will not oscillate uncontrollably. Leaving this condenser off is sure to cause whistles and instability on the lower part of the wave length band. The .0045 midget condenser is the feed-back condenser to control regeneration in the loop circuit. This device provides greater sensitivity and at the same time will help to sharpen up loop tuning because of the regeneration present. This condenser is mounted on the sub-panel since it requires adjustment only once at about the center of the wave length.

The .002 condenser across the primary of the first audio transformer provides a low impedance path for the radio frequency component in that circuit. One mfd condenser is connected from the B battery terminal, 90 volt, to the negative filament terminal to prevent radio frequency passing through the B battery. The 6 ohm rheostat which has the switch mounted to it is marked "FILAMENT" in the center of the panel, and controls the filament current to the four amplifying tubes. The amplification of the intermediate stages is regulated by increasing or decreasing the current going through the tube with the variations produced by the rheostat when it is turned one way or the other. The other 6 ohm rheostat "Sensitivity" on the right hand side of the panel, controls the two detector and oscillator tubes. The 2000 ohm Hi-Hat is the volume control and is connected directly across the secondary of the first audio transformer. This is marked "VOLUME" on the extreme left hand side of the panel. The in-put resistance is the first audio tube, is increased or decreased with this resistor and the out-put from the speaker accordingly regulated. When resistance is at the maximum the out-put is greatest and when resistance is at minimum the out-put is very low. The filament voltage is automatically switched on when the rheostat "Volume" is turned from minimum towards maximum. The theoretical function of this super is practically identical with any super-heterodyne of this type in use and today is common knowledge to most radio fans.

They would tell you—that only at the precise and definitely prescribed filament current, or temperature, can their tonal qualities, clarity and sensitiveness be brought out to the full. That "A" battery current constantly varies according to the age of the battery and state of charge—and operation with too little or too great current is certain death to efficient tube performance—and too quickly, of the tube itself. That only AMPERITE can automatically supply and control this exact current despite battery variation—as long as sufficient current is to be had. That you should never confuse AMPERITE with fixed filament resistors which do not do the Amperite's job. AMPERITE is sold by dealers everywhere. Price $1.10 mounted (in U. S. A.).

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REG. U.S. PAT. OFF.

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Write for my Big 1928 Radio Catalog—just off the press. Thousands of marvelous bargains in national and local advertised goods. All the LATEST in radios and radio equipment. Lowest wholesale and retail sale prices. FREE Look and Call Book and Catalog. Get your copy today.

Hall of Fame
1928 Catalog

Please Mention Radio Age When Writing to Advertisers.
so we will not discuss it here.

The photograph (Figure 1) is a very clear picture of the set as it looks when complete. The three cord tip jacks on the right are for the loop while the three jacks on the left are for the C battery; the two in the center of the panel to the right are for the loud speaker. The cable plug receptacle is visible beneath the panel to the left. This makes it a simple matter to connect or disconnect the receiver from the battery and loop. The knob to the right is the midget condenser control for regeneration. All the wiring is beneath the sub-panel, only the wires connecting the dial lamps are visible.

In tuning the set, rotate both dials at the same time so that the numbers will be almost alike. In tuning for distant stations, the sensitivity control should be turned almost completely to the right or maximum and left that way until later on. The center knob or "FILAMENT" control should be turned to the right until the set oscillates which is indicated by whistles or other noises. Slowly rotate the oscillator dial and follow the wave-length dial so that both dials are in resonance which can be noticed by the hissing noise. When the dials are out of resonance the hiss disappears. Once the set is logged it will remain so permanently. Until the log is complete, the tuning should be done very slowly as otherwise stations will be passed over unnoticed. After a distant station is tuned in, adjustment should be made on the midget condenser, which until now should have been set that the plates are completely out of mesh. This condenser should be adjusted preferably on a station around 300 meters. If oscillations occur in the detector when the dials are returned, the midget condenser should be again adjusted to the point where oscillation ceases and the signals are at their maximum intensity. After this the SENSITIVITY control can be adjusted for best results and then left that way. Any given station can be tuned in at two positions on the oscillator dial amounting to a frequency difference equivalent to the B frequency which is in this case about 37 kilocycles. That is, the two positions at which a station can be tuned in are twice 37 or 74 kilocycles. Some times a given station will come in better at the upper setting than the lower setting or visa versa, due to interference on either one or the other of the settings. Several hours of experimenting will soon lead to skillful handling of the dials.

Chicago Radio Fan Hears Australia in Midsummer

Chicago, Ill.—"It can't be done—but here it is," says Virgil C. Zeis, of 106 S. Thatcher Avenue, Riverforest, Illinois, as he produces his verification of reception from The Westralian Farmers Limited, relating to the reception of Radiophone 6WF, located at Perth, Australia. The reception was accomplished in the wee small hours of the morning on June 25th, proving that the early bird with a good set gets the long distance stations.

Mr. Zeis uses a superhetrodyne in his radio prowling around the globe, in which he has included a number of his own ideas. He has built the circuit around the World's Record Super transformers more generally known as Selectone R-410 and R-400, which are manufactured by the Scott Transformer Company.

In a recent letter to Mr. E. H. Scott, the designer of the Selectone radio transformers, he says:

"Dear Mr. Scott:

I feel sure that you will be interested to know that the receiver I am using, which employs your transformers, is performing wonderfully. I have just received verification of reception of 6WF at Perth, Australia, on the morning of June 25th, 1927. This station came in with sufficient volume to be heard all over the downstairs of a big house.

He climaxpes his letter with the modest mention, "I have also received Station JOCK at Japan, and am at present waiting for verification of this reception."

Panel Template of 1928 "Nine-In-Line".

<table>
<thead>
<tr>
<th>List of Parts for 1928 &quot;Nine-In-Line&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1—H. F. L. Transformers No. H210</td>
</tr>
<tr>
<td>2—H. F. L. Transformers No. H215</td>
</tr>
<tr>
<td>3—H. F. L. Transformers No. H210</td>
</tr>
<tr>
<td>1—H. F. L. R. F. Choke L425</td>
</tr>
<tr>
<td>1—H. F. L. R. F. Transformer L430</td>
</tr>
<tr>
<td>1—H. F. L. Output Transformer C16</td>
</tr>
<tr>
<td>1—Benjamin Sockets No. 9044</td>
</tr>
<tr>
<td>2—Benjamin Brackets No. 8629</td>
</tr>
<tr>
<td>2—Remler Universal Drum Dials</td>
</tr>
<tr>
<td>2—Remler .0005 mfd. Variable Condensers</td>
</tr>
<tr>
<td>2—Carter 1 mfd. By-pass Condensers</td>
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<tr>
<td>1—Carter .0005 mfd. Fixed Condenser</td>
</tr>
<tr>
<td>2—Carter .002 mfd. Fixed Condensers</td>
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<tr>
<td>1—Carter 6 ohm Rhoestat</td>
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<tr>
<td>1—Carter 6 ohm Rhoestat with Switch</td>
</tr>
<tr>
<td>8—Carter Cord tip jacks</td>
</tr>
<tr>
<td>1—Carter 200,000 ohm &quot;Hi-Ohm&quot;</td>
</tr>
<tr>
<td>1—Amperite Type BM Multplug</td>
</tr>
<tr>
<td>1—Celeron 7'x26&quot;x3'/16' Drilled and Engraved Panel</td>
</tr>
<tr>
<td>1—Celeron 8'x24&quot;x3'/16' Drilled Sub-Panel</td>
</tr>
<tr>
<td>3—Ampereit</td>
</tr>
<tr>
<td>30—Feet Acme Celeste Wire</td>
</tr>
<tr>
<td>1—Package Kester Radio Solder Miscellaneous Lugs, Screws, Nuts, etc.</td>
</tr>
</tbody>
</table>
Now a World Chain
(Continued from page 29)

WGY is known throughout the world as a result of rebroadcasts of its short wave stations. Perth, Australia, over 11,000 miles away, picked up the Schenectady stations and rebroadcast. Last winter a half hour from WGY was a program feature of the British Broadcasting Company every Tuesday night for several weeks. Stations in South America, Germany, Spain and France have all carried WGY’s programs. So well known is the reliability of 2XAF and 2XAD’s signals that cables are generally received when sporting events of international interest are planned. On the eve of the Dempsey-Sharkey, and Dempsey-Tunney fights, 2XAF was asked to broadcast these features. Men in the service, Army or Navy, have already written WGY from distant posts, requesting that the Army-Navy football game be carried on short waves. Three polar expeditions reported receiving the Dempsey-Tunney fight story via 2XAF.

Engineers of WGY are hopeful that the management of 2FC may be interested in carrying a special program for the United States at an hour when more listeners will find it convenient to be at their radio sets. This would mean that Australia must start its program about 6:00 a.m.

Linked Broadcasting
One chance of relief from the present overcrowded situation of the radio broadcasting stations in the United States was indicated by O. H. Caldwell, Member of the Federal Radio Commission for the Eastern District, at a meeting of the New York Section of the American Institute of Electrical Engineers in October. The plan is to have a number of the broadcasting stations use the same radio wave for the same program. There is a growing tendency for broadcasting stations to operate in chains, a number of stations being connected by long-distance telephone wire so that all broadcast simultaneously a program coming from the same studio. On one recent occasion as many as 87 stations in all parts of the country were thus linked together. Such linked stations now use different wavelengths, so that the ether over the United States is apt to be clogged with the self-same program material.

One wavelength would be enough, for then anyone who wanted that program could tune in to that wavelength and receive any one of the stations in the chain broadcasting it. The chief difficulty in arranging this is the technical one of keeping all of the stations exactly on the same wavelength. A very tiny variation would spoil the result, as the stations would then interfere with each other. The problem is not unlike that of an orchestra leader, who must see to it that all the musicians under his baton are playing in exactly the same key. Mr. Caldwell believes, however, that this technical difficulty will soon be solved.

“The World’s Finest Loud Speaker”
Never before in the history of Radio has there been a more outstanding success. The “Ensco” 3 foot cone has been the wonder of the leading Radio Engineers. The faultless tone, reproducing perfectly every musical frequency has astonished many leading artists.

Build It Yourself From The “ENSECO” Kit
The “Ensco” is sold only in kit form. Every necessary part is included in the kit. The “Ensco” unit designed and patented by Clyde J. Fitch, is the only direct-drive unit which satisfactorily operates a 3 foot cone. No soldering necessary. Six styles and three sizes to choose from, all described in the illustrated instruction book which is included with every kit. Assembled in less than an hour.

STANDARD KIT $10.00
With Hardwood Wall Frame - $11.00

At Your Dealer or Direct From Us
Go to your dealers’ store today—hear the “Ensco” in competition with any other speaker regardless of price. To hear it, is to buy it.

If your dealer hasn’t supplied you, you may send your order direct to any of the offices listed below. Send Check, Money Order or C. O. D. (shipping charges paid.) In Canada, the prices are $11.50 and $12.50.

You take no chance when you order direct, our money back guarantee protects you.

Engineers’ Service Co.
25 Church St., New York
20 E. Jackson Blvd., Chicago
73 Cornhill, Boston
231 Bay St., Toronto, Ont.
Enesco Ad. No. 129-O. V. 1927

Please Mention Radio Age When Writing to Advertisers.
Short Wave Receiver
(Continued from page 6)
bus are needed. There is no advantage in square bus other than it is rigid and stays where it is put. Often the capacity between wires has a material effect on signals. If flexible wire is used, a slight jar will be sufficient to completely throw the circuit out of resonance, destroying the calibration.

Use nothing else but rosin core solder in soldering connections. Be sure that the tip is applied to the wires until the solder and rosin flux flow freely insuring a good electrical contact. Often when rosin core solder is used and not heated properly the rosin will form a coating beneath the solder which results in a poor electrical connection or none at all. Do not use acid or paste flux.

Instruments for use on short waves are far more critical than is generally believed. A condenser which is perfect on 300 meters is a dismal failure on forty. The condensers must have rigid plates and must stay where placed. Moving one a hair's breadth is enough to lose a station. This requires a very low vernier ratio. The condensers selected meet these requirements, especially in conjunction with drum dials which will tune to half a hair's breadth and not move at all when the fingers are removed from the knobs.

On each dial is mounted a pilot light which is run directly from the six volt storage battery. The lighted dial is a sure tone to the nerves, relieving all strain effectively.

To be really efficient a coil must have a minimum dielectric in the field, have spaced turns and be wound with heavy wire. The ones we use fill these requirements to a dot. They are mounted on a transparent form and are rugged enough to withstand rough handling. Signals are frequently so close that it is impossible to remove one coil from the socket and place another in in less than three seconds, giving an almost instantaneous shifting of wave bands.

A single primary coil is used which will easily handle both bands. This is mounted on a pivot so it may be rotated to vary the coupling. The primary circuit is not critical, but many operators find that by using a primary condenser they are able to increase the volume of signals and add a bit of music to their programs. If the same aerial is used for both the broadcast and short wave receivers, then the condenser has to be employed. Any old one you happen to have on hand will be good enough.

In order to regenerate the radio frequency current must be fed from the plate into the feedback coil. By consulting the diagram one will see that there is a choice of two channels, the one other one through the amplifying transformer. This latter course is most undesirable so to prevent radio frequency current from entering the choke must be used. This choke must be small and compact. It successfully retards all tendency of high frequency current to pass but allows the B potential to reach the plate without loss.

If code signals are especially desired a high ratio transformer must be used. One of six to one ratio will give greatest volume and plenty of distortion. This is advisable for it is often necessary to distort a signal to make it stand clear of a background of static or other interference. If music and voice is wanted most then a regular broadcast transformer is desirable. On 90 volts a 4½ volt bias is used. It is not advisable to use a higher plate voltage than this. As this receiver is designed primarily for headphone use only one step of amplification is employed in the loudspeaker. Loudspeaker reception on short waves has been as a rule a bit unsatisfactory for signals are so sharp it is quite hard to tune them in.

In connecting the batteries to the receiver place them as close to the set proper as possible and do not make long leads good for they interfere with the receiver. It sounds rather queer to the uninitiated, but a set of this nature will tune a full fifteen meters lower on the largest coil when out of a cabinet than when in. Opening the lid of the cabinet changes the tuning five meters. If the receiver must be housed, place it within a grounded metal case. Now to get back to the batteries. Short waves every piece of wire in the circuit acts as a miniature aerial. If the battery leads amble all over the room they are liable to set up some interference. An eliminator is no good, for the hum cannot be ironed out on wavelengths longer than forty meters.

The operations of this set is similar to the old style regenerative receiver, only the "wax and sugar" tuning is fairly easy, the regenerative condenser being far from critical. If the tuning is disturbed when this condenser is swung it is a sign that the receiver is not functioning properly. Also while on the subject, no signals should be heard when the aerial and counterpoise are disconnected unless set is inductively coupled to another in the same room. The wire from the aerial is a definite proof that the set has too much wire in it. On twenty meters every Ford with in 200 feet will be distinctly audible, and at times are quite objectionable. No other car save certain trucks have any effect. The short wave receiver at the laboratory this receiver picked up signals from the Philippines, Syria and Czecho-Slovakia, not to mention numerous stations in America. Since that time we have logged every continent but Africa and expect to get that soon. All of these were of course telegraphic, that is, code.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC. REQUIRED BY SECTION 351, ACT OF CONGRESS OF AUGUST 24, 1912.

Of RADIO AGE, published monthly at Mount Pleasant, N. Y., for October, 1927.

State of Illinois.

County of Cook.

I, a, a Notary Public in and for the State and county aforesaid, personally appeared Frederick A. Smith, who, having been duly sworn according to law, deposed and said that he is the President of the RADIO AGE, and that the true and correct statements of the following particulars, which is true and correct statements of the following particulars, namely: The nature of the paper, the circulation, etc., of the aforesaid publication for the date shown in the above required by the act of Congress of August 24, 1912, embodied in section 431, Postal Laws and Regulations, printed on the reverse of this form, to wit:

That the names and addresses of the publisher, editor, managers and business managers are: Publisher, RADIO AGE, 2424 N. Lincoln Ave., Chicago, Ill.; Editor, Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; Managing Editor, Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; Business Manager, M. B. Smith, 500 N. Dearborn St., Chicago, Ill.; and that this is the office of the publication.

That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of the individuals having a beneficial interest in the corporation, including officers and directors. If the corporation is a trust, the name and address of the person entitled to the trust must be given.) RADIO AGE, Inc., 500 N. Dearborn St., Chicago, Ill.; Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; M. B. Smith, 500 N. Dearborn St., Chicago, Ill.; J. H. Lobbeck, deceased, St. Louis, Mo.

That the known bondholders, mortgagees, and other security holders owning or holding one per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

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That the average number of copies of each issue of this publication sold or distributed through the mails in each of the six months immediately preceding the date shown above is 5,000 copies (this requirement is required from daily publications only).

FREDERICK A. SMITH, Editor.

Sworn to and subscribed before me this 15th day of October, 1927.

AMANDA FRIS.

My commission expires Mar. 5, 1929.
Court Victory for A. R. R. L.

Municipal ordinances designed to limit or regulate amateur radio transmitting stations within their jurisdiction are unlawful and unconstitutional and cannot be enforced, in the opinion of Judge A. M. Cochran, of the district court of Kentucky, who has just handed down a decision in a test suit brought by a member of the American Radio Relay League, requesting an injunction against a Wilmore, Ky., radio ordinance.

Pointing out that radio communication was obviously interstate commerce, and as such was subject only to Federal regulation and control, Judge Cochran turned down a plea for dismissal on the part of the city authorities and sustained the request of the League's counsel for an injunction preventing enforcement of the local ordinance.

The Wilmore ordinance, which is similar to many other municipal ordinances, was passed by the city in 1926, and was aimed at amateur stations operated within the city limits. Various regulations in connection with the operation of such stations were set down, and a yearly license fee of $100 was imposed.

The American Radio Relay League of Hartford, Conn., the national association of amateur radio operators, immediately instituted suit for an injunction on behalf of the local operator through its counsel, Mr. Paul M. Segal, of Denver, Colo. Mr. Segal, who has had considerable experience in radio legal matters, pointed out that amateur radio communication was interstate commerce and of such nature as to require a uniform system of regulation for the entire country.

"Since amateur radio communication admits of a uniform system of regulation throughout the United States," pointed out Mr. Segal, "it follows that the complete and exclusive regulation thereof is vested in Congress and its agencies, and that the non-enforcement of Congress in any phases of amateur radio is equivalent to a declaration that in those respects it shall be free and unregulated.

"In amateur radio communication," he continues, "there is practically nothing of local concern. Wavelength, power, note, type of apparatus, time of operation, etc.; all these are matters of national and international concern and hence far above the power of the State or the municipality to reach through the police power."

The decision of Judge Cochran is expected to constitute a precedent in connection with similar regulatory measures now in effect in other cities throughout the country. In addition, Mr. Segal believes that few new measures along these lines will be passed, in view of the outcome of the Wilmore suit.

The text of Judge Cochran's opinion is as follows: "This suit is before me on defendant’s motion to dismiss the bill for want of equity and that it does not state facts sufficient to entitle plaintiff to the relief which he seeks."

"The plaintiff is an amateur radio operator. He lives in and operates an amateur radio station located in the City of Wilmore, a municipality that of this State located in this District. This he has done since

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KEI Earl L. White,...Burbank, Calif. 229
KEX Western Broadcasting Company,...Portland, Ore. 222
KFAB Nebraska Buick Auto Co.,...Lincoln, Neb. 309
KFAD Electrical Equipment Co.,...Phoenix, Ariz. 273
KFBB Bishop School Dist.,...Los Angeles, Calif. 268
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October, 1924. He has a license to do so from the United States. It was granted to him October 19, 1923, for two years by the Secretary of Commerce, under the Act of August 13, 1912, and was extended March 15, 1927 by the Federal Radio Commission, appointed under the Act of February 23, 1927, by General Order No. 1, to further orders therefor.

The designation of his station is 9ALM.

"On October 1, 1926, the defendant by its Board of Council passed an ordinance requiring all persons, firms and corporations operating a radio broadcasting station, either commercial or amateur, to pay a license tax thereby providing a penalty for failure to do so. The tax provided is not on the property of the radio operator, but on the business of radio broadcasting. Radio communications are all interstate. This is so though they may be intended only for intrastate transmission. And interstate transmission of such communications may be seriously affected by communications intended only for intrastate transmission. Such communications admit of and require a uniform system of regulation and control throughout the United States. And Congress has covered the field by appropriate legislation. It follows that the ordinance is void as a regulation of interstate commerce. "The motion to dismiss is overruled."

A. M. J. COCHRAN, Judge.

Marconi Uses "Mike"

The inventor of radio, Senator Guglielmo Marconi, hadn’t faced a microphone for more than five years until he went on the air in a brief message to the American people, through Station WRC at Washington, during his recent hurried visit to the United States to address the international radio conference.

Marconi hadn’t time to visit the station studio, so wires were strung through his hotel corridors and a microphone installed in his room. He spoke in his shirt sleeves, necktie in hand, while dressing to attend a farewell dinner in his honor at the Italian embassy, after which he was to catch a midnight train to New York to make his boat, which sailed the following morning.

"The amazement of the world, twenty years ago, at the invention of the young Italian genius, seemingly was equaled by Marconi’s amazement at the extent to which America has developed radio. "Broadcasting in America," he said, "has gone far beyond all early expectations. Its preeminence in this country today is due in large part to intelligent public interest and the appreciation of radio possibilities by American technical and merchandising organizations and the support they have given to its development.

"I am told that a series of programs is soon to be put on over a chain of no less than 28 stations by General Motors. Hardly a greater proof of the dependability and value of radio broadcasting could be given than the decision to utilize so extensive a network in development of radio programs. "The adoption of radio broadcasting by an industrial organization of the magnitude of General Motors is ample proof that radio is definitely accepted as an efficient and powerful method of maintaining contact with the public.

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The Melody Ship

And now comes the unexpected—A loud speaker that is really pleasing to look at. Perhaps it may be considered rash to speak of the loud speaker as a thing of beauty, but the Melody Ship is an object that combines the great advantage of a utility with its handsomeness.

The Melody Ship is a new loud speaker. To all appearances it is a beautiful ship model handsomely decorated, sails of an intricate net work of riggings, rope ladders and guides that seem to wander aimlessly amongst the sails and masts.

