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# RADIO WORLD

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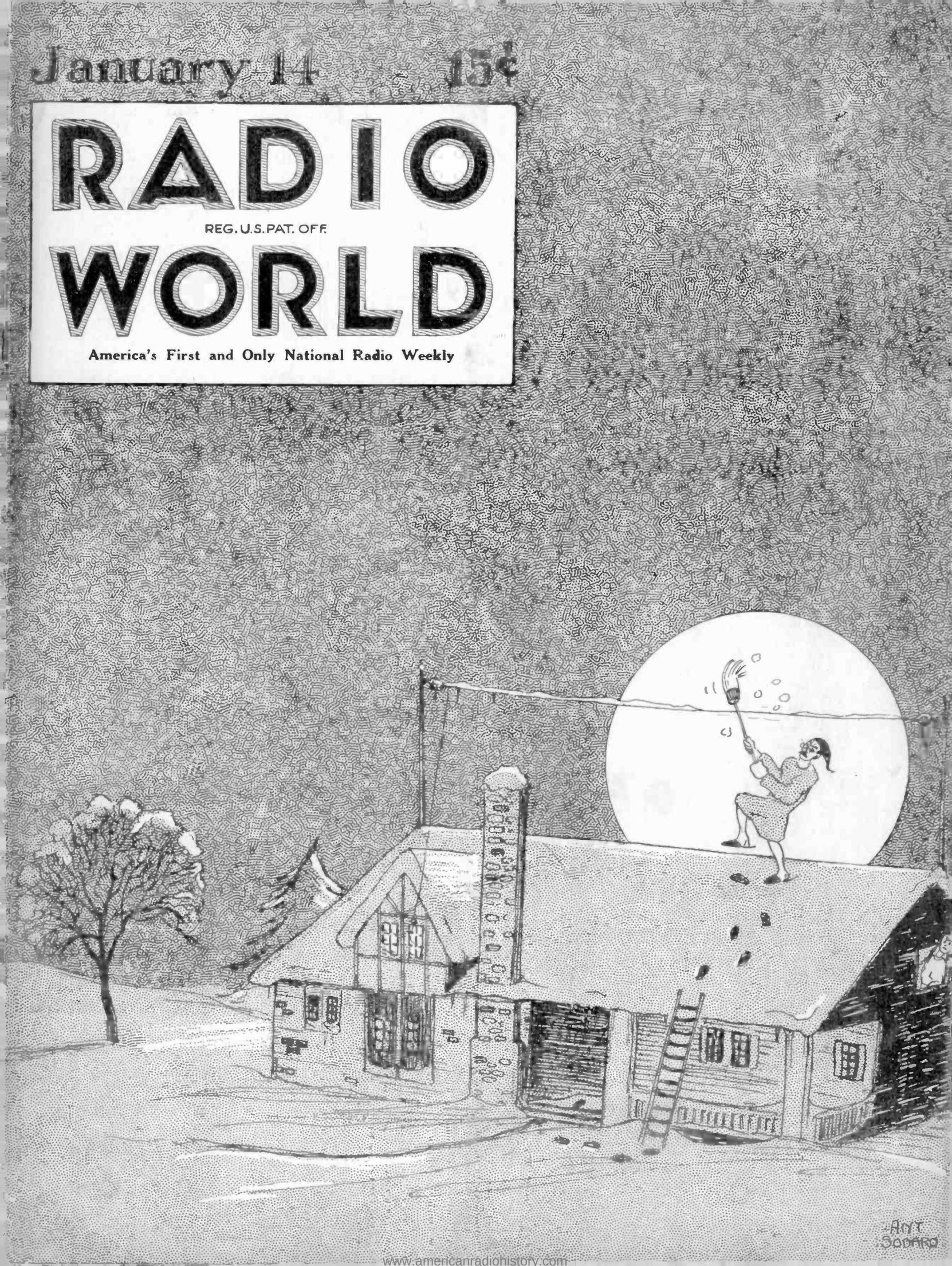
# WORLD

America's First and Only National Radio Weekly



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# *The Assembly and Wiring of*
# The Shielded Grid Six

*[The performance of the Shielded Grid Six—both loop and outdoor aerial models—was discussed in last week's issue (January 7) by McMurdo Silver, in the first of three articles on the remarkable receiver utilizing the brand new shielded grid tubes. The theory of the circuit was expounded masterfully by the distinguished author. The following is the second instalment of the first national presentation of a tuned RF circuit utilizing these powerful tubes. The final instalment will be published in next week's issue of January 21.—Editor.]*

*By McMurdo Silver*

BY comparison with all radio receivers that have gone before, the six tube shielded grid receiver to be described is a most remarkable set. It is possessed of a degree of sensitivity to distant stations and selectivity for cutting through local broadcast stations that is unequalled by any other commercial receiver at the present time.