On close observation one will notice that the decorated main sail is the diaphragm of a loud speaker. Behind the diaphragm one will see a loud speaker unit fastened to the main mast. Two slender wires running from the unit is the only indication that the ship is anything but an excellent replica of a historic vessel.

The evolution of the loud speaker has been from the horn type to the cone type, the most advanced change in loud speakers. The cone type because of its large diaphragm and peculiar construction of the reproducing unit has a wider tonal range than the horn type. Following the development of the cone speaker much attention has been given to combining beauty with tone quality.

With this idea in mind which provides a loud speaker which would be beautiful both to the eye and ear, J. E. Sanders, an engineer of the Miniature Ship Models, Incorporated, of Philadelphia, has developed such a practical instrument after many months of experimentation. The reproducer which he called the Melody Ship is both unique in its design and beautiful in appearance. He has reproduced a number of the most historical ships of many centuries ago and incorporated with them the melody sail. The ship is made entirely of wood which is a distinct aid to toning quality and eliminates counter vibrations which cause distortion. Every part of the ship is a material aid in catching the vibration of the speaker and enriching the tone quality.

The development of the Melody Ship was not merely an accident. Many months of diligent labor and experimenting were spent before Mr. Sanders arrived at the present degree of perfection. Many difficulties had to be overcome in shaping the diaphragm to conform to the shape of the ship's sail. Even the seemingly insignificant joining together of the seam in the diaphragm presented almost insurmountable obstacles. It was found that the different tone qualities resulted from the manner in which the melody sail was placed on the ship.

When Mr. Sanders developed the Melody Ship he did so with the idea of using it solely for his own use but the novelty of the idea met with such instantaneous approval that he incorporated it with the ship models that he was manufacturing in the knock down form.

It is a very simple matter to build one of these radio loud speaker ship models in a few hours. The building of ship models has become so simplified that small boys and even small girls are building them in all parts of the world. The knock down system of building by what the
manufacturer supplies, all necessary parts and complete instructions for assembling, has been an added impetus to ship model building.

Now that the loud speaker has been incorporated with the ship model it is expected that the small ship replica will have even greater use.

Paralysis of Tubes
Vacuum tubes, in use today, for the most part, have so-called thoriated tungsten filaments, the action of which, even at this late date, is not fully appreciated by the average listener.

The electronic emission of the thoriated tungsten filament, according to S. Ruttenberg, Chief Engineer of the Radall Company, depends upon the presence of a layer of thorium atoms on the outer surface of the filament. It will be noted that, unlike the oxide-coated filament found in some tubes, the thoriated tungsten filament is not merely thorium-coated, but it is permeated throughout its entire mass with the rare element thorium. During the normal operation of such a filament, the thorium on the outer surface is gradually evaporated, reducing the emission current and, if permitted to continue, rendering the tube short-lived.

However, while the heat of the filament serves to evaporate the thorium particles on the surface, it is also boiling fresh thorium particles out of the mass and up to the surface. Thus the surface is being continually replenished. Just so long as the filament voltage is not increased beyond 10 per cent above the rated value, this evaporation and replenishing process continues at an equilibrium rate, so that a constant layer of thorium is maintained on the surface.

When subjected to an over-voltage on the filament, however, the evaporation becomes excessive, so that the tube accordingly becomes more or less paralyzed. Operating these tubes at sub-normal voltages is also liable to paralyze them slowly, as the filament temperature is then so low that the process of boiling out the thorium from the interior of the filament becomes abnormally retarded. Hence it is important that the thoriated tungsten filament tubes be operated strictly at their rated voltage, by means of hand rheostats with an accurate voltmeter, or, better still and simpler, by means of amperites, the self-adjusting rheostats.

SUPERS IN DECEMBER
Read the December issue of Radio Age for another extensive group of how-to-make articles on the latest supers.

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The biggest edition ever published. Brimful of newest information, latest circuits and hook-ups, new revised list of world's broadcasting stations with schedules and new wave lengths in meters and kilocycles. 264 pages of news, ideas, and valuable information for fans, set builders, radio dealers and everyone interested in radio's advancement.

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All Electric
Or Battery Operation

AGAIN Marwood is a year ahead—with the Radio sensation of 1928—at a low price that makes the Radio profitable. Here's the sensation they're all talking about—the marvelous 8 Tube Single Control Marwood for BATTERY or ALL ELECTRIC operation. Complete Discount Control. You can't beat this price, for it is below that of smaller, less powerful Radios. Big discounts to Agents from this price. You can't beat this wonderful new Marwood and you can't touch this low price. Why pay more for less quality? To prove that Marwood can't be beat we let you use it on 30 Days Free Trial in your own home. Test it in every way. Compare it with any Radio for tone, quality, volume, distance, selectivity, beauty. If you don't say that it is a wonder, return it to us. We take the risk.

New Exclusive Features

Do you want coast to coast with volume enough to fill a theatre? Do you want amazing distance that only super-power Radios like the Marwood can deliver? Do you want a Radio free from cutout interference? Then you must test this Marwood on 30 Days Free Trial. An emergency service awaits you. A flip of your finger makes it ultra-selective—or broad just as you want it. Truly Marwood is perfectly BALANCED—a real laboratory job. Its simple one dial control gets ALL the stations on the wave band with ease. A beautiful, guaranteed, super-efficient Radio in handsome walnut cabinets and consoles. A radio really worth double our low price.

Buy From Factory—Save 1/2

Why pay profits to several middlemen? A Marwood in any retail store would cost practically three times our low direct-from-the-factory price. Our policy is highest quality plus small profit and enormous sales. You get the benefit. Marwood is a pioneer, responsible Radio, with a good reputation to guard. We insist on the best—and we charge the least. If you want next year's improvements NOW—you must get a Marwood—the Radio that's a year ahead.

Get Our Discounts
Before Your Buy a Radio

Don't buy any Radio till you get our big discounts and catalog. Save half and get a Radio that is 8 Radios. Try any Marwood on 30 Days Free Trial at our risk. Tune in coast to coast on loud speaker with enormous volume, clear as a bell. Let your wife and children operate it. Compare it with any Radio regardless of price. If you don't get the surprise of your life return it. We take the risk. Don't be surprised of the life return it. We take the risk. Don't be surprised of the life return it. We take the risk. Marwood is not the highest quality. We have smashed Radio prices. You save half.

6 Tube—1 Control

This is the Marwood 6 Tube, 1 Control for BATTERY or ALL ELECTRIC operation. Get's coast to coast on loud speaker with great volume. Only $47.00 retail. Big discounts to Agents. Comes in handsome walnut cabinets and consoles. This low price cannot be equaled by any other high grade 6 tube Radio. Has the volume of any 7 tube set. If you want a 6 tube Radio you can't beat a Marwood and you can't touch our low price.

$47 RETAIL PRICE

Big Discount to Agents
From this Price

Rush for Free Trial

M AR W O O D R A D I O C O R P.
5315 Ravenswood Ave., Dept. B-3, Chicago, Ill.

Get your own Radio at wholesale price. It's easy to get orders for the Marwood from your friends and neighbors. Folks buy quick when they compare Marwood quality and low prices. We want local agents and dealers in every territory to handle the enormous business created by our national advertising. Make $100.00 weekly or much more spare time demonstrated at home. The experience or Marwood sales will open your dreams of the biggest season in Radio history. Everybody wants a Radio. Get in now. Rush coupon for 30 Days Free Trial. Beautiful Catalog, Agents' Confidential Prices and Agents' New Plan.

$98 RETAIL PRICE

Make Big Spare-Time Money

Has Complete A-B Power Unit
A REAL, ALL ELECTRIC Radio with one of the best A-B power units on the market—no batteries needed—at the world's lowest price. This Marwood can't be excelled at ANY price. If you have electricity in your home, just plug into the light socket and forget batteries. No more battery trouble and expense. Costs less than a day to operate. Always have 100% volume. ALL ELECTRIC Radios are high priced because they are new. We cut price to the bone and offer $75.00 worth for $99.00 retail and $4.50 to Agents. Don't buy any Radio till you see results of this sensational new ALL ELECTRIC Marwood.

Little Agents

A G E N T S

Comes in handsome walnut cabinets and consoles. This low price cannot be equaled by any other high grade 6 tube Radio. Has the volume of any 7 tube set. If you want a 6 tube Radio you can't beat a Marwood and you can't touch our low price.

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Radio A Continuous Story

In order to get the most out of his radio magazine the reader should follow it issue by issue, for the reason that many of the more important constructional articles partake of the character of serials, covering the development of a circuit. For example readers probably will not want to miss future articles on the Quadrode Superheterodyne.

Comprehensive articles on other circuits will be starting in the December issue. The set builder should get the original articles so that he can follow the circuits through their various stages.

Give your order for the December issue to your dealer now or, better still, send $2.50 in stamps, money order, or registered currency remittance for a year's subscription.

RADIO AGE
500 North Dearborn Street, Chicago, Ill.
10,144 Mile Reception with a Subantenna

10,144 miles—and the music came in loud and clear! Mr. J. O. White, residing at 217 Wyckoff Ave., Brooklyn, New York, established the world’s distance record for reception within the B.C.L. band of 200 to 550 meters by tuning in 2FC and 3AR Australia with a simple six tube tuned radio frequency set—and a Subantenna. Think of it! 10,144 miles, and reception that was not only audible—but loud, clear, crystal clear, enjoyable music and song that Mr. White listened in on for some time before tuning it out and seeking other far away stations. The results obtained by Mr. White prove the distance getting capabilities of Subantenna beyond all doubt.

More Stations—No Static
"I get plenty of stations with my Subantenna, on the loud speaker, that I have never been able to reach with my outside aerial. It absolutely cuts down interference to the minimum, cuts static out too—not just partly out—but ALL OUT."—H. S. M., North Carolina.

Results—Almost Unbelievable!
"After years of testing aerials I at last found the master in the Subantenna. The first night I used it was a very hot summer night. Static was very bad on my outdoor aerial. I connected my Subantenna and could hardly believe the results. It was wonderful."—F. L., Co., Massachusetts.

Say “Static Is No More”
"I have received the Subantenna. My son installed it. STATIC IS NO MORE. I am well satisfied. I can tune in stations I could not hear out of the air even though I was on a long aerial."—A. E. F., Kansas.

Ground Waves Are Practically Static-Free—That's Why Subantenna Gives Greater Distance and Clarity
The same radio waves that you have always taken out of the air, also travel through the ground. The only difference between the air and ground components of the broadcast wave, is that the latter is practically static free, while the air component is always accompanied with static or noise of one kind or another. Scientists have long recognised this fact, and knew that if some device could be perfected for the reception of ground waves, clear, loud, long distance reception would be a reality for the owner of the modest three or four tube set as well as for the possessor of the larger, more powerful set. Subantenna is the answer—tried, tested and proved by thousands of owners of all kinds of sets, and recommended to you by such leading radio laboratories as Radio News, Popular Radio, Radio Digest, and others.

Try It On Your Set FREE
Install Subantenna. Leave your old aerial up. Select a bad night when DX is almost impossible with the ordinary aerial. Make a comparison station for station, concentrating first your aerial, then Subantenna. If, from stations that are just a mess of jumbled noise with the old aerial, you don’t get reception that rivals local in sweetness and clarity the instant you switch to Subantenna, this test won’t cost you even a single penny. Obtain a Subantenna from your dealer or send coupon at once for scientific explanation of Subantenna and for particulars of GUARANTEE and FREE TRIAL OFFER.
If you have anything to buy or sell, don't overlook RADIO AGE's classified advertisements.

The classified advertising rates are but four cents per word for a single insertion. Liberal discounts are allowed on six and twelve-time insertions, making rate of 3 and 2 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for December issue must be sent in by Nov. 10.
A combination of a beautiful ship model and a loud speaker that is easily worth $100. You can build it yourself in a few spare hours with no other tool than a small tack hammer.

The famous Melody Ship which has met with instant approval everywhere it has been shown and played can now be purchased in knock down form at the startlingly low price of $12.50. This remarkable speaker combines

PERFECT TONE - PLENTY OF VOLUME - NO DISTORTION

No doubt you have often admired ship models and yearned to possess one but could not do so because the price was too high. Now it is possible to own a beautiful ship model and loudspeaker combined at a small cost. Let the WORLD'S LARGEST BUILDERS OF SHIP MODELS AND SHIP MODEL LOUD SPEAKERS supply you with all the necessary parts, cut to fit and ready to assemble from which you can build a beautiful model of the historic Mayflower, the Santa Maria or the La Pinta in a few hours. To all outward appearances the completed model is a beautiful ship model but upon closer observation a loudspeaker can be seen cleverly incorporated into the mainsail.

The loud speaker unit is of the Electro Magnet type. Power amplification is not needed to force the low tones through. They come through with perfect ease and do not interfere with the high notes, giving faithful reproduction at all frequencies. The mainmast, upon which the unit is securely fastened is seated two inches deep in a three and a half pound solid wood hull, making it impossible for counter vibrations to affect the perfect reproduction of the Melody Sail. The driving pin is attached to our super-vibrating, especially prepared, Melody Sail. The installation of the Melody Sail does not change the appearance of the model in any way. Melody ships come in three beautiful models, the Mayflower, the Santa Maria and the La Pinta, with parts cut to fit and ready to assemble. No tool needed but a small hammer.

You need not know anything about ship building or carpenter work in order to build one of these ships. No special knowledge of ship model building is necessary either. We will supply all the parts from the hull down to the smallest piece of rigging, all cut to fit and ready to assemble. You cannot go wrong. Diagrams and plans of parts that are included with each kit tell exactly what to do with each part.

These plans show you step by step just how the model is constructed. Everything is made so simple that even a small child can build a beautiful model.

All you need is a small hammer to tap the parts into place. Here is a part of the instructions copied word for word from the diagram and instruction sheet that goes with the kits. "Take part No. 57 place it in front end of part No. 56 and tap lightly with a hammer. Next take part No. 58 and place it up against No. 57 and tap it with a hammer to bring it into place."

Easy! Nothing simpler. The instructions are like that from beginning to end. Do this and that and before you realize it a beautiful ship model has grown before your eyes.

Write for our free beautifully illustrated catalog which contains photographs of all our models together with complete details and price of each. We will send this catalog without obligation to you. Fill in the coupon below and we will act upon it immediately.

If, after assembling the model you do not think it worth many times the purchase price, return it to us in good condition and we will gladly refund your money.

MINIATURE SHIP MODELS, Inc., DEPT. 22

Canadian Prices Slightly Higher. Send all Canadian Orders to Canadian Office.

MINIATURE SHIP MODELS, Inc., DEPT. 22

Please send me complete parts, cut to fit and ready to assemble for the Melody Ship. ____________________________________________________________________________ for which I agree to pay postage $12.50, plus postage.

PLEASE PRINT NAME AND ADDRESS NEATLY

Name __________________________________________________________________________________________

Street or R. F. D. _______________________________________________________________________________

City ___________________________________________________________________________________________

State _________________________________________________________________________________________
When the ball goes 'round the end for 40 yds.

"You're there with a Crosley!"

The Crosley Radio Corporation
If you explain "balancing," no folks can understand it. No technical people know that Hazeltine's neutrodine principle is a wonderful thing. If you can make it understandable, you must be a good man.

Young Life, Chicago, Ill.

N-tube always puts obstacles in our way. When we learn to apply for patents and discoveries they find that there are many obstacles to move before a successful desire can be built. This was the rate with the automobile, the telephone, the airplane, and every other major invention that you can think of. The vacuum tube is, perhaps, one of the most remarkable inventions ever made. We found that we could use it to amplify the radio signals. But when we tried to tune them, so that they would help us get the desired signal, we found that the vacuum tube had a tendency to mislead.

When a tube is used to amplify, the output voltage is much stronger than the input voltage. This is the result of the amplification. But there is a path back through the tube which some of the strong output voltage can get back to the lower side of the tube. This voltage is then again amplified and again returns to the output side, so that the result is that the tube goes wild. It becomes a miniature broadcasting station on its own hook. If we can provide a second path from the output circuit to the input circuit, we can prevent this tendency to mislead. This is called "balancing." It involves that the second path is adjusted so that it balances the path through the tube. The Hazeltine method of balancing (or neutralizing) is used to work through the vacuum tube. The advantages that are developed are unique advantages over all other methods. These have been proposed, this is why Crosley Radio uses the Hazeltine "neutral-dyne" method.

Signal Voltages Leaving Tube: Greatly Amplified but Some Run Around to Entrance and Cause Tube to Sound Like Radio Station. How to Eliminate This Disturbing Signal.

Signal Voltages: Leaving Tube: Greatly Amplified, but Some Run Around to Entrance and Cause Tube to Sound Like Radio Station. How to Eliminate This Disturbing Signal.

Hazeltine Diodes Bolster Tube Voltages. Balancing Each Other by Opposites. How They Cause No Disturbance in the Tube and Program Signals Go Through Amplifier Without Interference

This new Crosley Bandbox 6 Tube Receiver de luxe is the national radio hit at $55.

The "All American" radio of 1928! With license to participate in the enormous radio resources of The Radio Corporation of America, The General Electric Co., The Westinghouse Co., The American Telephone and Telegraph Co., and The Hazeltine and The Latour Corporations, the Crosley Bandbox of 1928 is an "eleven" of super-efficient features and amazing co-ordinated performance. In it are incorporated:

1. The best idea of balancing.
2. The best ideas of shielding.
3. The best idea of sharp turning.
4. The best idea of controlling volume.
5. The best idea of station selection.
6. The best idea of finish and comfort.
7. The best idea of power tube use.
8. The best idea of console installation.
9. The best idea of power supply connections.
10. The best idea of AC tube operation.
11. The best idea of converting AC current to necessary radio DC.

Operation of the Bandbox receiver from house current is possible with the AC model at $65, which uses the new amazing R. C. A. AC tubes. Power converter costs $60 more.

These new Bandbox receivers are now on display at over 16,000 Authorized Crosley dealers. Their faultless reception of the many wonderful events constantly on the air is proving such a startling demonstration that a national enthusiasm sweeps the country in the natural exclamation—"You're there with a Crosley!" If you cannot locate the nearest dealer, write Dept. 63 for his name and literature.

Crosley Radio is licensed only for Radio Amateur, Experimental and Broadcast Reception.

Approved Consols

$65

$85

$35

Selected by Fowey Crosley, Jr. as ideal, aesthetically and mechanically for the installation of the Crosley "Bandbox." Gen- uine Masses built in. Crosley dealers secure them from their patrons through H. T. ROBERTS CO., 1200 S. Madison Ave., Columbus, Ohio, Retail Agents for Approved Canadian Factories. Showers Radio Sales Company, Columbus, Ohio, The Wolf Music Industries, Ltd.

IMPROVED MUSIC BOXES

Musicles improve the reception of radio stations. They are priced for every home and reproduce every note for true tone and quality. A half-inch model with brown mahogany finish, 30 inches high, $8.50; 16-inch Super-Musicles to per- fect sound with "Bandbox" $16.75; 8ncech, $11.75. A Musicles, $9.95.
In This Issue

Robertson-Davis Hot Spot Fourteen
(With Blueprints)
Quadrode Superheterodyne Developments
More About the Screen Grid Tube
Highly Efficient Tuned R. F. Receiver
The New Infradyne Amplifier

A Manual for the Set Builder

Latest List of Broadcast Wave Lengths
Battery or All-Electric Operation

Here is the great value offer of the day. Test and try this powerful seven-tube Randolph Radio for thirty days. After it brings in stations from coast to coast with amazing clearness—with easy one-dial tuning—after it easily equals any other radio regardless of cost—after you are more than satisfied then you can buy it direct at factory prices. Every Randolph must make good before it is sold.

The seven-tube console illustrated here can be had for use with batteries or connected direct to the electric light socket—absolutely batteryless—no batteries, chargers or acids—just plug in and tune in. 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities—by leading radio publications and laboratories.

7 Tubes—Single Control
Illuminated Drum

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a seven-tube tuned radio frequency receiver. Has built-in tone loud speaker that compares with any on the market. Accurately reproduces complete range of musical notes from the highest to the lowest pitch.

Beautiful Walnut Console
Built-in Cone Speaker

The Randolph Seven-tube Ampliphonic Console illustrated above is housed in a genuine burled-walnut cabinet with two-tone hand rubbed finish giving it unsurpassed beauty. The same expert cabinet work has gone into the making of the consoles in the finest furniture. Has built-in tone loud speaker that compares with any on the market. Accurately reproduces complete range of musical notes from the highest to the lowest pitch.

What Users Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas. I have logged 15 stations from Cuba to Seattle; the set is a world beater.—J. Tampkinson, Detroit, Mich. Your set is a revelation, has all others tied in the post for distance and selectivity.—Waldo Powers, Vergennes, Vermont. On strength of its performance sold two more sets this week.—T. Scanlow, Orlando, Florida.

MAIL COUPON NOW!

The Senior Six
Now you can have a new, modern, single-control, six-tube radio. Do not compare this set with old style 5-dial 4-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers. Comes in a handsome solid walnut cabinet of hand-rubbed finish. Single control turns the large tuning cone with ease. Accurately tuned to best frequencies. Hand-rubbed finish. Dependable and very selective. Sent for 30 days Free Trial. You test it before you buy.

The Randolph Radio Corporation are pioneers in the manufacture of radios. All of its vast and unlimited resources have been used in making and perfecting of the Randolph Receivers. Because of our long and successful experiences in the radio business, we are able to offer you a complete operation set for 6 tubes. We know what it will do. Mail us the coupon now for the greatest radio offer ever made.

Randolph Radio Corporation
711 West Lake Street
Dept. 306, Chicago, Illinois

Use this Coupon NOW!


Send me full particulars about the Randolph Six and Seven-Tube All-Electric and Battery Table and Console Sets with details of your 30 Day Free Trial Offer.

Name ...........................................
Address .........................................
City .................................................. State ..........................................
Mark here □ if interested in Agent's proposition.
“MEN! Here’s the ‘dope’ you’ve been looking for—

How to get into the Radio Business”

EARN BIG MONEY
in Work That is
Almost Romance

If you’re earning a penny less than $50 a week, clip coupon now for FREE BOOK. New Book, 64 pages, profusely illustrated, tells all about the Radio profession, thousands of opportunities—in work that is almost romance! You can learn quickly and easily at home, through our tested, improved methods, to take advantage of these great opportunities! Why go along at $25 or $35 or $45 a week, when you can pleasantly and in comparatively short time learn to be a Radio Expert, capable of holding the big pay jobs?

Clip Coupon for Free Book

Don’t envy the other fellow who’s pulling down the big cash! Our proven home-study training methods make it possible for you, too, to get ready for a better job, to earn enough money so you can enjoy the good things of life. One of the most valuable books ever written on Radio tells how—interestingly and easily!—to master this great field, and how we can prepare you, quickly and easily in your spare time at home, to step into a big-pay Radio job. You can do what others have done through our training. GET THIS NEW FREE BOOK. SEND COUPON TODAY.

J. E. SMITH, President
NATIONAL RADIO INSTITUTE
WASHINGTON, D. C.

Send this coupon today

Name

Address

City

State

Please mention Radio Age When Writing to Advertisers.
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Chats

It is now proposed by the Federal Radio Commission to eliminate three hundred additional broadcast stations from the present list. This will bring the total down to less than four hundred stations. This news will bring joy to a group of broadcast station owners who may have reason to believe that they will not be among those cut off. As the number of stations is reduced, the value of the remaining stations is increased proportionately. The station which has a considerable investment in equipment and in a progressive campaign of good will will be reluctant to give up its tangible and intangible property without a protest.

The commission has cut out a difficult job for itself. The federal radio law has not been submitted to any recent acid test by any of the more influential station owners and it is likely that the wholesale reduction in the number of stations will precipitate such a test. E. F. McDonald, Jr., of the Zenith Radio Corporation gave the Washington authorities a shock when he chose his own wave length for WJAZ and then went to court and whipped the government when they objected that the station was "pirating." That led to legislation, which helped to clear the air and for such service Mr. McDonald received both blame and praise.

Far be it from this editorial sanctuary to say what the radio commission should do or should leave undone. It is perhaps permissible, however, to hope that the federal bureau will leave the broadcasting stations alone insofar as is consistent with public convenience and private interest. We have no doubt that the commission is tormented with pressure from political and other influences who desire special privileges but we assume that the commissioners are as aware as the rest of us of the fact that yielding in any measure whatever to such influence would grievously injure public confidence in this commission, or in any commission.

Frederick Smith

Editor of RADIO AGE.
Here is the Eveready Layerbilt “B” Battery No. 486, Eveready’s longest-lasting provider of Battery Power.

Silent Magic

Turn your radio dial, and presto! you turn your home into a theater, a concert hall, a lecture room, a cabaret, a church, or whatever you will. Turn the dial and your attentive ear does the rest. That is all there is to this magic of radio.

Or almost all. If a radio set is to work at its very best, attracting no attention to itself, creating for you the illusion that can be so convincing, you must pay a little attention to the kind of power you give it. There is but one direction, a simple one—use Battery Power. Only such power is steady, uniform, silent. It is called by scientists pure Direct Current. Any other kind of current in your radio set may put a hum into the purest note of a flute, a scratch into the song of the greatest singer, a rattle into the voice of any orator.

Don’t tamper with tone. Beware of interfering with illusion. Power that reveals its presence by its noise is like a magician’s assistant who gives the trick away. Use batteries—use the Eveready Layerbilt “B” Battery No. 486, the remarkable battery whose exclusive, patented construction makes it last longest. It offers you the gift of convenience, a gift that you will appreciate almost as much as you will cherish the perfection of reception that only Battery Power makes possible.

Radio is better with Battery Power

NATIONAL CARBON CO., INC.
New York [***] San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour
Night—9 P. M., Eastern Standard Time
WEAF—New York
WJAR—Providence
WEEI—Boston
WFTI—Philadelphia
WGR—Buffalo
WGAE—Pittsburgh
WSAI—Cincinnati
WTAM—Cleveland
WWJ—Detroit
WGN—Chicago
WOC—Davenport
KSD—St. Louis
WCCO—St. Paul
WDAR—Kansas City
WRC—Washington
WGY—Schenectady
WHAS—Louisville
WSM—Atlanta
WMC—Memphis

Pacific Coast Stations—
9 P. M., Pacific Standard Time
KOP—KGO—San Francisco
KPOA—KONO—Seattle
KFI—Los Angeles
KGW—Portland

The air is full of things you shouldn’t miss
Build Your Own
Power Amplifier

Transform your Receiver into a Real Musical Instrument!

With a screwdriver, a pair of pliers, and a soldering iron you can build a Thordarson Power Amplifier and B-supply in your own home that will equal the finest commercial amplifier on the market. Complete constructional booklet and simple diagram accompany every transformer.

Thordarson R-210 Power Compact
The Thordarson R-210 Power Compact is scientifically designed to give maximum electrical efficiency and to make home assembly of power amplifiers as simple as possible. The R-210 Power Compact is the foundation unit and contains the following apparatus: (1) A power supply transformer designed for UX-216-B rectifier; (2) Two filter chokes of 30 henries inductance and 65 M.A. current carrying capacity; (3) A 7½ volt supply center tapped for the filament of one UX-210 power tube. Wiring of the complete amplifier is simple—20 leads complete the assembly.

New Metal Baseboard for R-210 Compact Amplifier
To further simplify home construction of the R-210 type amplifier, you can now buy this new cranked finished metal baseboard. All spring sockets and binding posts are mounted and included in the list price. All mounting holes are drilled. All holes for sub-panel wiring are carefully insulated. Location of all sub-panel wiring is marked under baseboard.

R-171 Power Compact
This power compact is similar to the R-210 type, but is adapted for home construction of power amplifiers using the Raytheon BH rectifier and UX-171 power tube. Designed to meet the popular demand for a low priced, yet highly efficient power amplifier. Delivers 320 volts either side of center to the Raytheon BH rectifier. The two choke coils are rated at 85 M.A. 30 henries. The filament winding of 5 volts center tapped is suited to one UX-171 power tube. Two 0.1 Buffer Condensers are also included in the case. Wiring the complete amplifier and B-supply is merely a matter of connecting 18 leads.

T-2098 Power Supply Transformer—T-2099 Double Choke Unit
Here is an extra heavy duty power amplifier supply that will satisfy the most exacting demands for excess power. An amplifier using this transformer and choke unit will deliver 425 volts at 130 M.A. drain, sufficient for the heaviest receiver using two UX-210 tubes in power push-pull. Transformer T-2098 delivers 550 volts each side of center tap and is designed to supply two UX-216-B rectifiers (full wave). The 7½ volt filament supply will easily handle two UX-210 power tubes. The double choke unit T-2099 consists of two 30 henries 130 M.A. choke coils mounted in a compound-filled case.

Get this FREE Book!

THORDARSON
Power Compact

THORDARSON ELECTRIC MFG. CO.
500 West Huron St., Chicago, Ill.

Gentlemen:
Please send me a copy of your free booklet "Power Amplification Simplified."

Name:

Address:

City: State:

THORDARSON ELECTRIC MANUFACTURING CO.
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill., U.S.A.
The Quadrode Super-Heterodyne

A Super-heterodyne in the simplest form, with new features and new merits, that make it an outstanding performer among super receivers

Builders everywhere were deeply interested in the description of this circuit in the November issue of Radio Age.

By FRANK FREIMANN

EVERY month brings a "new" circuit of some "dyne" or other into creation, so new in fact, and so wonderful, that, according to its creator, it will send everything else into oblivion. The public has been so overfed within the last few years on circuits that petered out on test that they have finally ceased to be. There have in reality been very few new circuits invented or created, although there have been great strides made towards better radio in the development of better apparatus. Comparison of our present tubes, audio transformers, loudspeakers, and other devices with those of the past years will confirm this. Is it a wonder then that we should hesitate in proclaiming a new super-heterodyne? We did so last month in the November issue, and the interest displayed by readers who built the set gives us no cause for regrets. The super-heterodyne described is new, not for novelty's sake, but because there is actual merit in its newness.—The Editor.

THE Quadrode super-heterodyne—so named because a quadrode or four element vacuum tube is used in the mixer circuit—made good all that has been claimed for it. In a two weeks test for consistent reception at least two West Coast stations were brought in nightly, and on fair nights as many as a half dozen stations west of the Rockies were heard. Broadcasts from the states of Washington, Oregon, and California came in with sufficient volume to entertain a room full of people. A small Bodine loop or the house lighting system was used to pick up the energy, an outside wire was never used at all. One enthusiastic fan wrote a letter containing a log of some 52 stations outside of Chicago and the surrounding stations area, which were received in a two nights' vigil, through the maze of locals. These and other verifications are a sure proof of the pudding.

Nothing about the set or circuit is radically different from the usual super-heterodyne receiver. The present change is, however, obviously an advantage over the usual super-heterodyne. The highest grade of material was chosen for the make-up of the set, and this, together with the superior design, make it a better super-heterodyne. Very likely, the principal feature that has put this set into good graces with radio set builders, is the minimum of effort required to build and operate it, with the minimum strain on the money pouch, and the maximum efficiency that is derived from it.

The departure from the customary super-heterodyne, as has already been pointed out in the article which appeared in the November issue of Radio Age, lies in the mixer circuit. Why run the loop or grid lead all over the set to pick up energy from the oscillator tube and mix it in the detector tube to obtain a beat frequency, when this can be accomplished in one tube with less wiring? That is what we wanted to know.

The first progressive step was taken by some designers by using direct coupling from the plate circuit of the oscillator tube to the detector tube plate circuit. But why the extra tube?—we still ask.

Attempts were made a few years ago to popularize a circuit in which one regular three element tube was used for a mixer. Careful balancing of condensers and other tedious adjustments were necessary, and then what was the result? The circuit
met its fate early so what does it matter after all? A well known concern for several years has been the problem of designing a simple receiver or crystal set to allow a battery to do duty in oscillating at the right frequency to supply a suitable signal for tuning the set. All of the unsuccessful systems have been either mechanical or electrically tuned. The amplitude modulated systems have been interfered with or distorted by wave lengths of different frequencies, and the electrically tuned systems have had the limitations of low efficiency and instability. A method of overcoming the frequency limitations of a crystal set and at the same time increasing the efficiency is possible by utilizing the high output frequency of a super heterodyne receiver and the comparatively low input frequency of a superheterodyne frequency changer.

The crystal set is used to receive the signal of the desired frequency and to produce an output frequency which is approximately equal to the difference between the frequency of the incoming signal and the frequency of the crystal set's operating frequency. This output frequency is then passed to the frequency changer, which is designed to change the frequency of the signal to a fixed frequency which can be amplified and used as the input frequency for the super heterodyne receiver.

The superheterodyne receiver then amplifies the signal and produces an output signal which is of a much higher frequency than the input signal. This output signal is then passed to the crystal set, which then produces an output signal which is of the desired frequency.

This system has the advantage of allowing the crystal set to be used as a frequency changer, which can be designed to have a much higher efficiency than a crystal set with a fixed frequency. It also allows the receiver to be used as a superheterodyne receiver, which can be designed to have a much higher sensitivity than a crystal set with a fixed frequency. The system also has the advantage of allowing the crystal set to be used as a frequency changer, which can be designed to have a much higher efficiency than a crystal set with a fixed frequency. It also allows the receiver to be used as a superheterodyne receiver, which can be designed to have a much higher sensitivity than a crystal set with a fixed frequency.

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More About World’s Record Super 10

By Alexander Maxwell

The Scott World’s Record Super 10 has had remarkable success since its introduction on the market early this season.

The basic reason for its phenomenal popularity lies in the surprisingly dependable operation and uniform performance. We all have dissimilar ideas as to what perfect radio performance should include. To some tone is paramount. The midnight dial twister wants nothing but DX. The dweller in the metropolitan area will consider nothing but extreme selectivity. The rural radio man wants a receiver that will be sensitive. The non-technical man wants simplicity. The man with limited means wants low cost and a set that will not be obsolete before his bank book has ceased to groan. Those with mechanical bent want to build their own but demand a reasonable assurance it will function when completed. Ease of maintenance is insisted on by all, and the latest problem to confront the designer is a set which will function directly from the light socket.

The name Scott World’s Record Super 10 covers a lot of ground. So does the set. The “10” merely indicates the number of tubes that are used. They are used in a circuit that has as its chief purpose the interception and faithful amplification of local and long distance radio signals. Just how successfully this is accomplished may be fully appreciated only by hearing the receiver.

Four, undisputed, unchallenged long distance broadcast reception records, duly attested and verified, entitle the receiver to be called the “World’s Record Super.” The brief story here related explains why this receiver carries this inspiring name and further justifies all claims made for the same. It is an interesting and colorful tale of radio adventures.

One of Mr. Scott’s contributions to the art of radio is the method of manufacturing, testing and matching radio transformers. His outstanding achievement, however, is the establishment of four world’s records for long distance reception which was accomplished some time ago but still stands unequalled and unchallenged.

These four long distance records were made with an early model of his famous receiver. This nucleus bore no special name and consisted of nine small peanut tubes and suitable equipment, considered at that time the best that could possibly be obtained. After innumerable tests, Mr. Scott felt that the receiver was ready for a rigorous sensitivity test, and forthwith journeyed to New Zealand, where he conducted listening tests with this receiver.

The results of these tests are radio history. Consistent reception was accomplished over the span of more than six thousand miles, and no less than four world’s records were established, aside from the many other astounding feats of performance of the test receiver. The log of reception covers seventy closely written pages. Space does not permit the publishing of the account in these pages at the present time.

The consistent reception at New Zealand of stations 6,000 miles or more distant is ample evidence of the sensitivity of a radio set. From the information gleaned by this performance the World’s Record Super 10 was developed. From an engineering viewpoint the present model is vastly superior to the original test model, chiefly because radio has progressed and better and more accurate parts are now obtainable on the open market. The basic circuit and essential parts have not been changed, the

The B Eliminator for the World’s Record Super 10
Method of attaching the World's Record Super 10 receiver to the phonograph to get richer, sweeter music out of the whirling record

only difference in the finished product being the minor refinements which only years of constant experimenting can bring about.

You can appreciate this receiver only by hearing it in actual operation, bringing in local and long distance stations with an ease that makes one gap. Not only are distant stations brought in right through the high-powered local stations (the laboratory is located in the shadow of some of the strongest of Chicago broadcasters), but the volume and clarity is superior.

"How is such natural tone possible?" is a question commonly asked the user of a World's Record Super. The superior quality of tone is obtained by careful and painstaking observance of certain engineering principles which most receivers fail to stress. A correctly designed audio system, carefully biased, by-passed and energised is employed. The largest receiving power tube now on the open market is used in the last audio stage to handle the tremendous output. There is consequently no distortion of any kind in the received music or program, even when the receiver is functioning on a high powered local. A 112A tube in the first audio stage further insures that there are no irregularities in the amplification of the received signals.

The audio amplifier is only at its best when used in conjunction with the preceding circuits of the World's Record Super 10, all of which are designed for tone quality as a prime requisite. The result is music, sweet and true.

Of course it is understood a good, well designed reproducer must be used. Silvery music never issues from a tin horn. Money invested in a reliable loud speaker is well spent.

Owners of the World's Record Super 10 in Chicago tune in WJZ with ease when the closely adjacent WMAQ is on the air, without an iota of interference practically every night. This is a 10 kilocycle separation, the keenest tuning that any receiver may accomplish without sacrificing tone quality. The volume is sufficient for dancing, and there is absolutely no background from WMAQ. Who can ask for a more drastic test than this?

Here in Chicago users have picked up KFI in Los Angeles as often as three or four times a week, and held them as long as desired. KFI is just 10 kilocycles from WCFL, but the signals come through loud and clear with no interference or distortion.

Certain fans will remark about this time, "Why bother with distant reception when local programs are unbearable?" One answer is, everyone is not fortunate enough to live where there are truly appreciable local entertainments, and another answer is the same as may be asked the owner of a car. Why pay good money for a car that will go a mile a minute when the law says thirty-five miles an hour is enough? The answer to both questions is that the user has the satisfaction of knowing that he can get a burst of speed when no cop is in sight, and the same may be said of the radio, for should even the most conservative user suddenly turn DX hound and crave the annihilation of half the world, he has the weapon for accomplishing the feat at his hand. It is the satisfaction of knowing he can if he chooses, that makes the owner of a Scott World's Record Super 10 swell out his chest with pride.

There are a number of features peculiar to the World's Record Super 10. Enumerated briefly they are as follows:

1. The use of a very short antenna (30 to 50 feet).
2. The filtering action of two stages of tuned radio frequency amplification, increasing range, selectivity and making the set a "one" spot receiver.
3. The use of the beat frequency principle of reception which is the most selective and sensitive system of reception known to radio engineers today.
4. The use of three stages of intermediate frequency amplification of intelligent, efficient and practical design.
5. The general design of the transformers used in the receiver in conjunction with the choice of associated equipment which represents an aggregation of the finest devices in radio today.

There are any number of fine engineering points involved in each of the foregoing enumerations that could be discussed at great length.

The first impression of a radio set is the one obtained by the eye. If this is distasteful it takes a heap of efficient functioning to counteract it. From the foregoing description one is liable to arrive at the conclusion that a set which will perform in such a phenomenal manner must resemble a printing press in appearance, or at least a telephone switchboard. It will then be a pleasant surprise to see that there are only two tuning controls on the panel, with three small knobs which are used for vernier adjustment. Infinite pains have been expended to make this receiver as pleasing in appearance as it is simple to operate and efficient. Figure 1 shows the front view.

There is no guess work in the operation of a World’s Record Super 10. After the preliminary adjustments have been made the set is given an operating test, then it is ready for continuous service. There is no guesswork, even the tuning is now calculated for you beforehand by ingeniously calibrated tuning strips which accompany each set of transformers. These calibrated tuning strips are fitted on the Remler Drum Dials and tell exactly where they should be set for the reception of a particular wavelength. This is an exclusive World’s Record Super 10 feature and is possible only because of the exceptional uniformity of the Selectone Transformers. Each set of transformers is matched, and each matched set is uniformly and precisely the same. This explains how tuning may be laid out beforehand, even before the transformers have been built into a receiver.

A receiver isn’t considered modern unless it is connected to the light socket. There is more power available in the lighting mains than any reasonable number of batteries. The World’s Record Super 10 is a powerful set and batteries are not adequate for the power delivery.

In this connection a special plate current supply has been designed, a unit expressly conceived for use with this receiver. With your kit of parts your dealer will supply you with a full sized working blue print showing the construction and assembly of this power supplying device. It has provisions for all the necessary voltages as required by this receiver, and in addition supplies C battery energy for the 310 power tube in the last stage audio amplifier.

This power supply is a simple affair to build, requiring about two hours of actual construction time. The instructions are so clear it is practically impossible to make a mistake.

The World’s Record Super 10 cannot be purchased completely assembled from a manufacturer. Your local radio store will more than likely have one on demonstration that is put together. This receiver is custom-built. You may build it yourself if you choose, or any of the better grade radio service men will do the wiring for you.

The release of full sized working blueprints showing the wiring and assembly, in conjunction with the issuance of printed instructions giving the order of the operations to be performed makes the job of building the World’s Record Super 10 a simple pleasure.

When you install the World’s Record Super 10, with its associated power equipment, you simultaneously provide yourself with another fine source of music, equivalent to the wonderful electric phonographs now in vogue. This feature is the adaptability of the World’s Record Super 10 to phonograph pickup, and provides you with the electrical reproduction of phonograph music, equal to the most expensive combinations now being exhibited in music shops.

Phonograph pickup, simply explained, is the playing of phonograph and vitrola records through your radio loud speaker. The audio amplifier is used to intensify the electrical vibrations generated by an
ingenious device that is called a pickup.

When installing the pickup arm it is only necessary to remove the second detector tube and insert the plug provided. Figure 2 shows how this is done. The pickup arm is either attached to the tone arm of the phonograph, if it is to be permanent, or set separately alongside the record table. The needle of the pickup unit is then placed on the record instead of the usual reproducer.

Radio for R. R. Trains

After many months of developmental work on the lines of the New York Central, the radio engineers of the General Electric Company, have designed an effective and reliable system of radio communication between the front and rear ends of trains, particularly of long freight trains.

The new system, and some of the problems encountered were explained recently by I. F. Byrnes, a radio engineer, at a meeting of the New York Railroad Club.

Preliminary investigation was carried on at Schenectady on engine and caboose. Several different types of antenna were investigated on the locomotive and it was found that the most effective type consisted of a wire running parallel to the boiler, and about fifteen inches from it. This was stretched between the stack and the rear end of the cab roof, as far as possible from the boiler and at the same time within the clearance limit of the right-of-way. The caboose antenna was placed four and a half feet above the roof, running parallel to the caboose. Antennas of the type used on engine and caboose do not possess any marked directional characteristic, but they are inefficient radiators, due to their low effective heights, and for this reason require more power for a given transmission range, than would be necessary if higher antennas were available.

Tests showed that the 2300 to 2750 kilocycle band offered the best transmission frequency. In order to provide a strong telephone signal at a distance of from one to two miles a power of 50 watts delivered to the antenna, was found necessary. While communication is possible on less power, there must be sufficient margin to care for unusual conditions.

A radio telephone system must incorporate an effective calling system if it is to have a maximum degree of utility. The original work included the use of a bell actuated by a relay for calling purposes. This arrangement was later discarded because it was comparatively easy to secure false indications of calls. Excessive jars caused relay contacts and it was also possible for static and other disturbances to cause the bell to ring. The calling system finally developed utilized a loud speaker which produces a shrill note whenever a push button is depressed at the transmitting end. The pitch of this note is adjusted so that it is easily heard above the usual train noises. In addition the loudspeaker may be used in place of earphones for receiving conversation when the running noises are not too great.

Radio Saves Forests

The Department of Agriculture and other agencies concerned with the protection of Federal, State, and private forests from fire are keeping as watchful an eye on the weather these days as the navigators of ships at sea.

Increasing realization of the important role the weather plays in the forest fire hazard has led the Weather Bureau of the United States Department of Agriculture to establish a systematic forest fire-weather warning service in several sections of the country, and regular forecasts are being sent out to apprise foresters and forest owners of dangerous fire weather so that they may shut down logging operations and slash burning and mobilize fire-fighting units with the least possible delay.