The performance of the 630-SG radio receiver is so revolutionary (and the word "revolutionary" is used with a full knowledge of its meaning) that it is absolutely safe to say that this set represents the turning point from the old era of receiver performance to the new era, in which the 630-SG offers results which absolutely cannot be equalled by any other commercial radio receiver at this writing.

A wide stretch of the imagination is needed to fully appreciate the performance of this set, without having heard or tuned it. Just visualize for a moment a six tube radio set, upon the front panel of which are the tuning dials and a non-critical volume control—a set that won't squeal or howl no matter how it is operated.

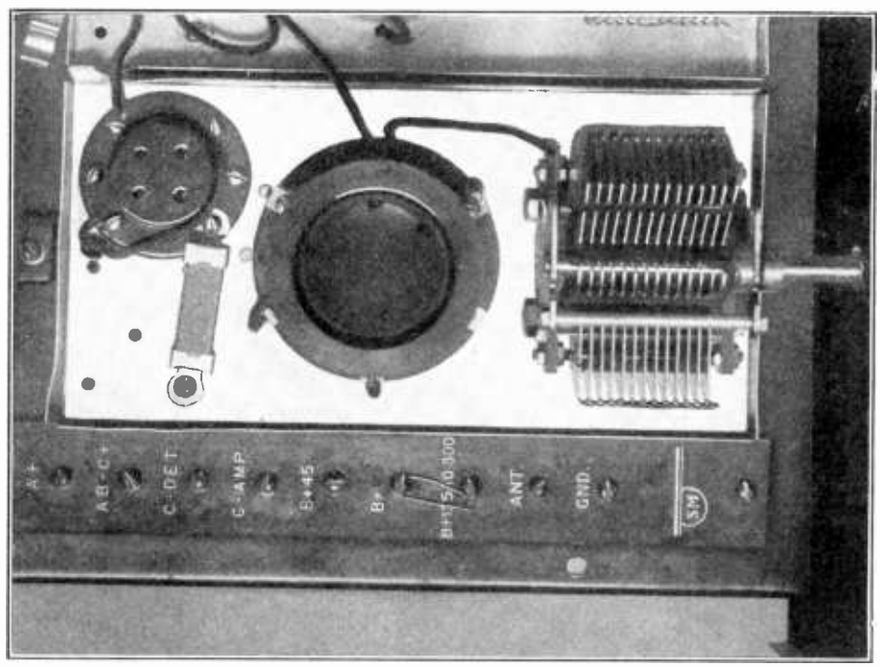
Imagine sitting down to tune this set in an average American home, with, say, a fifty foot outdoor antenna and a good cone loudspeaker.

Imagine, if you can, starting at zero on the dials and slowly tuning them up a degree at a time and hearing station after station for almost every dial degree—sometimes two stations in each degree.

### Locals Sharply Tuned

Imagine, in Chicago for instance, each one of the fifteen local stations spreading over not more than two to four dial divisions, and most of them tuning in or out in one to two dial divisions. Imagine selectivity so great that as the dials are tuned stations do not tune in and out gradually, but literally "plop" in and out with an infinitesimal dial movement.

Then picture the log of stations heard at the end of the evening, all with *too great* loudspeaker volume—so loud the set had to be tuned down. Picture a log of fifty—even a hundred—stations, on the East Coast, on the West Coast, in Canada, from Montreal to Vancouver, from Cuba to Texas and Mexico—all tuned in by moving just two dials, and never touching another knob if you don't mind signals that literally roar in. And, for the final touch, imagine any factory-built set you can think of, sitting beside the 630-SG receiver, and not even bringing in at all lots of the stations the Shielded Grid played on the loudspeaker with ease!




**THE DETAIL OF THE TERMINAL STRIP AND THE VIEW INSIDE THE FIRST SHIELD.**

The above paragraphs are not a dream of the ideal radio set; they are just a simple explanation of the average performance of a 630-SG receiver—and all with tone quality finer than that of any other standard receiver you might build or buy.