In the Pacific Coast region, where some of the most valuable forests in the United States are situated, the fire-weather warning work has been under way for some time, Fire-weather forecasts are issued twice daily by the Weather Bureau and are disseminated by telegraph to important key points, by radio and by newspapers. The radio broadcasting of these forecasts is one of the most recent developments, and fire-weather bulletins now are being sent out from 16 Pacific Coast and Northwestern stations.

The worst fires in Washington and Oregon occur in connection with the dreaded east wind. When these winds are preceded by a period of warm, dry weather fires start easily.

After Factory Facts

For the first time in the history of the radio industry, official information regarding radio manufacturing is to be made available to the public and to the industry through cooperation of the United States Government and the Radio Manufacturers Association. The Federal Government, through the Department of Commerce, has accepted a plan proposed by the Radio Manufacturers Association to gather statistics from the nation's manufacturers of radio receiving sets, accessories and parts. Reliable and official statistical information as to the radio manufacturing industry will be issued quarterly.

With the assistance of the RMA, the manufacturing statistics will be gathered, compiled and published by the Electrical Equipment Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, of which Mr. Marshall T. Jones is chief. Comprising as it does more than 300 or virtually all of the leading manufacturers of radio of the country, the RMA is fortunately in a position to give the utmost service to the Government in securing manufacturing data hitherto unobtainable.

The Department of Commerce is now engaged in issuing to manufacturers a questionnaire showing in detail their factory shipments for the last three months of 1927.

The information will be published by the Department of Commerce early in January. This and subsequent quarterly publications of manufacturing statistics will inform the public regarding the progress of the radio industry and be a valuable guide to manufacturers in determining their production. The information is to be given in strict confidence by the manufacturers to the Government with the expectation of wide cooperation by the manufacturers.

A Radio Christmas

More radio receiving sets will be installed in homes this Christmas than in any previous year. Interest in radio is constantly increasing and to the thousands of new owners of radio sets as well as the millions of devotees of broadcast entertainment, Powel Crosley, Jr., President of The Crosley Radio Corporation, will sponsor a special Christmas festival of music to be broadcast through the Red Chain of 25 stations, Christmas afternoon, December 25, from 5:30 to 6:30.
Highly Efficient R. F. Receiver

Loftin-White Constant Coupling adapted for commercial use in a simple, effective, rugged circuit

As MANY of our readers know, the Loftin-White circuit was developed about a year ago by Edward H. Loftin, former Lieutenant-Commander, U. S. N., in charge of radio research and patent work, and S. Young White, a private experimenter of note in radio engineering circles. The circuit which bears their name was brought about as a result of their investigations aimed at overcoming the difficulties inherent in tuned radio frequency circuits.

Immediately after the appearance of the circuit there was a good deal of enthusiasm over it on the part of experimenters, but the circuit did not reach full popularity until recently. This article deals with a commercial adaptation of the perfected radio frequency circuit of unique character. We are all familiar with the difficulties encountered in tuned r. f. receivers, these were explained quite fully in the November issue of Radio Age in the article entitled "Hints on the Performance of Tuned R. F. Sets." The greatest difficulty has been to design a set that would function with uniform efficiency over the whole wave length band. As you know, it has usually been necessary to introduce losses in the form of voltage reducers in the filament or plate circuit to get stable operation; and to vary these controls as the wave length is varied in order to maintain a satisfactory condition, since for reasons which will be explained later, the conditions in the circuit keep changing as the tuning of the set is varied.

An ideal radio frequency circuit is one that provides maximum and uniform efficiency over the entire tuning range; one which requires no adjustments to maintain this condition, the only controls being those to tune in stations and to vary the volume to any desired level. Loftin and White have attained this ideal by developing a new system of coupling, and a system of suppressing oscillations. By combining with the regular inductive coupling a electro-static coupling, automatic compensations are made for the deficiency of the inductive coupling on the high wavelengths, resulting in a uniform transfer of energy. The oscillations are suppressed by a clever method of phase difference between the input and output circuit of the vacuum tube.

The following is a simple explanation of how the difficulties which are so common in tuned radio frequency amplifiers are overcome in the Loftin-White circuit: Fig. 3 shows the usual transformer or inductive coupling. The numerals 1 and 2 represent the primary and the secondary, respectively. The inherent characteristic of such a transformer is to convert more energy to the secondary (and succeeding tube) at higher frequencies than at the lower. This is illustrated graphically in figure 4. The vertical line represents the voltage transfer to the secondary, and the horizontal line the frequency and the direction in which it is increased. It may be observed that the coupling, or energy transfer increases as the frequency is increased (wave length decreased). Since a specific coupling is required in a transformer for a particular tube, it can be seen that the amplification will increase at the high frequencies and fall off at the lower frequencies (higher wave lengths), thus being "optimum" coupling over a narrow band of frequencies only. If the coupling is adjusted for best amplification at the middle of the broadcast band, the amplification will fall off at the higher wave lengths, and at the lower wave lengths due to the increased coupling, the amplification will increase to such proportions (due to the coupling increase) to cause the tube to oscillate.

An electro-static coupling can be so arranged to produce an effect exactly opposite in characteristic to that of inductive coupling. Fig. 5 is a simple diagram showing how it is done. This circuit is equivalent to circuit Fig. 3, 1 being the primary circuit and 2 the secondary circuit. The fixed condenser takes the same place in the plate circuit as does the primary of a transformer. However, the variable condenser here is also a factor in determining the coupling, for the greater the ratio of the fixed condenser to the variable condenser the less will be the energy transferred from 1 to 2. It can be readily seen that the values or proportions of the fixed condenser to the variable condenser will change as the capacity of the variable condenser is changed to tune the secondary 2. Assume for instance that when the variable condenser is all the way in (tuned to highest wave station) the values of the two condensers are equal, and we will say that the coupling is 50 per cent, now if the condenser plates are turned half way out, or to half the maximum value, the fixed condenser comprises two-thirds of the whole value (ratio 3 to 1), bring the coupling or energy transfer down to 33.3 per cent, for the voltage developed across the fixed condenser is inversely proportional to its ratio with the variable condenser.

Suppose the variable condenser plates are turned out still further, so that the condenser will have only one-fourth the original value, then the variable condenser will be only one-fourth as large as the fixed condenser, and the coupling will be only 20 per cent. Taking actual values, the maximum capacity of the variable condenser might be 500 m. m. f. (.0005 m. f.) and the capacity of the fixed condenser 500 m. m. f. The minimum capacity of the variable condenser we will assume to be 50 m. m. f. With the variable condenser at maximum the reactance across the fixed condenser will be half the total value or 50 per cent. With the condenser at minimum value to tune in the highest frequency station, the fixed condenser will be ten times as large as the capacity of the variable condenser, and consequently, the coupling will be only 9 per cent. This action is shown graphically in Fig. 6. It can be seen that the coupling decreases as the frequency to which the set is tuned increases, and is just opposite in its action to inductive coupling which increases as the frequency is increased.

Combining the two methods of coupling just outlined will result in the much desired uniform energy transfer for all fre-
quencies, provided that proper values are chosen to get a correct balance. Fig. 7 shows the circuit for combining inductive and electro-static coupling, and Fig. 8 shows graphically the result obtained in doing so. The uniformly high energy transfer is at any wavelength a result of the sum of the energy transferred by the coil and the condenser at that wavelength. Thus, it is possible to so proportion and combine a coil and a condenser in the circuit that the energy transfer will be maintained at the maximum point at all wavelengths, the inherent losses by one being compensated for by the inherent gains of the other. This is the backbone of the Loftin-White system of “constant-coupling.”

Preventing oscillations in a tuned radio frequency circuit is still another story. This is brought about in the Loftin-White circuit by changing the phase relation in the plate circuit to that in the grid or input circuit. The principal cause of oscillation in radio frequency circuits is the feedback of energy to the input circuit through the capacity between electrodes of the tube. It is necessary, however, that this feedback be in phase with the impressed grid voltage, or input voltage, in order to produce oscillation. Feedback may be negative or positive. Naturally when the feedback is negative it will not aid in bringing about oscillation, and when it is positive it will encourage oscillation. With inductive reaction in the plate circuit (coil) the feedback will be positive because the voltage in the plate circuit will be almost in exact phase with the grid voltage. With capacitive reaction in the plate circuit the feedback will be negative and out of phase with the grid voltage, hence, no oscillation or regeneration. In the practical adaption of the Loftin-White circuit a small variable condenser is used in the plate circuit, in series with the primary of the transformer, to shift the phase to such a relation with the input circuit so that no regeneration, or a limited amount of regeneration takes place. This is called the “phasing condenser.”

Every radio engineer immediately appreciates the tremendous possibilities offered by this circuit for improved reception in manufactured receivers, but it remained for the engineers and management of the Arborphone Division, Consolidated Radio Corporation, to design and manufacture a visualized perfect receiver, with the Loftin-White circuit as an inspiration. In it they have incorporated some unique mechanical features of their own, which are interesting contributions to radio receiver design and manufacturing practice.

A single glance at their product, the new Model 25 Series Arborphone, makes us conclude that they have accomplished their objective. Figure 1 shows the completed receiver, and Figure 2 the circuit diagram. The circuit diagram it will be noticed has distinctive features that are quite new. The condensers between the secondaries and the variable condensers are the coupling condensers, while the condensers between the plates and the primaries are the phasing condensers. The r. f. choke coils in the plate circuits are to prevent the radio frequency energy from going to the plate power supply instead of taking the proper path through the phasing condenser, the primary of the transformers, and the coupling condensers to ground. Choke coils are used in the grid returns for the same purpose. It is interesting to see that a negative bias of four volts is applied to the grids of the radio frequency tubes, through the chokes. This cuts down the power consumption and increases the selectivity of the set by virtue of increasing the input impedance of the tubes.

By adjusting the phasing and coupling condenser in each stage the receiver can be made to maintain a very sensitive state over the whole broadcast range. With these adjustments the set can be put into a state of regeneration, and yet without oscillations, over the whole band. Resistance introduced into the circuit by close shielding can be compensated for by the condition of regeneration, or “regenerative contribution.” The circuit adjustments
are all made at the factory and remain "put" indefinitely. Even variations in tube capacities will not unbalance the set.

The new design has four full tuned stages, three stages of radio frequency ahead of the detector, controlled by a single dial. It is positively single dial control, once a knob on the panel adjusts the antenna secondary circuit to the particular antenna with which the receiver is to be used, except possibly for a now-and-then refined adjustment of this knob in extremely long distance reception.

Complete double shielding is employed, each of the three radio frequency stages and the detector (four tuned stages) being inclosed in its own fully shielded compartment (see figure 1), but each compartment is no larger than physically needed to house the necessary parts for a stage. As a result, the four compartments form the interior of a metal box condensed to the dimensions of 12 inches long by 6 inches wide. Yet, by reason of the Lothin-White circuit this unheard-of close shielding is accomplished without loss of efficiency from absorption.

In the Model 25 Arborphone a distinct step forward has been made in the mechanical construction of radio receivers. Each compartment for a radio frequency stage is so dimensioned and the apparatus in it so located that it is the exact mechanical equivalent of every other compartment, and each rotor of the 4-gang condenser moves identically the same in relation to the apparatus in its own compartment. In effect, by thus making the compartments exact mechanical equivalents and maintaining them so at every point on the broadest band, a decided engineering step has been taken toward the necessary maintained electrical equivalency for successful single dial control.

The inductance and coupling coils, choke coils, coupling condensers, and phasing condensers peculiar to the Lothin-White circuit for each stage are built into compact units around a tube socket. Most of the electrical connections between these elements are permanent structures, eliminating the usual maze of interconnected wires soldered to clips. Figure 9 is a view of the Model 25 Arborphone chassis base, showing the compactness, clean-cut appearance, simplicity, and beautifully balanced layout of these units.

Each unit is the exact counterpart of every other one, so that they can all be assembled and tested before inserting into the complete receiver. Greater accuracy of assembly results, and freedom from imperfect connections caused by soldering in inaccessible places after the parts are all located in the cabinet or shielding compartment. This, too, is an interesting departure in mechanical practice and seems to be distinctly better.

Four of these perfectly assembled and tested units are mounted on a chassis that forms the base of the shield box. There is but one wire connection between one unit and the succeeding one, and one wire connection between each unit and its own gang-condenser unit. In brief, the unsightly and difficult wiring common to some radio receivers has been eliminated in this design, freeing it from loose connection difficulties. Figure 10 is the under side of the chassis base, showing the highly simplified and permanent character of the wiring. Except for the two connections referred to above, this is all there is to the wiring.

**Oil-filled Cables in Use**

The latest development in underground transmission of electricity was described by Arthur Williams, Vice-President in charge of Commercial Relations, of The New York Edison Company, in a radio talk over station WRNY.

Mr. Williams told of an underground cable that has an oil-filled core its entire length of 12 miles and that carries twice the amount of electric energy carried by the underground cables generally in use today. The new cable promises, Mr. Williams said, to have a large future influence upon the efficient distribution of electric energy. The 12 miles of oil in the center of the cable is about three-quarters of an inch in diameter, is surrounded by 132,000 volts of electrical pressure and about 125,000 horsepower of electric energy—a higher pressure, a greater amount of power, and a longer distance than has been possible of accomplishment in underground transmission in the past, he said.

**New Zenith Sales Manager**

Paul B. Klugh, Vice President and General Manager of the Zenith Radio Corporation, Chicago, announces the appointment of Thomas H. Endicott as sales manager. This executive position was made vacant in August when the former sales manager, N. A. Fegen, resigned in order to become a wholesale distributor of Zenith in Cleveland and northeastern Ohio.
Power Tube Puts Music into the Set

The development of the power tube and suitable equipment associated with it has been without a question the biggest boon towards making the radio set a musical instrument. Even the improvements in the design of audio frequency transformers are not as great an asset towards quality reproduction as is the power tube. Few people realize that their old set, whose tone is so inferior in contrast to that of a modern receiver can be made to sound like a modern set, or nearly so, by adding the proper equipment. Nor is it necessary to make radical changes in the receiver itself to bring this about.

Most of the receivers which were built or bought three years ago still use the 201A type of tube in the last stage of the audio amplifier—and there are still many such receivers in use today. The engineering world, and most of the people associated with the technical or sales angle of the radio industry have been educated to the fact that a loud-sounder cannot be operated satisfactorily from the output of the 201A, the WD12, or the "99" tube. However, to many of the people who are not interested in the technicalities of the radio set, there is little meaning in the type of tube used in their set. When they go to a radio store for replacements they merely ask for the type of tube corresponding to the old one in the set, and as a result have never made the proper changes which entails small expense and promotes a worthy cause.

It is our aim here to explain the difference in the various types of tubes and how these tubes should be used. The general purpose tube of today (201A type) is still very similar in its characteristics to the tube of four or five years ago. At that time the tube was designed as a voltage amplifier, as is the same tube now. As a voltage amplifier no power is actually taken from the tube. The purpose is to amplify the voltage across the primary of the detector tube circuit to as large a value as is possible without distorting the original form, and impressing the same on the succeeding tube. The tube itself is a voltage operated device and takes no current from the transformer which is working into it. In the last stage power is actually taken from the plate circuit of the tube and expended in the reproducing unit (phone or loud speaker). At ninety volts plate supply the undistorted power obtainable from a 201A type tube is only about 15 milliwatts. Just about enough power to operate the diaphragm of a pair of telephones to a comfortable listening volume. When more power is taken from the tube than 15 milliwatts nothing but distortion can possibly be obtained.

Fortunately—or unfortunately—few people will recognize distortion until it exceeds 50 per cent. Some can not be convinced that their radio set sounds "terrible" until an actual comparison with that which is almost perfect is made. They have been listening to this poor reproduction so long that they have become accustomed to it. A loud speaker operated from the out-put of a general purpose tube is utterly hopeless. Applying 135 volts to the plate is some improvement—the undistorted power out-put is increased to about 50 milliwatts.

The smallest power tube, the 112 type, makes available a power out-put of 120 milliwatts at 135 volts plate potential; more than twice as great as the 201A type at its best. This is also an improvement, but still not enough power to operate a good loudspeaker to full volume. At 157 volts the out-put increases to 195 milliwatts, still better, and good enough to operate a speaker for comfortable one-room volume with noticeable distortion. The 171 power tube has an undistorted power output of 700 milliwatts when operated with a plate voltage of 180 volts. This affords very good reproduction on a good loud-speaker and will fill a room with plenty of volume.

It seems ridiculous, then, to try to get loud-speaker volume from a tube capable of delivering an output less than one-twentieth of that required for good reproduction.

The proper grid bias is specified with each tube, and must be followed if undistorted reproduction is at all expected. The larger the power output of the last tube the greater will be the voltage changes required on the grid of the tube. This voltage is derived directly from the transformer or other device working into the tube. The out-put follows with the amplitude of the voice or music voltage impressed on the grid, the larger the grid voltage the larger the power out-put. Under ideal conditions a sinusoidal wave is impressed on the grid of the tube—that is the positive portion of each sine has the same form as does the negative.

To preserve this condition the grid of the tube must never be positive, but more negative and less negative, following the alternate negative and positive potential from the secondary of the transformer. The C bias must, of course, be large enough to take care of this, for if say, an alternating current of twelve volts is applied to the grid of the last tube (power tube) and the grid bias potential (C battery) is only nine volts, it is apparent that
Robertson-Davis
Hot Spot
Fourteen

By Frank Freimann

The theory that any number of amplifying stages may be cascaded with an amplification gain in each stage, provided that the gain per stage is limited to a comparatively low value, has been put to practice in the late Robertson-Davis development—the Melo-Heald Hot Spot Fourteen. Dr. A. W. Hull points out in one of his recent articles that radio frequency amplifiers may be added stage after stage until a tremendous amplification is built up if the amplifier is designed to give an amplification gain of not more than four per stage.

One naturally scoffs at the thought of limiting the amplification of a tube and transformer to a value only four times as large as the input voltage, when the tube is capable of producing a much higher amplification. On second thought—or perhaps third—one begins to realize the possibilities in an amplifier which has only half the regular amplification but twice as many stages. Taking for instance the average three stage amplifier with an amplification gain of about ten per stage; the total amplification will be one thousand. With an amplifier using four stages at a gain of six per stage the over all amplification is 1296. In an eight stage amplifier with a gain as low as three per stage, the over-all gain will be 3⁶ or 6,561. It is well known that when a two tube amplifier is designed for maximum amplification per stage another stage can not be added with a resultant gain equal to the product of the additional stage of amplification and the amplification of the first two stages. The tubes will start oscillation, due to the feed back of energy into the input circuit. The amplification

List of Parts for “Hot Spot” Fourteen

<table>
<thead>
<tr>
<th>Part Description</th>
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<tr>
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<td>3—Robertson Davis Multistage Meloformers</td>
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<td>1—Jewell 0-100 Milliammeter</td>
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<td>1—Formica Drilled Sub-panel</td>
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<td>30—Feet Acme Celasite Wire</td>
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Figure 3. Schematic circuit diagram of the Melo-Heald Hot Spot Fourteen
of each stage must be decreased until oscillations cease, which results in a much lower over-all gain. (Amplification contributed by the regeneration when the system is operated just below the point where oscillations start is not considered here.) Thus, a four stage amplifier designed to give a gain of ten in each stage will not deliver a voltage amplification of 4,000 because before such proportions are reached oscillations will start.

For this reason, heretofore, amplifiers have been limited to three or four stages. More stages resulted in nothing but a very unstable radio set with apparently not much more gain in amplification for the additional tubes and transformers. In the Melo-Heald Hot Spot Fourteen advantage was taken of the fact that when the amplification in each stage is low enough the feedback of energy from plate to grid and from the following stages will not be great enough to start oscillations. Naturally, the set is very powerful. Great amplification may be expected. Great amplification will be obtained.

As its name implies, fourteen tubes comprise the glass works; fourteen transformers complete the army of voltage amplifiers. Each unit does its bit and does it well. With their combined efforts infinitesimal impulses which have been worn down on their long journey across the continent are built up to the volume of the original sound that activates the microphone in the studio a few thousand miles away. This is the first time to our knowledge that such an elaborate combination has been made practical. Not only has the set tremendous power, but also the much desired capability of discriminating between the local ether bombarding and the stations in New York, Seattle, or what-have-you. The music is clear and sweet, too, even though it has traveled far and has to compete with a shower of static here and there.

Figure 1 shows the neat front panel appearance of the HOT SPOT 14, and Figure 2 a rear view of the set. The two major controls are the loop tuning condenser and the oscillator tuning condenser. A Jewel millimeter and a voltmeter show constantly conditions under which the set is operating. The small knob between the two main tuning controls offers very sensitive control of the regeneration in the loop circuit. The three remaining controls (1000 KC) in the close proximity of the receiver cannot appear on the upper part of the dials. This parasite is caused by the second harmonic of the oscillator (doubbling the oscillator frequency) falling on one of these stations when the oscillator is tuned to the high wavelengths. However, in this super-heterodyne the range of the second harmonic is between 2000 and 4000 KC and is again out of the broadcast frequency range. The range of the second harmonic frequency of super-heterodynes operating on a comparatively low frequency is between 900 and 3000 KC making the receiver susceptible to "repeats" of the low wave stations if they are very powerful, unless the input circuit is selective enough to eliminate these.

Figure 2. Rear view of the Hot Spot Fourteen

stations. This freedom from repeats and interference is one of the chief merits of the Melo-Heald "HOT SPOT".

The test set in the Radio Age laboratory performed splendidly. Selectivity was there for certain, and in the most perfected form. The tuning is remarkably smooth; stations slide in and out without the frequent smearing of the local station over the DX station ten kilocycles away. In other words, the ten kilocycle separation applies to local stations as well as to those remote. On a good night a station will be found on practically every channel. The West Coast stations came in with pep, including one or two that were not heard before. Another point of vantage is the low response to static the receiver has. It is by no means a "static eliminator," but static is diminished more than it is on a super working at a relatively low frequency.