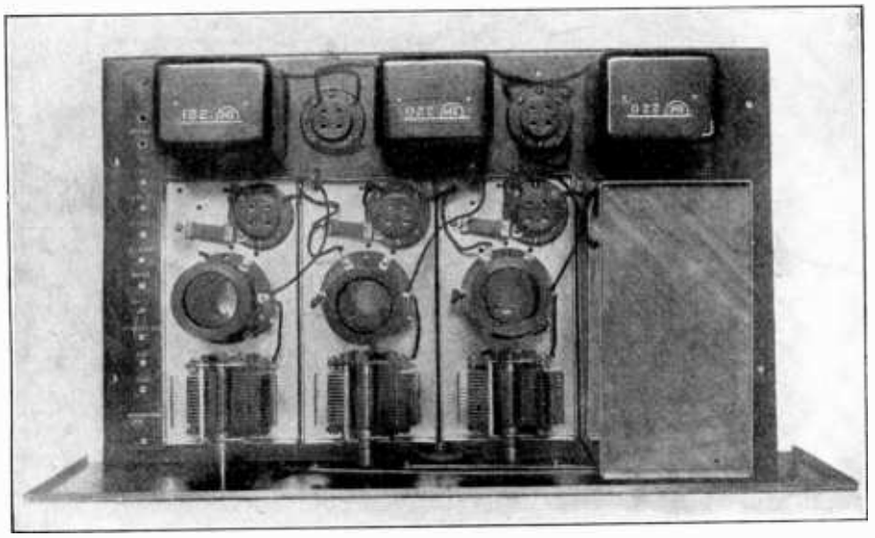
In a nutshell, the new 630-SG set will give you greater sensitivity, far greater selectivity, and finer tone than any other tuned radio frequency set you could build or buy, and far better than that of 99 per cent of the super-Heterodynes you could build at greater cost.

### Good for Years to Come

And the 630-SG is a set that you can house in any cabinet or console, and that won't be obsolete for years to come—witness the fact that every one of the thousands of Shielded Sixes ever built can be converted to use shielded grid tubes at a cost of $15.50 list, so thoroughly modern is the design of the original Shielded Six—and each and every one will represent today a value far greater than that of other sets costing three times the price of the Shielded Sixes!

The Shielded Grid Shielded Six receiver, employing the new UX222 shielded grid Radiotron or equivalent tubes, is a six tube radio receiver kit assembled of the highest quality parts and similar in external appearance to the famous Silver Shielded Six kit of which thousands have been sold and which has stood at the head of the list through two radio seasons as the finest tuned radio frequency receiver kit ever developed.

Two models of the set are available in standard kit form, one for small antenna operation and the other for loop operation. The performance of model 630-SG for antenna operation has been described; model 630-LSG for loop operation is identical except that the antenna coil, coil



TOP VIEW, WITH THE LIDS OF THREE OF THE SHIELDS REMOVED.

socket, and stage shield is omitted, the loop being substituted for the antenna coil secondary. The 630-LSG loop receiver costs about $91.50 and is recommended for all general use in preference to the antenna operated model since the selectivity of the latter can be easily ruined through the careless use of too long an antenna. The 630-LSG loop receiver, on a small Bodine loop in Chicago, located in a steel frame hotel, will bring in stations on the East and West Coasts with loudspeaker volume.

### Details of Constitution

The 630-SG receiver consists of a heavy pressed metal chassis 12 inches deep and 19½ inches long, upon which all parts of the receiver, except the control dials, are mounted. Attached to this panel is a beautifully decorated etched bronze control panel 7 inches high and 21 inches long. On this panel are mounted two harmonizing walnut finished, gold trimmed, vernier control dials marked "Station Selector I" and "Station Selector II." All tuning is done with these two dials, the settings of which are varied to tune in station after station. The dials "log" absolutely, in that a station once heard at any dial setting may be brought in again at the same dial setting, and the two dials "track" sometimes within a degree of each other.

In the lower center of the control panel is an absolutely non-critical volume control not affecting oscillation and serving merely to regulate the volume of received signals to a desired level. In the lower right-hand corner of the panel is an on-off switch completely turning on or off all power for the entire receiver by a simple flip of the fingers.

In the lower left corner of the panel is a switch of similar appearance, allowing the choice of either selective or non-selective adjustments of the antenna circuit to accommodate varying lengths of antennas such as would be encountered in different locations.