The schematic wiring diagram is shown on blue print pages. It can be seen that the mixer circuit (oscillator and first detector) is a distinction from the customary. Two coils are in parallel, the oscillator grid coil and the coil coupled to the detector circuit, this has the effect of increasing the oscillator frequency to that required for the intermediates, and at the same time affords very close coupling. The first two units comprise the oscillator and mixer circuit, the following nine transformers are the intermediates, while the last three are the audio transformers. The whole system consists of the oscillator circuit, first detector circuit, eight intermediate frequency stages, second detector, and three stages of audio frequency amplification. In the first detector rectification is procured by means of the grid condensers, and in the second detector by means of a 4½ volts grid bias. The 400 ohm potentiometer is employed to control the amplification and tendency towards

Figure 1. Front view of the attractive Melo-Heald Hot Spot Fourteen
oscillation in the intermediate amplifier. The three ohm rheostat provides control of the 199 tube filaments, the four ohm resistance in series with this rheostat limits the voltage so that the tubes can not be injured. The 200,000 ohm Frost potentiometer across the secondary of the second audio transformers provides a perfect separate units, that is, all the necessary parts should be mounted on the sub-panel and front panel, and each panel wired as shown in the sketch of Figure 5, and the blue-print. When the assembly and wiring of each section is completed the sub-panel should be mounted on the base board on pillars of metal rods as shown in the mounted only a dozen joints need be unsoldered to set the sub-panel free from the front panel. The layout for the front and the sub-panel is in the blue-print section. The dimensions can be transferred to a panel that is to be drilled. The drilled and engraved panels for this set may be obtained

control of volume. On this potentiometer is mounted a filament switch by means of which the filaments are automatically turned on when the knob is moved towards maximum volume position.

The set should be assembled as two various illustrations. Then mount front panel in its place. After the set is completely mounted the two panels should be connected together in the manner pictured in the blue-print. Should it be necessary to get beneath the sub-panel after it is through your radio dealers. Enough photographs showing the completed set at all angles are shown in this article to make the building of the Melo-Head Hot Spot simple. Follow the wir-

(Continued on page 45)
A Constant Voltage B Eliminator

This B power unit is designed for the Quadrode Super-Heterodyne or any other highly sensitive Super receiver.

IT is commonly known that the requirements of a B power unit are, first, that it should deliver sufficient current at the required voltage, with no hum; second, that the voltage remain constant under varying load conditions. All power units do not come up to these specifications, and yet for some purposes the eliminator will fill the bill very nicely. Especially so for receivers employing not more than five tubes. When however, as in many cases, a B power unit that worked satisfactorily on a five tube set is applied to a superheterodyne, the results will be all but satisfactory. Sometimes the unit is incapable of delivering sufficient current to the set, and naturally the set will not perform to the best of its ability. Also the set is apt to “motor-boat” for this reason, or “hum” because the choke coils in the filter system are saturated.

One of the most frequent failings of a B power unit when used with a large set is that the voltage drops much lower than that required for good operation, and that it varies with adjustments made on the receiver. This can be largely compensated for by the addition of a voltage regulator tube which will keep the voltage constant regardless of load conditions, provided that the power unit can supply sufficient current. This should be about seventy milliamperes, and means that the 85 milliamperes type of rectifier tube such as manufactured by the Raytheon Manufacturing Company, or similar tube must be used. A transformer having voltage of 300 on either side of the center tap should be used, and also the choke coils should be capable of carrying 85 milliamperes without saturating.

The Raytheon Manufacturing Co. have recently turned out a very fine regulator or “R” tube. The advantage of this tube over all preceding tubes on the market is that it can be connected directly across a 90 volt potential and it will immediately begin to function, where previous tubes required a potential of 120 volts or more before the gas in the tube ionized and the tube worked. This advantageous condition is realized by the addition of a “starting anode” within the tube, along with the usual or “running anode.” The “starting anode” is much closer to the cathode than the usual anode and therefore requires much less voltage to “ignite” or start ionization of the gas. Due to the low voltage required to start the tube it will not go out when a large load is taken from the eliminator as other regulator tubes do.

The tube can be used to an advantage on many B power units that are not at present supplied with such a device. The cathode is connected to the minus B terminal, the running anode to the 90 volt terminal, and the starting anode may be connected through a 40,000 ohm resistor to the highest voltage tap on the unit.

The tube not only keeps constant the voltage on the 90 volt and 45 volt terminals but also adds to the filtering effect of the eliminator. With it no “motor-boat” will take place.

The simple B power unit to be here described has the features being able to supply enough current for almost any radio set; its voltage will not vary under load conditions, it is “humless,” and has provision for operating the power tube from a. c., thus making it possible to operate the receiver from an “A” power device having a capacity of about two amperes.

From the picture its construction is obviously simple, and with the aid of the circuit diagram it can be wired by any one. The popular Thordarson R171 Power Compact is used for the voltage supply, the chokes being self contained; a Sangamo condenser block is used for the filter and by-pass system, and Electrad wire wound resistors are employed as resistor units. These resistors deserve mention since they are new on the market and of unique design. They are “wire wound,” in the form of springs on insulating material, and are then wound on insulating rods. These resistors are able to dissipate a great deal of current without getting hot, and are very easy to mount.

The parts can be mounted on a suitable base-board. The picture is self explanatory and details are unnecessary.

The three Electrad resistor units for the plate voltage supply are mounted on a bakelite strip with four XL binding posts. If a couple of survivors of the dark ages in the form of metal top sockets are still in the junk box they can be brought to a more practical purpose by using them for the Raytheon B11 rectifier tube and the voltage regulator tube. The
starting anode connection is taken from the metal base of the voltage regulator tube. A permanent wire may be soldered to the metal part of the socket for this connection or a flexible stranded wire can be bent over the edge of the socket so that when the tube is put into the socket a tight electrical connection will be made. The free end of the wire can be fastened to one of the terminals on the socket that is not being used for another purpose.

A Frost socket is mounted on the right hand side of the power compact, the filament leads facing the filament supply voltage terminals on the compact. The connections can be made by soldering the two lugs together. The 2000 ohm resistor is mounted (one end) to the center tap of the filament winding and the other end connected to the center of the high voltage transformer winding on the other side of the compact. The voltage drop across this resistor furnishes an automatic bias for the power tube when the tube is operated from the filament winding.

The 40,000 ohm resistor in series with the starting anode is mounted directly to the center terminal of the choke coils (on top of the compact).

When the unit is to be operated as a B power unit only, that is, the power tube being right in the radio receiver, the four voltage terminals should be used as indicated in the diagram. However, when the power tube is put into the B supply unit the 180 volt terminal can be left disconnected and the loud speaker terminals should be connected as shown in the diagram. One to the negative B terminal and the other in series with a 2 mfd. condenser to the R-196 Thordarson Choke Coil and plate of power tube. The 2 mfd. condenser is employed to prevent d. c. current from flowing through the loudspeaker windings.

The tube socket plug is put into the last audio tube socket in place of the power tube when the latter is operated in the power unit. The wire is connected to the grid terminal of the tube socket in the unit. Be sure to connect the wire which otherwise is connected to the minus C 40 volts to the negative B terminal when the power tube is not used in the set itself.

It is very apparent that variable resistors are unnecessary since the regulator tube takes care of all loads and keeps the voltage across the 90 volt terminals, and to a considerable degree across the 45 terminals, constant.

A Deep Note Speaker

Tastes in musical quality differ but the great majority prefer a deep rich tone, which accentuates the mellowness and harmony of the selection, even if the high notes of vocal selections are slightly modulated. The average user of a radio set desires music while he reads the paper or while dining. For this purpose a tone chamber has been developed by Dray Laboratory, Chicago, which removes all the clash and startling peals which are so disturbing to one who desires relaxation.

The construction of this tone chamber is unique in that it is composed of alternate layers of cement and burlap. These layers are placed on the form by hand till the required number are present. This combination has an almost unbelievable power for absorbing vibrations of a high frequency while those of lower and moderate pitch pass unimpaired.

The horn is so mounted in the console that all vibration is carried direct to the floor and so distributed there will be no disharmonic overtones. It is advised against placing the receiver on top of the speaker for then vibration will be transferred to the tubes, resulting in howling.

—"See here waiter, why can't I have soup if I want it?"
—"Sorry, Sir, but we have orders not to serve soup when our orchestra is broadcasting."

Angry Customer: "You call these safety matches? Why, none of them will strike!"
Shopkeeper: "Well, you couldn't 'av anything safer than that, could you?"
The Screen Grid Tube
And How to Use It

The official announcement that the new screen grid tube CX322 would be soon available to the radio trade has created more enthusiasm than ever in circuits that are applicable to this latest development in the tube industry. There is much curiosity afoot. Questions are asked: What about it? Can this tube be used in my present set, if not, why not? etc. Another frequent question is: Is this going to bring about any radical change in the radio receiving situation, and is it going to render present receivers obsolete? In this article we endeavor to bring light to these questions and satisfy many curious minds.

In the first place the screen grid tube can not be used in the average present receiver. In some cases where proper shielding is already installed it is possible to make changes in the wiring and a few little additions, besides the tube itself, to bring this about. Next the new tube will have no "over night" revolutionary effect on the radio trade. The coming of the AC tube brought about no radical changes; sets for DC operation are still being sold, and so it will be with the newest tube, the XC322. Next season no doubt there will be many sets on the market in which the new tube will be used; nevertheless, due to economical manufacturing and other factors the radio set as we know it today will still be in general use. It is certain, however, that these new tubes will be instrumental in providing radio receiving sets with a range far greater than anything we have today.

Perhaps before many moons the reception of West Coast stations in the eastern part of the country, and vice versa, will no longer be considered a feat. The atmospheric conditions and interference from other stations will be the only limitations in getting distance. There is no doubt that with this new method receivers can be built with amplification great enough to reach the "noise level" (the point where infinitesimal noises are as great or greater than the station signal) in any location, be it in a noisy congested area, or atop a high mountain.

Last month a little detail was given on the appearance, externally and internally, of the shield grid or screen grid tube. It was pointed out that, except for the metal cap on top of the bulb the tube has the same geometric dimensions, and the same UX base as the ordinary general purpose tube. The filament current consumption is .132 amperes (about half that of the 201A) at a voltage of 3.3 volts. The other voltage requirements are as follows: 135 volts for the plate, 45 volts for the screen grid (for r. f. amplification), and 1.5 volt negative bias for the control-grid, that is, the grid which serves the same purpose as the grid in the general tube.

The elements within the glass bulb are the big departure from the tube with which we are so familiar. First, as has already been mentioned, there are four instead of three elements. The control grid, cylindrical in form, is arranged in a manner similar to that of the CX-299, except that the connection to this element is brought out at the top of the bulb. The screen grid is interposed between the cylindrical plate and the control grid, completely surrounding the plate. The plate is also cylindrical, but larger in diameter than the plate in the type CX199 tube.

The construction of the tube is very rugged, perhaps even more so than that of the ordinary tube.

This tube has been designed especially as a radio frequency amplifier, although it can be operated as an audio voltage amplifier as well. As a radio frequency amplifier, it is possible to obtain a very high amplification gain per tube, and with freedom from oscillation. The parasitic capacities between the elements within the tube are reduced to a negligible quantity; thus oscillations will not be created as long as there is no feed-back of energy due to associated wiring and apparatus.

The voltage amplification depends upon two factors: First, the mutual conductance of the tube, which determines the amplitude of the plate current changes, resulting from the signal voltage impressed upon the control grid. Second; the load impedance. The voltage across the output load is directly proportional to the load impedance in the plate circuit of the tube. This means that the amplification available is dependent, and directly proportional, to the impedance in the plate circuit of the tube. The resultant amplification is the product of the mutual conductance of the tube, which is about 300 microhms under proper operating conditions, and the impedance in the plate circuit.

The most practical way to get a high impedance in the plate circuit for radio frequency amplification is by tuning a coil and condenser to the frequency which is to be amplified. This is shown in the circuit diagram accompanying this article. The impedance is highest when the circuit (Continued on page 34)
None More Satisfactory than Cle-Ra-Tone Sockets for the "Hot Spot" 14

Benjamin Cle-Ra-Tone Sockets are positively the greatest contribution to the non-noisy operation of a set. Anti-microphonic. Stop tube noises. The tube "floats" on four perfectly balanced springs which absorb all jars and shocks. With knurled nuts for binding post connections or handy lugs for soldering. One-piece tube to terminal connection, eliminating high resistance joints.

At Your Radio Dealers

BENJAMIN ELECTRIC MFG. CO.
120-128 S. Sangamon Street
Chicago

247 W. 17th St.
New York

448 Bryant St.
San Francisco

The Famous ROBERTSON-DAVIS HOT

GIVES 200,000,000 AMPLIFICATION

The case with which you can receive distant stations with the famous Robertson-Davis HOT SPOT Fourteen Receiver is at once apparent from the results of our official laboratory test which proved that the radio frequency signal picked up by the loop on any HOT SPOT RECEIVER is actually amplified 201,550,000 times after it passes through the eleven Melomerco Radio Frequency Transformers and three Meloformer Audio Frequency Transformers into the room from the loud-speaker.

For Best Results With the HOT SPOT "14"
Use Only the HAMMERLUND "Midline" CONDENSER and the "HAMMERLUND, JR." Midget CONDENSER

Specified by the Designer HAMMERLUND MANUFACTURING CO.
424-426 W. 33rd St., New York

THE SEASON'S CHAMPIONSHIP RECEIVER EASY TO BUILD—BEAUTIFUL PANEL & CHASSIS

Anyone with an inclination and interest in radio will find the Robertson-Davis HOT SPOT Fourteen Receiver easy to build from the illustrated article and Blue Print Plate printed in the editorial section of this issue of Radio Age. This Championship Receiver comes to you with a reputation of performance that agrees with what you are looking for. 14 Tubes. No Oscillator Repeaters. Only 2 Tuning Controls. No Receiver Harmonics. Racer Edge Selectivity. Real Single Point Reception. A Beautiful Panel and Chassis.

PERFECT RECEPTION—DX OR LOCAL

The HOT SPOT Fourteen is simple and easy to operate. Brings in DX clear and loud through local interference—crosstown on any night.

Sept. 16, 1927—JAS. H. BRADSHAW, 706 N. Kedzie Ave., Chicago, writes: "Gentlemen—I can get distant stations any night and with local volume. Local stations tune out at 3½ point of dial; and that is just what Chicago needs. I have had my "HOT SPOT" operating a month now and pulling in most every station in the city under the most unfavorable atmospheric conditions possible, as you well know the hot weather we have been having."

Similar reports reach us daily from all over the country. Copies of actual letters gladly sent on request.

YOU DON'T NEED A SILENT NIGHT TO GET PERFECT DISTANCE RECEPTION WITH The Famous HOT SPOT FOURTEEN

Photo above shows John H. Hartley of Brooklyn with his 1927-28 Prize-winning World's International Championship Hot Spot Fourteen Receiver.
SPOT FOURTEEN Championship Receiver

GAIN FROM LOOP TO LOUD-SPEAKER

John Harrison Hartley of Brooklyn won the 1927-28 World's International Championship for arc building with a Robertson-Davis HOT SPOT Fourteen Receiver at the Radio World's Fair in New York. You will find him, his prize-winning receiver and trophy cup in the photograph below. The secret of the success of this famous circuit is the perfect constant resistance and fundamentally correct hook-up of the Certified Robertson-Davis Melocouplers and Melocouplers illustrated here.

PRINT section of this issue of Radio Age

JEWELL Instruments

The selection of the highest quality radio parts for the Hot Spot Fourteen naturally includes Jewell instruments. Their use permits that exactness in radio control that makes the Hot Spot Fourteen stand forth as a most selective and powerful receiver.

Both instruments are of the same size and style of case and have a fine D'Araonval moving coil movement. The Pattern No. 135-B, illustrated, has a double scale 0-7.5-150 volts and a handy push button switch for shifting from the low to the high range. The low range checks filament voltage—the high scale checks plate voltage. The Pattern No. 135 0-100 Milliammeter is placed in the plate circuit and used with the Pattern No. 135-B gives a real comprehensive indication of the set operating condition.

YAXLEY MFG. CO.
9 So. Clinton St.
CHICAGO

For best results in your Hot Spot Fourteen, stick to the parts originally specified.

Yaxley parts specified are:

1 Yaxley 3 Ohm Switching Rheostat, No. 903K...$1.75
1 Yaxley 4 Ohm Fixed Resistance, No. 804......... .15
1 Yaxley 3 Ohm Semi-Fixed Resistance with double Arm, No. 503DA.......................... .50
1 Yaxley 6 Ohm Semi-Fixed Resistance with double Arm, No. 506DA.......................... .50
1 Yaxley 200 Ohm Potentiometer, No. 200........... 1.75
1 Yaxley Cable Connector Plug, No. 609........... 3.25

ROBERTSON-DAVIS COMPANY, INCORPORATED
(Engineers & Manufacturers of Electrical Windings)
412 ORLEANS ST. Dept. RA-12 CHICAGO, U.S.A.

See Your Dealer or Jobber

Robertson-Davis Hot Spot Fourteen

A super with actual single point reception

No Receiver Harmonics.
Razor Edge Selectivity.
No Repeats—It Registers at
One Point like a Thermometer.
14 Tubes—8 Stages of Intermediate—
3 Stages of Audio.
2 Tuning Controls.

This newest and unusually successful achievement in radio reception uses the same mixing system that made the Robertson-Davis MELO-HEALD Eleven Circuit famous. Each Intermediate Transformer is designed specifically for its position. Quickly built and easy to operate. If you want and can afford the best that radio reception offers, build a HOT SPOT Fourteen Receiver.

See Spring 1927 Issue sensitive

Radio Call Book for Details of the famous
MELO-HEALD ELEVEN RECEIVER

SPOT FOURTEEN
Another Melo-Heald Design.
A Quadrode Record

Radio Age, 500 N. Dearborn St., Chicago.

Gentlemen:

I am sending you herewith a list of stations received on the "Radio Age Quadrode Super-heterodyne."

Station | Location | Antenna Condenser | Oscillator Condenser | Wave Length
--- | --- | --- | --- | ---
WHO | Des Moines | 93 | 97 | 535.4
KYW | Chicago | 92 | 95 | 526.
WOW | Omaha | 87 | 89 | 508.2
WFAA | Dallas | 86 | 88 | 499.7
WBAP | Ft. Worth | 86 | 88 | 499.7
WEAF | New York | 84 | 85 3/4 | 491.5
WCFL | Chicago | 83 | 84 | 483.6
WSUI | Iowa City | 81 | 82 | 475.9
WBO | Chicago | 68 3/4 | 68 3/4 | 464.6
WHAZ | Troy | 68 | 68 | 439.8
WTAM | Cleveland | 65 | 65 | 398.9
KWKH | Shreveport | 64 | 64 | 394.5
WJFT | Chicago | 62 | 62 | 389.4
KGO | Oakland | 62 | 61 | 384.4
CKY | Winnipeg | 61 | 60 | 384.4
WJJDWEBH | Chicago | 58 | 57 | 365.6
WSAI | Cincinnati | 56 | 56 | 361.2
KFWB | Hollywood | 55 | 55 | 361.2
CHIC | Toronto | 55 | 55 | 356.9
WJW | Detroit | 54 | 54 | 352.7
WLS | Chicago | 52 3/4 | 52 3/4 | 344.6
WCBD | Zion City | 52 | 52 | 344.6
WSM | Nashville | 51 | 51 | 340.7
KNX | Hollywood | 50 | 50 | 336.9
WHB | Kansas City | 50 | 50 | 335.6
WBZA | Boston | 50 | 50 | 331.1
KOA | Denver | 48 | 48 | 352.9
WQAM | Miami | 47 | 47 | 322.4
WGN-WLIB | Chicago | 43 3/4 | 43 3/4 | 305.9
WTMJ | Milwaukee | 41 | 41 | 293.9
WEAO | Columbus | 39 | 38 | 282.8
WPG | Atlantic City | 38 | 38 | 272.9
WGC | Culver | 36 | 34 3/4 | 258.5
WDAG | Amarillo | 34 3/4 | 33 3/4 | 263
WJAZ | Chicago | 33 | 33 | 263
WMBB | Chicago | 32 | 30 3/4 | 252
WDOD | Chattanooga | 29 | 28 3/4 | 245.8
WGFS | Chicago | 27 3/4 | 27 3/4 | 241.8
WGCR | Evansville | 27 | 25 | 236.1
WTAD | Quincy | 27 | 25 | 236.1
WJKS | Gary | 25 3/4 | 24 3/4 | 232.4
WJAY | Cleveland | 25 | 23 | 227.1
WWE | Chicago | 25 | 23 3/4 | 227.1
WLAC | Nashville | 24 | 22 | 224.8
WABQ | Philadelphia | 22 | 20 | 222.7
WCRW | Chicago | 21 1/4 | 21 1/4 | 223.7
WMT | Manitowoc | 21 | 21 | 222.1
WCBS | Springfield, III. | 22 | 20 | 209.7

"Old Glory Station"

WJGS | 21 3/4 | 19 3/4
WSA | Springfield, Tenn. | 20 | 18
WEHS | Evanston | 20 | 17 3/4 | 215.7
WJB | Forest Park | 18 | 15 | 208.2
CKY | Winnipeg | 13 3/4 | 8 3/4 | 10

Amateur (Voice)

Texas Amateur Calling (Voice) | 13 | 8

The stations received were all on loud speaker (Newcombe-Hawley horn and New Era units) and the tone quality was excellent. I have built radio sets for my own amusement for the past six years. It has been some time since I have sat down (Continued on page 36)

Please Mention Radio Age When Writing to Advertisers.
SM

The Most Remarkable Receiver Ever Developed

No matter what you might do—no matter what other receiver you might buy—the new Shielded Grid Shielded Six will literally walk rings around it from every and all standpoints of performance. This is a broad statement, but it does not begin to tell the whole story.

Operating on a loop in a steel apartment hotel in the heart of Chicago it will bring in KFI with WMAQ and WCFL going at full blast within two miles of the receiver, any night in the week. Practically all signals come in with such tremendous force that the volume control must be turned down. A new station will be found at almost every division of the two tuning dials. Powerful near-by locals come in on one point only and do not cause "repeats" or harmonics and never spread more than from two to four dial degrees. The Shielded Grid Sixes are even better than super-heterodynes for this reason. They go right down to the noise level, do not repeat on the dial and gives distance reception absolutely unbeaten by any other radio receiver.

The Shielded Grids are tremendous—simply by placing a finger on the antenna post of 630-SG set, stations 1000 to 2000 miles away will come in with loud speaker volume! With a loop on the 630-LSG (or with a 20 foot antenna on the 630-SG) you literally have the whole country at your fireside, coast to coast regularly—not once in a while.

The Shielded Grid Shielded Six receivers will—from every standpoint—out-perform anything on the market and at the same time give you a tonal beauty that is not to be excelled. These are facts that you can prove to your own satisfaction. Build the 630-LSG or the 630-SG and if they will not out-perform any set you’ve ever listened to—if you’re not more than satisfied—return the parts and your money back. The 630-SG kit for antenna use is $97.00 and the 630-LSG for loop operation is $91.50. Both sold under the unqualified guarantee to out-perform anything that the market offers.

The Famous 440 Time Amplifier

With a greater degree of selectivity, with a greater amplification factor—the 440 Jewelers Time Signal Amplifier offers possibilities never before realized in long wave amplifier construction. It is more accurate—with a finer degree of calibration than any long wave amplifier which may be bought from standard parts today. It’s so good that it simply can’t be beaten—with any combination of individual parts or anything else. It is housed in a copper and brass setacomb which completely and individually shields the three radio frequency and detector stages. The 440 Time Signal Amplifier is tremendously popular already, for thousands have been sold this season, simply because it’s the best long wave amplifier ever developed. It is tuned exactly to 112 K.C., the 257 meter wavelength of the Naval Observatory station at Arlington (N.A.A.). Price $35.00.

Silver-Marshall, Inc.
850-B West Jackson Blvd.
Chicago, Ill.

We can’t tell you here all about the new S-M developments. If you will send us 10c we will give you more authentic information about Shielded Grid receivers, A. C. operation, real audio amplification, how to use a 210 tube in your set and phonograph amplification, than you can hope to read in a week (blueprints and building instructions are 25c per set).

Silver-Marshall, Inc.
850-B West Jackson Blvd., Chicago

Please send me all data on the new Shielded Grid Shielded Six, the 440 Time Amplifier, real audio amplifiers and the new developments on A. C. operation for which I enclose 10c postage. Also: Blueprints and instructions for □ 630 Shielded Grid Sies....25c □ Universal all wave tuner........ 25c

Name

Address

Please Mention Radio Age When Writing to Advertisers.
It has been nearly three years since the Remler Infradyne first made its bow, and because it is steadily increasing in favor the manufacturers are bending every effort to develop further refinements.

Minor improvements have been made from time to time, but now a major improvement has been released, an enclosed New Style 710 Radio Frequency Amplifier. This unit is similar to the one furnished with the Infradyne Kit, the only difference being it employs a bias on the mixer tube instead of a leak and condenser, and therefore requires an additional terminal.

We will go into detail concerning the amplifier itself presently, but right now we desire to state that this article is written primarily for the man who already has an Infradyne of his own construction and desires to bring it up to date. If the reader is contemplating building the entire outfit from the ground up we advise constructing the Infradyne Kit, as described in these pages of the October number. If you do not have the October Radio Age it will be supplied upon receipt of thirty cents, post paid.

We take it for granted that the prospective remodeler has his set already mounted on panel and baseboard, and the parts wired at least somewhere near the specifications given at the time his particular model was released.

If so, the baseboard may be used as it is. If not, then all the parts must be removed and regrouped. If time is no object it will be advantageous to remove the subpanel entirely and replace it with one of bakelite, putting all the wiring on the under side. There are so many wires in the Infradyne, especially after the change-over switch has been added, the finished set is likely to look like the wrong side of a telephone exchange unless care is used in placing the wires.

Remler recommends using the bunched cable system, which we heartily second. The smaller wires are every bit as satisfactory as the heavy, unwieldy bus, and if a different colored casing is used for each circuit it will make wiring and tracing very simple.

All of the present radio frequency amplifier must be dispensed with. Other instruments are left as they were, and those in the enclosed box must be purchased in addition.

Each wire in a receiver acts as a tiny aerial, and not only that, but each and every coil is a miniature substation, redistributing the energy received from the aerial. There are several methods of preventing this intercoupling, as it is called, the two in most common practice being shielding and the use of coils with a restricted field. To be on the safe side the 710 Amplifier is provided with both methods. Copper partitions are placed between all coils, and a continuous shell surrounds the entire instrument. This shell and the partitions are grounded. Any stray oscillation that can penetrate this defense deserves a lot of credit. The coils deserve special mention for they are of unique construction. The secondary is split into two sections with their fields opposing, the grid and filament leads coming from the middle instead of the ends. The magnetic field extends just far enough to produce a coupling effect with the primary and right there it stops.

By consulting the wiring diagram of the 710 one will observe that the primary coil is tapped in four places and these leads go to the terminals as indicated. Tap number two is the grounded end of the secondary coil. The antenna compensator is furnished with the amplifier and is mounted on the panel between the drum and the meter. It consists of a tiny variometer and a three point switch, its purpose being to adapt the receiver to the particular aerial used, as well as providing additional selectivity in cutting out unwanted signals. It is a very important instrument, and it is rather delicate, so great care must be used, both in handling and in soldering the connections. Too much heat will melt other connections farther down the line, spoiling the entire effect and making a source of difficulty that is hard to locate. Use a bright iron and the minimum amount of solder, and do not apply the iron for more than five seconds at a time.

The Remler type 633 condenser is used in the amplifier. It is an elaboration of the original twin rotor condenser, maintaining all the desirable features and simplifying matters by the fact that all three condenser units are controlled in unison by a single knob.

It is practically impossible to make three variable condensers work in absolute harmony without a trimming device. In the case of the 633 these consist of small,
mica insulated compression condensers which are a part of the complete assembly and are not detachable. The three gans are adjusted to resonance before leaving the factory, but if at any time one desires to change the adjustment it may be readily accomplished by means of a wooden screw driver furnished with the amplifier. Each of the three trimming condensers is regulated by means of a screw with a slotted head. The wooden wedge is inserted in this slot and turned slightly. It is not advisable to make any adjustments on trimmers till the receiver is in working order, and then only when convinced beyond a shadow of a doubt the condensers do not align properly.

In order to obtain the greatest coupling effect at a specified frequency the primary of the radio frequency transformer must be varied. This is in direct relation with the rotation of the condenser. By means of a system of levers and an ascending cam, the primaries of the three transformers are rotated as the condenser is advanced. This insures a maximum energy transfer at a given point, or to put it a bit more positively, the maximum energy transfer on all points within the range of the condenser.

The primary inductance may be varied by means of a three point switch on the first one, which is incorporated in the antenna compensator, and a two point switch on the other two. The adjustments of the latter are made permanently when the Infradyne is put in operation and need not be touched again. The first is varied whenever the occasion demands.

It is well known that a resistance inserted in the grid lead of a radio frequency receiver has a tendency to prevent oscillation. Therefore 500 ohms is provided for the first stage and 1000 ohms for the second, with short circuiting switches when not desired.

Panel view of the New 1928 Infradyne Receiver

It is difficult without vernier controls to build an amplifier which will function equally well in both metropolitan areas and the more rural districts. Remler has taken this into serious consideration and believes the 710 to be a solution to the difficulty. By adjusting the four switches and the antenna compensator the receiver may be made to tune sharp enough to cut through the superpower station in the next block, or it may be broadened till the out of town user will have no trouble in picking up stations. Using the compensator as a vernier one should be able to bring in very weak signals with sufficient audibility to be readily distinguished.

Now that we know just what the instrument is with which we are dealing we will go ahead and install it. Perhaps you noticed that in the panel layout no vertical dimensions were given. It is a bit difficult to do this in remodeling because all baseboards and subpanels are not the same thickness. To determine the correct height for mounting the condensers fasten the 710 amplifier to the baseboard and fasten the mounting for the drum dial, using the holes provided. Leave the control shaft off for the time being. Now screw the new panel onto the baseboard and with a soft pencil or a scratch awl carefully trace around inside the hole through which the control shaft would protrude.

This gives a point around which to work and all other measurements are made in direct relation. Now unscrew the panel and with a small drill make a hole in the center of the scribed circle, from the back side coming forward.

Take the left hand Rembler Template and paste it to the panel, making sure it is aligned correctly and the drilled hole is exactly under the center lines of the corresponding marking. Take the center punch and make an indentation for each hole. To locate the oscillator condenser it is only necessary to carry the guide lines over, and paste the right hand template in the correct place. The others are purely a matter of personal taste. We furnish a suggested panel layout which one will do well to follow.

Beginning from the left hand end the first knob controls the R. F. condenser, the second the antenna compensator, the third the R. F. rheostat, the one under it the Yaxley switch, the fourth the Infradyne rheostat, and the last the oscillator condenser. Certain parts have been done away with, namely the 50,000 ohm variable resistance. Volume is controlled solely by the ten ohm rheostat which controls the filaments of the first two tubes. The one mfd. fixed condenser is no longer used as one which performs its function is built into the R. F. amplifier.
The two thirty ohm rheostats, one of which controlled the mixer tube and the other the 299 tubes have been replaced by a ten ohm rheostat, the one mentioned above, and another ten ohm rheostat used in conjunction with a six ohm fixed resistance. The Yaxley 69 switch has been replaced by a Yaxley 69 switch which provides an off position as well as changing from five to ten position reception.

Wiring, as stated previously, may be left as it was, with suitable changes, or all replaced. If using the cable harness style keep the plate and grid leads free or trouble will develop. The old oscillator coupler may be used, or a Silver Marshall 110B substituted. It is not material as long as it contains the correct amount of wire.

It is most important that directions are followed in regard to connecting the three condensers in the oscillator circuit. The .0001 mfd. is shunted across the .00035 mfd. and a .0005 Sangamo hooked in series with the lead which goes to the plate. The purpose of the .0001 condenser is to alter the range so that the entire 360 degrees of the dial will be used instead of just half as in former models. In order to use the original coil this manner two turns must be removed from the filament end of the grid coil. The coupler will then consist of an eight turn pickup coil, a twelve turn grid coil and a plate coil of fourteen turns.

As soon as the new receiver is finished it must be carefully tested to make sure that all connections are correct and the B battery is not turned through the filament circuit. This may be determined by placing the tubes in the sockets and after connecting the A battery and proving that all tubes light correctly remove one wire and touch it to each of the B binding posts. If nothing happens then it is safe to connect the B batteries. Use plenty of patience and don't turn anything without making sure it needs turning. The Amplifier is already adjusted for best results with an aerial of from 50 to 150 feet, when received. These adjustments are for localities where conditions may be termed average, in regard to interference and electrical noises.

Switches one, Two, and Three are set on "non selective," switch Four on "selective." In localities where conditions are excellent switch number one is set on "selective," number two on "non selective," and numbers three and four on "selective." In locations where interference is bad different combinations may be tried, but be sure to make notations of the original settings so one may return to them at any time. Remember that this amplifier is designed to function in all localities, and for that reason is a bit more complicated than the average. Once it is out of resonance and the combination lost it is about as difficult to get back in working order as it is to pick the combination on the First National. It has been said that no matter how badly it is jammed up, turning something else will make it a little worse. This just as a word of caution. It will work when received, and the best plan is to stay as close to the original scheme of adjustments as is possible.

When once in working order it should be left strictly alone, for nothing needs turning but the two tuning condensers and possibly the antenna compensator. The builder is probably so familiar with the adjustments of the Infadyne amplifier by this time no additional explanation is needed.
The Amperite Adapter

By means of a new device just introduced, it becomes possible to modernize the old set without the use of tools or the performance of a major operation. In fact, not a single wire within the set is altered; not a thing is changed; not a single practical fact need be known about radio; yet, according to an announcement of the Radiate Company, the old set is instantly transformed into a modern set so far as efficient and simplified operation is concerned.

Briefly, the new device is the Amperite Adapter, comprising a base with clips to take two standard Amperite units complete, which are thereby connected in parallel so as to obtain their combined current-carrying capacity. The Amperite units are selected in order that the combination may provide the desired amperage for the group of tubes in the receiver thus controlled. Combinations are available for the precise control of any set from the simple three-tube layout without power tube, to the six-tube layout with power tube.

The Amperite Adapter may be mounted within the cabinet or at the rear or again near the external storage battery, according to preference. It is connected in the minus A lead, between storage battery and receiver. No tools are required. The wires ends clip into place. The only remaining step is to turn the rheostats of the set full on. If there are individual resistances or so-called ballasts, these are short circuited.

The set is now ready to operate with group control of the tube filaments, removing all guesswork as well as the extra manipulation of antiquated rheostats. The receiver is started or stopped by means of a single switch. The longest life is assured from the tubes, since they are operated at the correct filament temperature at all times.

The Hi-Q Power Unit

Truvolt Resistors, both fixed and variable, are enjoying the distinction of being exclusively recommended for the Hammarlund-Roberts Hi-Q Six B Power Supply Unit.

In order to meet the demand for Truvolts resulting from this recommendation, Electrad, Inc., manufacturers of Truvolts have designed a special resistance kit for use with Hi-Q.

The kit is in attractive box form and contains four special resistors, designated respectively Nos. 1, 2, 3 and 4. It is the company's intention to carry these designations without values or type numbers in all literature on the Hi-Q Power Unit, because the resistors so designated are especially designed for use only with the Hi-Q.

In connection with this resistance kit, 25,000 Hi-Q booklets are being printed. These will carry full information on the Hi-Q Six B Power Supply Unit, together with diagrams showing how the Truvolt Resistors in the Electrad Kit are to be incorporated.

The Kit containing these resistors lists at $10.85.

Best Hookups—Thirty Cents Each!

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed the best hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

March, 1926
- How to Make a Wavemeter—Blueprint.

May, 1926
- Short Wave Transmitter—Blueprint.
- Simplifying Battery Charging.
- Protecting Your Inventions.

June, 1926
- Simple Crystal Set.
- Golden Rule Receiver—Blueprints.

August, 1926
- Receiver, Transmitter and Wavemeter.
- Beginners 200 mile Crystal Set.
- Changing to Single Control.

September, 1926
- How to Make a Grid Meter Driver.
- Short Wave Wavemeter.
- Power Amplifier for Quality (Blueprint)

October, 1926
- Crystal Control Low Power Transmitter (Blueprint)
- Raytheon Design for A B C Elimination
- Nine Tube Super Brings Back Faith

November, 1926
- Blueprints of the Henry-Lyford.
- Worlds Record Super With Large Tubes.

December, 1926
- Starting Radio with Crystal Set.
- Six Tube Shielded Receiver.
- Type of Rectifiers Discussed.

January, 1927
- Full Data on Worlds Record Set.
- Gough Super Design.

February, 1927
- Building the Hammarlund-Roberts.
- Making a 36 Inch Cone Speaker.
- Browning Drake Power Operated.

March, 1927
- Ideal Model Worlds Record Super.
- Building the Hammarlund-Roberts.
- Riddling Supers of Repeat Points.
- Loop and Four Tubes.

April, 1927
- Inexpensive B. Eliminator.
- One Spot Superhet.

May-June, 1927
- Complete Trouble Shooter for Supers.
- 9 Tubes for World's Record Super.

July-August, 1927
- Building Vacuum Tube Voltmeter
- Low Power Crystal Control Transmitter.

September, 1927
- New A. C. Tubes in a Six-Tube, R. F. Receiver
(blu prints.)

October, 1927
- The Thompson Super-Seven.
- The 1928 Infradyne.
- New World's Record Super-Ten.

November, 1927
- Quadrode Super-Heterodyne.
- Radio Age Short Wave Receiver.
- 1928 "Nine in Line."
- Airo-Seven.
- Camfield Super-Ten.

Radio Age, Inc., 500-510 N. Dearborn St., Chicago
You cannot possibly have any conception of the power of the Scott World's Record Super 10 until you spend a few minutes at its dials. Stations which you have heard in whispers on other sets, this receiver brings in with full, life-like volume.

VERIFIED RECORDS

9,400 Miles
1. On March 17th World's Record Super 10 received 11,575 miles with loud speaker volume.

9,000 Miles
2. On June 25th Scott World's Record Super 10 located in Chicago received for 10, 5,000 miles, 5,500 miles away.

6,000 Miles
3. On March 25th establishment of reception of six for- est stations 6,000 miles or more.

6,000 Miles
4. Established new World's Record for longest number of broadcasting stations 6,000 miles or more away.

6,000 Miles
5. Established new World's Record for most distant reception of stations 6,000 miles or more away.

6,000 Miles
6. Established new World's Record for most distant reception of foreign stations between December 27th and April 10th.

JEWELLED DIAL
Mechanically and from the standpoint of efficiency in the handling of radio frequency currents, the REMLER 3-IN-LINE is the last word in gang condenser construction. Staggered connection of plates shields each statuer section, one from the other. Balancing condensers are integral with the main unit and are easily and quickly adjusted.

REMLER DRUM DIAL
A precision product in every sense, reflecting in each detail of construction, the best in engineering and manufacturing practice. So designed that it is easy and quickly attached to any standard condenser, providing very smooth condenser control. Calibrated from 0 to 200 over the whole of its 360 degree surface. Handsome bronze panel face plate furnished with each unit.

BENJAMIN SOCKET
Spring cushioned, and hence completely shock-absorbing. Eliminates much tube noise and microphonic howl. Also greatly increases tube life by preventing jar- ring and consequent cracking of hot elements. Made of genuine bakelite, and so fashioned that tube contacts are positive at all times.

Thordarson R-200 Audio
Every test reveals the undisputed supremacy of Thordarson amplifying transformers. The pair of R-200 Thordarson's which are called for in the specifications of the Scott World's Record Super 10, will correctly amplify throughout the whole musical range, every audible frequency which the broadcasting station itself is able to register. To the "tweet" of the highest flute note and the "boom" of the cello, the Thordarson R-200 instantly responds. A Thordarson R-15 out-put transformer is also specified.

The Scott World's
MADE AVAILABLE TO YOU THRU THE COOPERATION

I GUARANTEE
That the Set You Build Will Be Every Bit as Good as My Laboratory Model
The Scott World's Record Super 10—the set which eclipsed all previous radio performance standards was not a freak. Evidence of this—and proof that the set you build will do every bit as much as my laboratory model, is the fact that builders in all parts of the country report new and greater distance records every day. Every Scott World's Record Super 10 should be as good as my laboratory model, because the vital parts of each kit are all matched to the laboratory standard, and the parts I furnish are so complete, precise and so easily understood that error is practically impossible.

Build the Scott World's Record Super 10 and you will have a receiver which is years ahead of the present day commercial conception of radio. Build this set and be the proud owner of the very finest receiver in your community. Real Distance—real Selectivity—and the tonal advantages of high voltage power tube amplification will all be yours in a combination that no other receiver can even approximately approach. Mail the coupon right now for the whole story of the Scott World's Record Super 10.

MR.
E. H. SCOTT

REMELR

R-200 Audio

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Mile Receiver!

The First Set to really Combine Extreme Distance ~ actual 10
Kilicycle Selectivity and absolute realism in Reproduction

The Scott World's Record Super 10 exceeds all present day standards of receiver per-
formance. Positively nothing else is like it. Distance? The whole world seems to be on its

Beyond all doubt, this receiver has been the subject of more enthusiastic interest than any
other ever built. It made its first bid for fame by establishing the world's long distance
record for popular receiving—63 57 miles. Since then it has picked up a host of records
which would be unbelievable were it not for the authentic verifications at hand.

Easy to Build in a Few Hours

The simplicity of the Scott World's Record Super 10 is the main reason for its
success. There is a great deal to this receiver. It embodies every known facility for converting and isolating the little
bits of energy that other receivers waste. Complete though it is—complicated as it may appear—it is so simple in design and
construction that the most inexperienced craftsman can build it with assurance of results he
had his fondest expectations.

Two Stages of Tuned R. F. for Correctly Amplified Input and Additional Selectivity—and
Three Stages of Long Wave R. F. for Power and Extreme Sensitivity

Most superheterodyne receivers depend solely upon the intermediate amplifier for radio
frequency amplification. The Scott World's Record Super 10 has two stages of high-gain
tuned radio frequency amplification preceding its intermediate amplifier. Hence, the strength of the intermediate amplifier, instead of being merely the weak impulse picked
up by the loop, is as strong as the output signal of a highly efficient tuned tuned radio
frequency set. The output is then tremendously amplified in the long wave amplifier, the pot-
ent which, therefore, is more sensitive than the regular receiver of other types of superheterodyne receivers. Power Supplies highly audible are built
up to terrific volume by the amplification system of the Scott World's Record Super 10.

And for much the same reason, this amazing receiver provides actual 10 kilicycle selectivity
no matter where it is located. The intermediate amplifier is peaked to pass only a 10
kilicycle band, and the two tuned stages which feed it, pre-sharpen the signal to a point with
perfect selectivity. The foregone conclusion is that the signal strengths at the time of input.
Indeed, there has never been such a receiver as the Scott World's Record 10—
that the performance was there, depended only upon the skill and sensitivity of the receiver.
No wonder it is the favorite in distances where broadcasting is completed. No wonder it is the favorite with those who feel
that nowhere in the world is there a station too far away to get.

Super Power Audio

Most naturally nothing less
capable than power audio am-
plification can come from a
second detector output of the
Scott World's Record Super
10. This was a foregone conclu-
sion at the time this re-
ceiver was designed, and it
was found, that not only was a
power tube necessary, but
that a good power tube and
only a 210 would handle all
that this receiver could feed.

The power output of the Scott World's Record Super 10 is limited only
by the power of the amplifier and the capabilities of the speaker used.

FREE CIRCUIT DIAGRAM

and Full particulars

The far superior performance of the Scott World Record Super 10 is not happenstance. It
is the direct result of coordinating many new and advanced engineering results to increase
and versatility of construction. Hence, the whole detailed story of the Scott World's Record
Super 10 is one of the most enlightening radio stories ever written—and of vital, interest
which means the free mail coupon and full particulars of the Scott World's Record
Super 10.

Mail Coupon Now, No Obligation.

MAIL COUPON NOW

SCOTT TRANSFORMER CO.
720-24 Eastlake Terrace
Chicago, Ill.
Send me FREE Circuit Diagrams and full particulars of the Scott World's Record
Super 10.