### Operation Requirements

The 630-SG receiver requires for its operation no less than 135 volts, and preferably 180 volts of B power, at a total current consumption of 30 milliamperes. A total of 180 to 220 volts is preferable.

In addition, C batteries, as dictated by the power output tube employed, are required, and a six volt storage battery or Balkite, Abox, or equivalent 6 volt A power unit. Using a standard B eliminator and A power unit, the receiver is completely light socket operated with the exception of dry C batteries, which are long in life and low in cost.

Three type UX222 Shielded grid Radiotrons, or three type CX222 Cunningham shielded grid tubes, or shield plate 122's, are required for the RF amplifier. For the detector tube UX112 or UX112A is recommended. For the first audio amplifier, a UX112 or UX112A is strongly recommended, though in both detector and first audio positions 201A tubes may be used with inferior results, due to overloading, so strong are the signals developed by the 630-SG receiver. For the last audio output stage a UX171 or UX112A is recommended if a plate voltage of 180 to 220 is available. If not more than 135 volts is available a UX112 or UX171A output tube is recommended. For the finest possible quality of reproduction, an S-M 675 B power unit should be employed, which furnishes B power to the entire receiver at a total of 425 volts, and which is equipped with an adapter which allows the use of a UX210 super power amplifier Radiotron in the last audio stage of the 630-SG receiver. So equipped, there is no finer receiver available upon the American market absolutely regardless of price.

### Electrical Circuits

The 630-SG receiver circuit consists of three stages of radio frequency amplification sharply tuned, followed by the sharply tuned detector circuit which, in turn, works into a two stage audio frequency amplifier. The radio frequency amplifier circuits consist of low loss variable condensers providing substantially even spacing of stations over the control dial scales and very low loss, low resistance, plug-in RF transformers.

One condenser and one RF transformer is used in each of the four RF stage circuits, one circuit being housed in each of the four aluminum shield cans. The antenna stage at the left employs a special antenna coupler provided with a tapped primary allowing the use of short or long antenna at will by means of the switch in the lower left hand corner of the panel.

The three RF stages employ shielded grid amplifier tubes and the battery circuits of these stages are so arranged and so bypassed that, together with the effective shielding provided by the aluminum stage cans, no oscillation tendency or trouble is experienced in the receiver.

A very special feature of the radio frequency amplifier circuit of the 630-SG receiver is that it does not employ the tuned impedance coupling which has been believed necessary to the operation of shielded grid tubes.

### Broad Tuning Avoided

This type of coupling is inherently extremely broad in tuning and is far from desirable, though circuits for tuned impedance coupling are given with the data sheets accompanying shielded grid tubes as a theoretical, but not necessarily as a practical, means of operating these tubes.

This type of coupling is highly undesirable in a radio receiver which is to be sufficiently selective on modern broadcast receiver conditions, and it introduces circuit losses occasioned by the necessary grid blocking condenser and grid leak which seriously impair the amplification possibilities of the shielded grid tube, for, unlike previous radio frequency amplifiers, regeneration is not employed in a shielded grid amplifier and may not well be utilized to offset circuit losses.

It is apparent to engineers that the amplification obtainable from a shielded grid receiver is dependent upon the excellence of the tuning circuit (coil and condenser) making up the RF amplifier stage, and, the selectivity upon the degree of coupling of one tube to the next through the tuned circuit. Because of this requirement, the 630-SG receiver provides a tremendously high value of radio frequency amplification due to the unusually efficient design of S-M plug-in coils and condensers.

In addition, the selectivity of the receiver has not been arbitrarily determined and put beyond the control of the user, but is made adjustable by means of extra taps upon the primaries of the RF transformers in order that the 630-SG receiver may be easily and simply adjusted by the merest novice to a point of highest efficiency whether it be located in the middle of a desert far from broadcasting stations or in the center of the most congested broadcast communities of the United States and Europe. This is a special feature of the 630-SG receiver, duplicated in no other commercial set.

### Tuning Arrangement

Due to the impossibility of definitely predetermining antenna characteristics, the antenna stage of the 630-SG receiver is tuned by the "Station Selector I." or left hand, dial control—the left hand variable condenser in the diagram, and contained in the left hand shield compartment of the receiver. The three variable condensers in the three right hand shield compartments tune substantially identical circuits consisting of carefully laboratory-matched coils and condensers, and