Name ________________________________
Address ________________________________
City ________________________________
State ________________________________

Please Mention Radio Age When Writing to Advertisers.
The Screen Grid Tube
(Continued from page 23)

is in resonance with the amplified fre-
quency, but it is also dependent on circuit losses. The more efficient the tuned circuit the greater the impedance and consequently the amplification. Supposing the impedance were 100,000 ohms (at broadcast frequencies) multiplied by the mutual conductance of 0.003 mhos would yield an amplification of 30 per stage. At lower frequencies it is possible to get a much higher impedance than it is at broadcast frequencies of 1,000,000 ohms and higher. At frequencies from 50 to 100 KC it is possible to get amplification as high as 200 per stage. For instance, with a plate impedance of 500,000 ohms and a mutual conductance of 0.003 mhos (300 micro-
mhos) and amplification of 150 is ob-
tained. It can readily be seen that the new tube also favors the superheterodyne methods of receiving, for at frequencies such as employed in intermediate fre-
quency amplifiers the amplification that can be obtained is four or five times higher than with tuned r. f. per stage.

It should not be assumed that the above results can or will be arrived at by merely connecting up the proper instruments. In these calculations it was taken for granted that there was no tendency towards oscil-
lations in the amplifier, however, under ac-
tual operating conditions we are con-
fronted with a different situation. It is true that the effective inter-electrode ca-
pacity within the tube is reduced as low as .02 m.m.f.d. (a negligible value), but there will still be capacity, and in-
ductive coupling between wires lead-
ing to the tube, coils, etc., and be-
 tween adjacent stages. Unless the ut-
most care is taken in making these couplings ineffective towards producing oscil-
lations there is little gain over our present methods with the usual tubes. Each stage must be isolated in a metal container of low r. f. resistance, and the grid and plate wires must be so arranged that the ca-
pacity between them is ineffective. A shield may have to be placed around the tube itself, or around the plate lead, or both, depending on the arrangement of parts, upon the frequency at which the amplifier is operating, and upon the am-
plification.

The circuit diagram is a suggestion for a five tube set using three CX322 tube, two as r. f. amplifiers, and one as an audio frequency amplifier, a CX301A is used for a detector and a CX371 power tube in the last stage. The broken lines indicate the shielding around each stage, this should be of copper or rather thick aluminum. Each stage must be well grounded. The coils should be highly efficient, for as explained before, the amplification depends on how good these coils are. They may be regu-
lar r. f. transformers with the primaries removed, and large enough to cover the whole wavelength band when tuned with .00025 condensers. Keep the coils well away from the shielding and the conden-
sers. The .00025 condensers are used to keep the high plate voltage off the grids, and should therefore have a high d. c. re-
sistance. The grid leaks are to carry the 1.5 volt bias which is provided by the

voltage drop across the ten ohm portion of the resistance in series with the fila-
ment to the grids. The 3.3-volt tubes are operated in parallel with the five-volt tubes by connecting the fifteen ohm re-
sistance in the negative side of the fila-
ment of each tube. The resistors should have a tap at the ten volt point to afford a proper bias for the grids. The choke coils L2 are of the ordinary r. f. type and used to prevent the r. f. from mixing in the battery circuit and instigating oscillations. When more than two stages of amplifica-
tion are used even more elaborate filters are required to prevent feed-back from this source. The condensers of course aid in the same manner and are quite important. A gang condenser can be used to tune the circuits.

It will be noticed that in the audio stage using the CX-322, the screen grid bias is only 22½ volts; this compensates for the voltage drop in the low resistance of 250,000. When a higher voltage is used the screen grid voltage should be corre-
spondingly increased. In this audio stage a voltage amplification of 35 may be easily gained, and with a perfectly uniform amplification of all frequencies. In the usual transformer coupled stages—transformer coupling is no good here, at least not with the tube connected as a high amplification tube. It is however possible to connect the tube in such a man-
ner to bring about a condition which makes possible the use of ordinary transformer coupling. This is known as the "space charge" effect. The "screen grid" is used as the control grid, and the inner grid is connected to the B battery.

The effect is to diminish the accumula-
tion of electrons around the filament, which ordinarily prevent a greater portion of the electrons radiated from the filament to flow to the plate. The electrons are drawn off by the proximity of the filament acts as a barrier and sends electrons back instead of allow-
ing them to pass to their destination, the plate. The more electrons flowing to the plate the less is the plate potential re-
quired, hence, by bringing the positively charged grid into or near the field of the accumulated negative electrons they are disaband and attracted to the plate—where all good electrons should go. The result is that it is possible to use a much lower plate voltage than we generally supply to our tubes.

There seem unlimited possibilities for experiments with these new tubes, and no doubt they will bring sleepless nights to many a fan because of the irresistible temptation to follow the many channels of experiments they will afford. There is much to be seen gratifying than startlingly good results after hours of experimenting with a set, and also nothing more disap-
pointing than having hours of work and dreaming result in nothing more than local stations and oscillations—the new screen grid tube will deal out both.
Standardization at Last!

Efforts of the Radio Manufacturers Association to bring about a single code of standards for the radio industry are at last achieving the desired results, according to an announcement from the RMA. The man who builds his own radio set, as well as the manufacturer, will be benefited by arrangements made toward the establishment of a single industry standard, to be determined with the aid of the American Engineering Standards Committee.

Although the Radio Manufacturers Association has a membership ten times that of any other manufacturer group in the radio field, a minority group has advanced a somewhat different code of standards. Both of these standards were drawn up in good faith, but by different groups, and accordingly reflected some differing opinions, bringing some confusion in the industry. Several attempts have been made to bring about a single set of standards.

The RMA announced last June that it would not publish any new standards until a very comprehensive plan could be made for the establishment of a single industry standard. A study of the situation showed that personal differences balked the single standard as long as it bore any trade association name. In recognition of this situation and as a practical expression of its sincere desire to bring about a single industry standard, the RMA arranged last September to drop the use of its name in connection with standardization, and to lend its efforts and influence toward the formation of a single industry standard, irrespective of what name any other and smaller group of manufacturers might desire to retain.

With the RMA taking this position and also desirous of securing valuable standardization suggestions from any expert source, a meeting was arranged by Dr. Agnew, Secretary of the American Engineering Standards Committee, and by Dr. Goldsmith, Secretary of the Sectional Committee on Radio of that association, with engineering representatives of the radio manufacturing interests to discuss their specific problems and differences. The result of this meeting, held recently (with the RMA represented by the Chairman of its Engineering Division, Mr. H. B. Richmond, of the General Radio Company, Cambridge, Mass.), was that a complete reconsideration is to be given to the existing codes of standards and their variances. An agreement was reached that all items on which there is no conflict shall be announced as radio industry standards. On items on which there is a disagreement the American Engineering Standards Committee will endeavor to analyze the situation, hear all evidence, and establish the industry standard with the understanding that any conflicting standards will be brought into harmony and agreement with the radio industry standards as rapidly as possible. The RMA will not publish any standards of its own, but will distribute to its members, and adhere to, the national radio standards as determined and approved by the American Engineering Standards Committee.

**The Finest A. C. Radio in America**

Uses Radiotron or Cunningham A. C. tubes—entirely self-contained—power units built-in—objectionable A. C. hum eliminated—A.C. volume control perfected—fully adjustable to variations in house current voltage—master control switch on front panel—exceptional tone quality and volume from push-and-pull power amplifier—equally good reception at every wave-length due to Loftin-White constant coupling—non-reactive plate circuit makes it entirely independent of tube capacity.

The perfected A. C. radio

**For Sale by Better Radio Dealers**

Write for 24 pp. booklet explaining the famous Loftin-White circuit as perfected in the Arborphone.

**Arborphone Division**

Consolidated Radio Corporation

Ann Arbor, Michigan

**Licensed under Radio Corporation of America, General Electric, Westinghouse Electric & Manufacturing Company, and Loftin-White patents.**

Please Mention Radio Age When Writing to Advertisers.
A Quadrode Record

(Continued from page 26)

and played "radio golf" and I certainly enjoyed tuning around and "seeing" who I would get next with the Quadrode. This set gets through and does not cut off the side bands. It is very sharp and requires careful tuning. Although my list shows only one-half numbers it will be found that about three stations can be obtained in some spots between points on the dials.

If the "radio modifier" or potentiometer is turned on full and the "audio modifier" only slightly some of the out of town stations like WWJ, Detroit, and WLV, Cincinnati, come in with the same volume as local stations. I would advise persons building the set to take a few hours to learn how to use that set before making a log. Don't forget to put a piece of wire between the last two binding posts if using an antenna. Also, loosen the coupler if locals are too broad. A resetting of the antenna condenser may be necessary if coupler is loosened while adjusting to a station.

I received station KFFK, Milford, Kansas, at about 8:30 a.m. Sunday morning, November 22nd, at distance of approximately 500 miles. Below 10 on the oscillator dial I heard amateurs talking. Another odd one was station CKY on about 192 meters or about one-half of their regular wave length. I don't find this listing on any published lists but reception was obtained on Tuesday night, November 22nd. They were staging the "Frolics."

None of the receiving was after 12 at night when it is easier to get the western coast stations. All the locals were on and I worked at it for only an hour or two on the nights of November 21st and 22nd, inclusive.

You will no doubt note that some of the stations are out of their proper place on the oscillator dial. However, they were received as noted. These differences are in the wave length and are as follows: WCMA Culver, WCBS Springfield, Ill., and WEHS Evanston, WSA Springfield, Tenn., is not listed on any list that I have. WSIX Springfield is listed but I received WSA Springfield, Tenn. All of these stations were received with an antenna. I am going to try a loop.

Yours very truly,
J. LOUIS ROBERTS.

The Quadrode Super-Heterodyne

(Continued from page 6)
such a device the power tube can be removed from the set and operated in the "B" supply unit, where provisions are made for it. The filament is operated from the five volt a. c. winding, thus making it practical to use a "A" power unit having only a two amperie capacity.

An outside antenna consisting of a single wire from 60 to 75 feet long (including the lead-in wire) will bring in the best DX, on the other hand the set is so powerful that fine performance can be obtained from a small loop antenna, or even a small indoor wire laid between the rugs, or around molding.

QUADRODE BLUEPRINTS

Blueprints of this popular super-heterodyne, which was introduced by Radio Age in the November issue, can be had at 25 cents each or for $1 the complete set of four. They are for panel template, sub-panel template, wiring diagram and picture diagram. Address Radio Age, 500 N. Dearborn St., Chicago.

HEADQUARTERS

for the Shielded Grid Six—Radio's Most Remarkable Receiver

The Lincoln Radio Corporation, manufacturers of the famous Lincoln Loops and Long 45 Tuners since the early days of broadcasting, are proud to offer you a radio set without a single quibble for qualification for its performance. In the long history of Lincoln engineering dating from the infancy of broadcasting, Lincoln engineers have never before discovered any other receiver that they could so whole heartedly endorse and so unconditionally guaranteed.

The Silver-Marshall Shielded Grid Sixes, the very latest radio sets using the new Shielded Grid tubes have in the Lincoln Chicago Laboratories brought in East and West coast stations regularly on the speaker using either a loop, a twenty foot antenna, and in some cases, no antenna at all—all this with marvelous tone on any night in the week, with fifteen to thirty local stations operating!

Custom-Built to Order

Lincoln offers you immediate delivery on the regular S-M Shielded Grid Six kits, 630 SC, for antenna operation at $26.50, and 630-LSG for loop use at $91.50. In the Lincoln Laboratories you can have these sets custom built, tested, and guaranteed at $25.00 each, and furnished in beautiful Frits walnut cabinets at $22.00 additional.

Lincoln custom built Shielded Grid Sixes and S-M kits are unconditionally guaranteed to give better distance, selectivity and tone than any set you have ever heard or used, or your money cheerfully refunded.

To set builders a profitable agency plan is available selling Shielded Grid Sixes. Think what the agency for a set that you can guarantee to out-distance any other set made means to you! Lincoln can furnish you accessories—tubes, cabinets, speakers, kits, sets and all standard merchandize at a saving, and with the Lincoln Laboratory guarantee.

Lincoln Radio Corporation
222 South Wood Street
Chicago, Ill.

Lincoln Radio Corp.
210 S. Wood St., Chicago

I am interested in your remarkable guaranteed Shielded Grid Sixes. I am interested in your profitable agency plan.

Name_____________________
Address__________________

RADIO AT WHOLESALE


It's a regular encyclopedia on radio. All should have one. Lowest wholesale prices. Lowest catalog prices. Lowest wholesale. Lowest catalog prices. Lowest wholesale catalog prices. LOW! LOW! LOW!


Please Mention Radio Age When Writing to Advertisers.
New Move by Independents
Co-operative research to perfect new radio circuits, as well as new inventions in radio tubes and other devices, will be inaugurated by the Radio Protective Association. This was decided upon at a convention in Cleveland, Wednesday and Thursday, December 7 and 8. As a basis for this program, leading members of the association have already offered to cross-license their valuable patent holdings with all other members of the organization. Plans for a general patent interchange—the first step in such cross-licensing to be taken in the industry—will therefore also be made as a result of the Cleveland meeting.

The Cleveland meeting will mark a decisive step forward for the independent radio manufacturers of the United States," said Oswald F. Schuette, executive secretary at the Chicago headquarters in announcing the Cleveland convention, "So far we have carried on an offensive and defensive campaign against the Radio Corporations of America and its constituent companies, to prevent the Radio Trust from monopolizing the industry by destroying the independent manufacturers and dealers. This campaign has been an effective one. But now we intend to supplement it with a constructive campaign of scientific research and discovery for the joint benefit of our members. Here the independents, unhampered by license agreements, have a great advantage. By co-operation we hope to show the world some startling progress in the great untapped fields of radio development. Although the Radio Protective Association includes the most important of the independent manufacturers, it is by no means a closed organization. We shall be glad to welcome independent companies everywhere, large or small, and to give them a fair share in this opportunity for perfecting the radio art. By a system of cross-licensing the patents of our members as well as those to be perfected by joint laboratory, we are confident that we will be able to keep the independents in the forefront of radio progress."

Soft Pedal on New Laws
Additional state or municipal legislation against unusually large volume loud speakers causing local disturbances, such as those used for demonstration purposes outside radio stores should not be enacted in the opinion of the Legislative Committee, Radio Division National Electrical Manufacturers Association, which held its midwinter meeting in Chicago.

It is believed by the members of the Committee, of which Dr. Alfred N. Gilbert is Chairman, that such operation of loud speakers as may interfere with the comfort or the health of neighboring persons, can be controlled either as a public nuisance or under the authority of the local health officials. Where such devices become public nuisances, they ordinarily come under the classification of a disturbance of the peace and can be dealt with without additional legislation.

The Committee also considered the question: Should States or municipalities pass legislation specifically directed against a

Sensational Success
Over 25,000 sold the first 6 months
—Overwhelming evidence that VALUE is quick to be recognized and appreciated. Unsurpassed quality is built into the Townsend "B" Socket Power Unit with money saved by unified production methods and lower merchandising costs. You get more—you pay far less—for the most remarkable value in Radio today.

New thousands of Radio set owners are learning this daily by installing Townsend "B" Socket Power. Sold on REAL GUARANTEE OF MONEY BACK IF NOT SATISFIED. Delivers up to 100 volts on any set, D.C., or AC.—any cycle. Full tone, clarity and volume.

SEND ORDER TODAY
Simply fill out the coupon and slip it into an envelope with only $1.00 and mail it to Townsend "B" Socket Power Unit, 713 Townsend St., Chicago, Ill. Deposit only $1.50 plus postage on the purchase price of the unit, and for the first 100 days if it does not do everything we say return it to us and purchase price will be refunded.

TOWNSEND LABORATORIES
713 Townsend St., Dept. 31, Chicago, Ill.

TOWNSEND LABORATORIES
713 Townsend St., Dept. 31, Chicago, Ill.

Dray Radio Lab.
6 E. Lake, Chicago 1266 Central

COMES IN AND HEAR THE
Long Air Column Dray
Deepspeaker
at $45 (in its own cabinet-table) performing on an 11 tube single
dial—A.C. operated.

INFRADYNE
Free Consultation for Infradyne
Builders

ALL Popufar Circuits
Set builders will find in the New Directory of Kix an itemized list of the parts used in all new cir-
cuits. Send 10 cents in stamps to cover mailing and handling for this new Kit Supplement.

Newark Electric Co.
223 W. Madison Street
CHICAGO II

ILLINOIS

Please Mention Radio Age When Writing to Advertisers.
RADIO AGE

38

for Dec-Jan., 1927-28

Correct List of Broadcast Stations
Station

Location

KSD
KFUO

St. Louis,

WMAK
WPTF
WFAA

WDAY
KFDY
WCAC
WHO
KFBK
WTIC

Kilocycles Meters

Mo
Mo

St. LoUis,

Y

Lockport, N.

Raleigh, N. C
Dallas, Texas
Fargo, N. D
Brookings, S. D
Mansfield, Conn

Des Moines,

la

Sacramento, Cal

WNYC
KFKX
KYW
KMTR

WMC

WWVA
WFLA-

WSUN
WTAG
WEEI

Hartford, Conn....
New York City
Chicago, 111
Chicago, 111
Los Angeles, Cal

Fla...

Worcester, Mass
Boston, Mass

KGW

Oakland, Cal

Providence, R. I
Laramie, Wyoming
Chicago, 111
Chicago, 111
Vermillion, S. D
Berrien Springs, Mich
College Stat., Tex

KFDM

Beaumont,

WSUI

Atlanta, Ga
Iowa City, la.

KFI

Washington, D. C
Los Angeles, Cal....-

WCAE

Pittsburgh,

WNACWBIS

KRLD
KFNF

WRR
KUOM
WJZ
KFRG

Pa

Tex

Shenandoah, la
Dallas,

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Tex

Mont

Missoula,

Bound Brook, N.

WMAQ
WQJ
KFOA
WJR-

Tex....

Boston, Mass
Dallas,

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WSB

WRC

......580

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Fort Worth, Texas
San Antonio, Texas
Portland, Ore
Bellmore, N. Y....

WEMC
WTAW

750

570
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Omaha, Neb

WEAF
WJAR
KFBU
WCFL
WLTS
KUSD

517

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WOW

KLX
WBAP
WOAI

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W. Va

Wheeling,

Clearwater,

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Memphis, Tenn

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San Francisco, Cal

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Chicago,
Seattle,

Power

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WCX

Pontiac,

WIBG

Elkins Park, Pa
San Diego, Cal

KFSD

WAAW
WLW
WLW
WMAF
WOR
KPO

WOS
WGNWLIB
WLIB-

Omaha, Neb
Harrison,
Cincinnati,

South Dartmouth, Mass
Newark, N. J
San Francisco, Cal
Jefferson City,

Chicago,

Mo

111

WGN

Near Elgin,

KHJ
WLIT
WFI

Los Angeles, Cal

WCCO
WEAR

Minneapolis, Minn.
Cleveland,
Cleveland,
South Bend, Ind

WTAM
WSBT
KMA
WHN

111

Philadelphia,
Philadelphia,

Pa
Pa

Shenandoah, la

New York

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City

.....710

Station

WQAOWPAP

KTW
KWSC
KWKH
KOB
WBBM

Kilocycle6

Location
| Cliffside, N. J

760

Wash
Pullman, Wash

Seattle,

WAAF
WJBT

Shreveport, La
State College, N. M..._
Chicago, 111
Chicago, 111
Chicago, 111

WABI

Bangor,

WQAM
WMBF
KGO
WBSO
KTHS
WCAJ

WGY

KNRG

woe
WDAF
KHQ
WMCA
WLWL
WEBH
WJJD

KMJ
WGSH
WSAI

KFWB

WWJ
WEW
WOO
WIP

WGBS
KVOO
KJR

KXA
WLS
WCBD

KWG

KFQD
WAPI

WJAX

WHB
woo
WSM
KNX

Me

Miami, Fla

_„

Miami Beach, Fla
Oakland, Cal

...780

Wellesley Hills, Mass......
Hot Springs, Ark
Lincoln, Neb...

Schenectady, N. Y
Santa Monica, Cal
Davenport, Ia...._

Mo

Kansas City,

Spokane, Wash
Hoboken, N. J
New York City

_

Chicago, 111
Mooseheart, 111
Fresno, Cal....
Portland, Maine

Mo

Wash
Wash

Seattle,

Chicago, 111
Chicago, 111
Stockton, Cal
Anchorage, Alaska
Auburn, Ala
Jacksonville, Fla

Kansas City,
Kansas City,

Mo
Mo

Nashville, Tenn
Los Angeles, Calif

KFQB
WJAD

Fort Worth, Tex

WBZ
WBZA

East Springfield, Mass
Boston, Mass

KSAC

KFJM

Manhattan, Kans
Grand Forks, N. D

KSEI

Pocatello, Idaho.....

WHA
WLBL
WRNY

WPCH
KOA

WRHF
WHAS
WKAO
KICK
WIAS
KOIN
KOIL
KFAB

KDKA
KPSN

WABC
WBOQ
KYA
KOMO
WHT
WIBO,

Waco, Tex

Louisville

San Juan, Porto Rico
Iowa
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Ottumwa, Iowa
Portland, Ore
Council Buffs, Iowa
Lincoln, Nebr
Pittsburgh, Pa
Pasadena, CaL
Atlantic,

Hill,
Hill,

N.
N.

Y
Y

San Francisco, Cal.__
Seattle,

Wash

Chicago, 111
Desplaines,

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Madison, Wis
Stevens Point, Wis....
Catesville, N. Y
Hoboken, N. J
Denver, Col
Washington, D. C

Richmond
Richmond

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Cincinnati, O
Los Angeles, Cal
Detroit, Mich
St. Louis,
Philadelphia, Pa
Philadelphia, Pa
Astoria, L. I. N. Y..._
Bristow, Okla
Seattle,

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Meter s Power
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5000
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radiating receiver? In general, it was the sense of the group that States or municipalities should not legislate against a radiating receiver. Some reasons given were: That such receivers may be regarded as transmitters in miniature, and, therefore are under the regulatory power of the Federal Government, since reception of signals from outside the State would be interfered with. It was also considered that most manufacturers have voluntarily stopped production of such receivers, and public opinion will compel their ultimate abandonment; and that statutes and ordinances against disturbing the peace or maintaining a nuisance are in existence and are apparently adequate; and that municipal and State regulations, if enacted, would not be uniform and would result in much confusion.

The Committee held that receiving stations or sets should not require any license whatsoever, either Federal, State, or municipal, since the present system is well-established; and that there was no more justification for licensing a radio receiving set than for licensing electric phonographs, electric refrigerators or other household conveniences.

It was the unanimous opinion of the Committee that the regulation of radio transmission should be solely handled by the Federal Government, since radio communication is interstate and international in character. Local control of radio transmission would be tremendously complicated and non-uniform; and furthermore a uniform enactment is essential under the Constitution of the United States, since the Constitution gives to the Federal Government the control of interstate commerce.

The results of this study by the Legislative Committee were presented to the Radio Division membership at its mid-winter meeting held at the Edgewater Beach Hotel, Chicago, Ill.

"Tube Clause" Attacked

Immediate action by the Federal Trade Commission on the complaint against the "tube clause" in the Radio Corporation of America's license agreement should result from the commission's decision that the text to the clause, requiring licensees to equip their sets with Radio Corporation tubes, is to be investigated in a separate action instead of under the general antitrust complaint against the corporation.

This is the view of the Radio Protective Association, an organization of independent manufacturers who are fighting the alleged efforts of the Radio Corporation of America to monopolize the radio industry.

"The decision of the Commission can only mean that it will now order immediate action on the 'tube clause'," said Oswald F. Schuette, executive Secretary of the Radio Protective Association at the Chicago headquarters. "By speedy action, the commission would check one of the outstanding efforts of the Radio Trust to destroy its independent competitors. It was to secure just such protection for the freedom of industrial competition that the Federal Trade Commission was created. The independents in the radio industry are entitled to immediate relief.

"The tube is the vital part of a radio set. The engineering of the latter is based on the characteristics of the tubes to be used in it."

"It is therefore vital that the 'tube clause', which is significant of the whole effort of the Radio Corporation to monopolize the industry, should receive immediate condemnation at the hands of the Commission. Such an action would constitute the most effective step on the part of the commission to protect the young but vigorous radio industry against this destructive monopoly."

The complaint against the "tube clause" was filed with the Radio Commission a month ago by Arthur D. Lord, receiver for the DeForest Radio Company, one of the largest independent tube manufacturers, among the members of the Radio Protective Association.
40

RADIO AGE

Kilocycles

WGR

Location
Troy, N. Y
Buffalo, N.

KSL

Salt

KFWO

Avalon, Cal

Station

WHAZ

KMOX
WBAK
KOWW
WWNC
WPSC

KUOA
WEPS

WSMK
KQW
WDEL
KGFW
WSMB
KLZ

WODA
WTMJ
KPRG

WLBW
KGCH
WGL
KGDW
KGEZ
WDBO
WENR
WBCN
KTBI
WNAT
KGBX
WKY
WSSH
WBET
WIAD
WBAL
KFAU
WJAG
KLCN

KMMJ
WCAL
WDGY
WAIU
KFXF
KFJR
KTBR

Lake

for Dec-Jan., 1927-28

Y
Utah

City,

Mo

St. Louis,

State College, Pa
Harrisburg, Pa
Walla Walla, Wash

C

Asheville, N.
Fayetteville,

Gloucester,

Ark
Mass

Jose, Cal

Wilmington, Del
Ravenna, Neb

New

La

Orleans,

Denver, Colo
Paterson, N. J
Milwaukee, Wis.....
Houston, Tex
Oil City, Pa.

Y

York, N.

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Philadelphia, Pa
St. Joseph, Mo
Oklahoma City, Okla...

Boston, Mass
Boston, Mass....
Baltimore, Md..
Boise, Idaho
Norfolk, Neb
Blytheville, Ark
Clay Center, Neb
Northfield, Minn

Minn

Minneapolis,

Columbus, Ohio
Denver, Colo

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Portland, Ore
Portland, Ore

Brownsville, Texas
Tuscola, 111

Mt. Clemens, Mich
E. Lansing,

Mich

Yankton,

Dak

S.

WHAR
WPG

Indianapolis, Ind....
Providence, R. I
Los Angeles, Calif
Atlantic City, N. J..
Atlantic City, N. J

WBAA

Urbana, 111
LaFayette, Ind

WRM
KFJF

Oklahoma

KFAD
WFBJ

Phoenix, Ariz

KSMR
WFDF
WSKC

Santa Marie, Cal

KLDS
WJAS

Independence,

KQV

Pittsburgh,

City, Okla

Collegeville,

Flint,

Bay

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Mich
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City,

Pittsburgh, Pa

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Chicago, I.ll._
Los Angeles, Calif
Dublin, Texas
Havre, Mont

KFSG

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Kalispell, Mont...
Orlando, Fla
Chicago, 111
Chicago, 111
Los Angeles, Cal.

WTAS
KFSG

WEAN

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Escanaba, Mich
Columbus, Ohio
New Haven, Conn
Colorado Springs, Colo
Oakland, Cal
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Rochester, N. Y

KFPL
KFBB

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Humboldt, Neb..

WRAK
WEAO
WDRC
KFUM
KTAB
WHAM
KWWG
WDZ
WGHP
WKAR
WNAX

WFBM

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Wayne, Neb

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Dayton, Ohio

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Kilocycles

Power

Station

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WGST

Atlanta,

WSOE
KOAC
KFLX
KGU

Macon, Ga.
Milwaukee, Wis..
Corvallis, Oregon
Galveston, Texas
Honolulu, Hawaii
Milwaukee, Wis

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WMAZ

WHAD
WBAO
WDAE
KSBA
KFLV

WLAP
KFWI
KFIZ

WOBU
WAAM

Location

Ga

Decatur,

1120
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Shreveport, La...
Rockford, III

San Francisco, Calif
Fond du Lac, Wis

KTSA

Takoma
Sport

WEAM
KGHP

WRHM

WOOD
KGA
WHBA
WCAU
WCMA

WDWF-

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Red Bank, N.

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N. Plainfield, N. J
Hardin, Mont
Minneapolis, Minn
Grand Rapids, Mich
Spokane, Wash
Oil City,

Pa

Philadelphia, Pa
Culver, Ind

WFIW
WFBL

Hopkinsville,
Syracuse, N.
Beloit, Wis.._

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Omaha, Nebr.....
Omaha, Nebr
Omaha, Nebr

KFUL

Galveston, Texas
Salt Lake City, Utah...
St. Louis,
Charlotte, N. C
St. Louis,

WBT
WSBF
KTNT
WCSO
KRE
KFUS

WBBR
WASH
WEBJ

WLTH
KGFX
WRVA
WREN
KFKU

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New York, N. Y.._
Brooklyn, N. Y
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Richmond, Va
Lawrence, Kansas...
Lawrence, Kansas

KMO
WTAQ
WCAX

Takoma, Wash
Eau Claire, Wis

KFHA
KGDA
WHEC-

Gunnison, Colo
Dell Rapids, S.

Burlington, Vt...

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Rochester, N.

KPLA

Los Angeles, Calif

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Grand Rapids, Mich

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Springfield, Ohio
Berkeley, Calif
Rossville, N. Y...

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Muscatine, Iowa

Oakland,

Power

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Crauiston, R.

WNAL
KOCH
KFOX

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Chicago, 111
Chicago, 111
Amarillo, Texas
Los Angeles, Calif..

WLSI

WEBW

1120
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Conn

Danbury,

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Park, Md.....

Hill,

Virginia Beach,

WJBI

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Seattle, Wash.....

WSEA
WJAZ
WMBI

KGEF
WJBO
KFPW
KGEK

Va

Tenn

Knoxville,

WCWS
WDAG

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Ky

Louisville,

Ames, Iowa
Cleveland, Ohio
San Antonio, Texas..

KKP
WBES
WIGG

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WGCP
WFPG

WNOX
WOI
WHK

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Tampa, Florida

Charlestown, W.
Newark, N. J
Newark, N. J
Newark, N. J
Altoona, Pa

WNJ

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Crosley Reviews Year
Powel Crosley, Jr., President, The Crosley Radio Corporation, says: "The saturation point in radio is far away. We anticipate no radical change in radio development during 1928. The trend will continue toward the AC type of set with many replacements of earlier battery-operated receivers. The demand for replacement of old equipment with new, up-to-date sets will be greater than ever in 1928."

"Unquestionably the most valuable or important radio development in 1927 was the AC tubes, bringing real AC operation in the radio receiving set. The changes are many. A small transformer supplying different voltages to provide the heat necessary to make a vacuum tube function, replaces the storage battery with its necessary charger or trickle-charger to supply current for the filaments or heaters.

"Economy of current is not so essential, when it is taken direct from the light socket as it is if the current is taken from a storage battery. The tubes, therefore, have much greater emission and greater ability to perform efficiently and give greater volume without distortion. These are but two of the important changes—there are many others.

"The trend is now unquestionably towards the AC set using AC tubes, wherever electric light current is available. 1927 has seen the development of more efficient receiving sets at lower prices than ever before. 1927 has brought better tone quality through more extensive use of power output tubes and improved loud speaking devices."

THE NEW YEAR
A FLOWER unblown, a Book unread
A Tree with fruit unharvested
A Path untrod, a House whose rooms
Lack yet the heart's divine perfume
A Landscape whose wide border lies
In silent shade 'neath silent skies
A wondrous Fountain yet unsealed
A Casket with its gifts concealed
This is the year that for you waits
Beyond tomorrow's mystic fumes—
—Horatio Nelson Powers.
<table>
<thead>
<tr>
<th>Station</th>
<th>Location</th>
<th>Kilocycles</th>
<th>Meters</th>
<th>Power</th>
</tr>
</thead>
<tbody>
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<td>1240</td>
<td>242</td>
<td>500</td>
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<td>KFON</td>
<td>Long Beach, Calif.</td>
<td>1240</td>
<td>242</td>
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<tr>
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<td>1240</td>
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<td>Superior, Wis.</td>
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<td>Birmingham, Ala.</td>
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<td>1250</td>
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<tr>
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<td>500</td>
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<tr>
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<td>Portland, Oregon</td>
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<td>240</td>
<td>2500</td>
</tr>
<tr>
<td>WBBR</td>
<td>Madison, Wis.</td>
<td>1250</td>
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Power Tube

(Continued from page 15)

a three volt positive potential will be impressed on the grid—the very thing we want to prevent. It can be seen that for a given amount of amplification, or volume, the type of tube, and the grid bias, and plate voltage are the primary factors.

The subject of obtaining "quality," or undistorted reproduction is not given the attention it deserves. It is true that many articles have appeared in various periodicals at different times concerning the construction of power devices and amplifiers capable of delivering large outputs, but in most cases the builder is ignorant of what is taking place in the appliance he is building, and of the requirements of the same for true reproduction. Articles devoted to this subject will appear in coming issues of Radio Age; written to give the experimenter and layman a better understanding of the audio frequency amplifier and reproducer. Only a small portion of the distortion of the received music takes place in the portion of the set which is ahead of the detector. The audio amplifier system and reproducer are directly responsible for the reproduction—assuming, of course, that the music received from the broadcasting station is perfect, or almost so, and that the radio frequency amplifier is not too drain.

For the present, we suggest that the reader who is still operating his set with the general purpose tube in the last stage and operating a loud speaker from it, invest in some type of power tube. If B batteries are used and the most economical operation is an objective then the 112 type tube should be used with a plate voltage of 135 volts, and a C bias of 9 volts. It must be remembered that the loudspeaker must be limited with this tube, but very much better than with the use of the 20A type. Where the "opposite" type tubes are used a "120" tube with a plate voltage of 135 volts and a C bias of 22½ volts. The undistorted power output of this latter tube is 120 milliwatts, but the amplification of the tube is only 3.3 as compared with 6.6 of the "opposite" type which it replaces. Where a B supply unit is available the 171 type of tube has a distinct advantage, and 180 volts should be applied to the plate (most B supplies eliminate this) with a C bias of about 40 volts.

Federal Corporation

The Federal Radio Corporation announces the appointment of W. F. Kroening as territorial representative in Michigan to replace H. H. Wilkin, who has been transferred to California. Although a new member of the Federal sales organization, Mr. Kroening has had several years of selling experience in radios, and is expected to continue the good record in Michigan. He will work in conjunction with the Grier-Sutherland Company, Detroit, wholesalers for Federal Ortho-sonic radio in that territory. Mr. Wilkin's assignment to California is being made by P. J. Rundle, who was recently made special representative.

The ACME Wire Company, New Haven, Connecticut

PARVOLT WOUND CONDENSERS

It has become standard practice to use

Parvolt Wound Condensers

in circuits which quickly break down ordinary bypass or filter condensers.

You will find that the same characteristics of accuracy, high direct current resistance, and the ability to give continuous duty at full rated voltage, make them desirable in circuits where even a poor condenser might "get by."

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Radio is an exact science, yet so new there is still much that is incorrect and unscientific in present equipment. The results are faulty reception and complaints.

To meet this need we have compiled the exact facts covering the entire scope of radio science and every type of receiver into one big, fine, new book. With it you can now Be The Man Who Knows!

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CHICAGO

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**R. M. A. Trade Show**

Director Herbert H. Frost, Chairman of the Association Show Committee has announced the date of the 2nd R. M. A. Trade Show as June 11-15, 1928, to be held at the Stevens Hotel, Chicago, Illinois.

Last year it was impossible to properly take care of all members because of the lack of space but this year Mr. Frost states that in addition to the Exhibition Hall, he has also arranged with the Stevens Hotel for use of the Grand Ballroom which will make available over 30,000 sq. ft. of exhibition space. Space application blanks will be mailed to all members within a few days.

Admittance this year will be the same as last, that is by invitation only to jobbers and dealers, and such others as the Show Committee might determine.

No applications for space at this Trade Show will be accepted from new members after February 15, 1928.

During the Trade Show week the Fourth Annual Convention of the Association will be held and reports received from all standing and special committees. The annual election of officers will also be held for the year 1928-29.

The R. M. A. Annual Banquet will also be held during the week of the Show.

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**The Hot Spot Fourteen**

(Continued from page 20)

The tuning diagram of Figure 5 carefully. Rather than to obtain parallel wires and angles, a point should be made to get the wiring as direct as possible, thus insuring short wires; one of the most important factors in building radio sets. The by-pass condensers should be clamped between straps made of thin brass strips and mounted on fiber or metal bushings to the sub-panel. In this manner the condensers are suspended from the sub-panel rather than mounted directly to it. The object is to permit clearance for wiring and other parts. The small Sanganmo condensers are mounted the same way. The bottom view of the sub-panel in Figure 4 corresponds to the drawing of Figure 5 completing the lay-out in every detail.

In the blue-print the relation of all parts to one another are illustrated. The top is the rear of the front panel with all parts mounted thereto and the bottom the top view of the front panel. The two 1 midi by-pass condensers are mounted to the baseboard. Reference should be made to the photograph in Figure 8, showing the top view of the completed set.

The tube requirements for the set are five 201A type, eight 199 type, and one power tube of the 171. A 201A is used in the first and second detector, in the oscillator, and the first two stages of audio. The 171 in the last stage, and the 199 in the intermediate stages. Despite the number of tubes used the plate current is not particularly heavy. With the proper voltages applied, the total current is about fifty milliamperes (180 volts on the 171 tube).

---

**“TONATROL”**

A True Tone and Volume Control

To have music at its best—the tone clear and sweet—the correct volume is necessary. With “Tonatrol” you can secure the proper volume instantly—with remarkable ease. Make your radio a greater joy by installing “Tonatrol” today.

Tonatrol—Standard Volume Control $1.50.

Tonatrol—Type W. S. (with filament switch attached), $2.00.

Write for free installation booklet for the proper way to control volume.

Dept. 42C, 175 Varick St.,

New York, N. Y.
## Dominions of Canada

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<th>Station</th>
<th>Location</th>
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## A Compact, Correct Call-Book

The foregoing list of American broadcasting stations includes kilocycles, wave-lengths by meters and the power each station is authorized to use. Despite difficulty in keeping pace with frequent changes in the station list readers will find this to be 100 per cent accurate as of date, December 1, 1927, the latest official information obtained on December 20, 1927.
The biggest Edition—
The biggest edition ever published. Brimful of soundest information, latest circuits and hook-ups, new revised list of world's broadcasting stations with schedules and new wavelengths in meters and kilocycles. 284 pages of news, ideas, and valuable information for fans, set builders, radio dealers and everyone interested in radio's advancement.

Citizens Radio Call Book Magazine
November, 1927, Edition
Now on Sale at Newsstands and Radio Stores
First with the Latest
All receivers designed and tested in our laboratories

Complete constructional details on the newest radio circuits are given and include the Camfield Shielded Grid Seven Receiver using radio's latest tube development, Magnaformer 9-8 A. C. Super, R. G. S. Octamonic Receiver, Madison-Moore International "One-Spot," Thordarson Power Amplifier System, Three Foot Cone Speaker construction article, Silver-Marshall Laboratory A. C. Shielded Super, Victoreen, Tyrman Ten, World's Record Eight, Knickerbocker Four and many other interesting circuit arrangements for experimenters and professional set builders.

Wonderful Rotogravure Section
One of the big features of the new Call Book is the 16-page rotogravure section; it is replete with photographs and views. Your favorite radio artists, pictures of studio life, prominent announcers and other features are shown in actual photographic views.

A Complete Radio Cyclopedia
Be sure that you get the CITIZENS RADIO CALL BOOK MAGAZINE, the original and most widely circulated publication of its kind. Accept no substitutes. Published four times yearly, September, November, January and March. On sale at newstands and radio stores the world over, or subscribe now and be sure of receiving each issue as published.

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MISCELLANEOUS

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GILLETTE STYLE Razer with 19 Blades $6.95 Propag. Lead Speaker $3.95. Speaker Unit $1.10 prepaid. Trans- mitted 25th, Noble Station A, New Haven, Conn.

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PERSONAL


RADIO

EXTRA HEAVY Antenna wire 7, 11, $1.50 100 feet, 17, 22 braided 5'-8" wire $2.00 100 feet all grand. Geo. Smith, Colum, Michigan.

SLICERTON LOWER Blast sold for our new wholesale catalog. Free to free. Kansas City Radio Company, Kansas City, Mo.

Radio Books—Construction of a modern Super Hetero- dync, 024; Receiver, 111; Transmitter, 111; Testing and Operation of 121, 125, 125; Radio Circuit Design, 252; Radio Physics, 236, Second Edition. Also complete sets of 1000 in 1515 pages, 75 cents; Kennedy's Workbok Rece- ivers 100 pages. 60 cents. Experimental Wireless Stations 303 pages $2.00; Wireless Telegraphy and Telephony. Simply explained. $1.00. Send grand or cash on receipt of price. Send price for our 8 page catalog of latest and best practical, scientific, mechanical and indus- trial books. Midland Products Co., Dept. R.D., 824 Courtyard Ave., Park Ridge, Illinois.

SLICERTON LOWER Blast sold to order .014", 10 lbs. 50 cents, 20 oz. 75 cents, less than 5 lbs. 50 cents per lb. 4 nibs inches to the lib post extra. At least 15 cents with wrote, 126 D. O., St. Louis, Colar, Michigan.

Mr. H. Badetzke, 1553 Addison St., Chicago, Ill., writes us in telias: "I bought one of your Radio Troub- ble Shooters, and the third time I have been looking for it this week. It is grand, and I wish to send the order which I received for one. It is perfectly sized for portable Metropolitan Radio & Elec. Co., 1103 Bedworth St., Chicago, Ill., Dept. C.

EDISON "A" BATTERIES—3 cell, 20 emery mouth, 50 metal cases. Price $2.65 each, ten more $2.50 each. Cash with order. Department B, 25 East South Street, Indianapolis, Indiana.

Set Builders. We furnish jobs. No fee. Register one or two men. Write for contract. Instructions published by us from your locality will be referred to you. We are headquarters for first class job men. Silver Bracketed Silk-Shed, Kora Sauseter, Broome—Farrow Guild, 330 Harken St., Harken, Pa. Write for order. Register at once. Give reference and experience. Allen- Reed-Men, 991, Dept. A, 33 West Street, New York, N. Y.

Classified ads for February issue must be sent in by Jan. 1.

Radio Age Classified Ads Bring Results
Better... than it looks

Some radio sets are all Queen Ann in front and plain Mary Ann when you lift the lid. A beautiful finish—to please the wife—is more important than quality in the actual working parts. And some circuits are sweet performers when it comes to radio reception but they certainly look like a junk-shop product when you have a party of critical friends in for the evening. But here is a set... well, just look at it. And then remember that its performance is even better than its appearance. Yes, of course, it's the

1928 Infradyne

This is a circuit which is never sold as a factory product. It can't be. But that does not mean that you have to work for weeks in building it up from small unmatched parts. Just buy four Remler units, a few extra parts, and in a few hours your Infradyne will give you the finest reception you—or anyone else—ever enjoyed.

Use the coupon below.

REMPLER
Division of
Gray & Danielson Mfg. Co.
260 First Street, SAN FRANCISCO
CHICAGO NEW YORK
Eastern Warehouse, Elkhart, Indiana
Amazing new AC radio tubes eliminate batteries by use of electric house current.

**NEW RADIO TUBES TO USE ORDINARY HOUSE CURRENT FOR POWER**

**NEW YORK, Jan. 3rd—**Much interest is being taken in radio today by the announcement that the radio tube had at last been perfected that used ordinary electric house current in the operation of radio.

**NEW RADIO TUBE WILL OBSOLETE ATTERY POWER**

The Crosley BANDBOX is the country's most talked of radio! The popularity centers around two major factors:

1. The imposing array of patents under which it is built.
2. And what value Crosley has added to the imposing engineering talent behind the BANDBOX.

The Crosley BANDBOX is in the country's most talked of radio! The popularity centers around two major factors:

1. The imposing array of patents under which it is built.
2. And what value Crosley has added to the imposing engineering talent behind the BANDBOX.

1. Complete shielding of all elements.
2. Absolute balance (genuine Neutrodyne).
3. Volume control.
4. Aneurysm for sharpened tuning.
5. Single cable connections.
7. Illuminated dial.
8. Adaptable to X-Y type installation.

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The metal outside case is easily and quickly removable. The set is solidly mounted on a stout steel chassis. All controls are assembled together in the front, cabinet panels are easily cut to allow their protrusion. The metal swivel is not screwed over the shafts and the installation is not complicated.

Two large furniture manufacturers have designed console cabinets in which the box can be suitably installed. They have been designed for a high standard of being built to order.

Crosley is advertised only for Radio Amateurs, Experiments and Broadcast Reception.

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Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher.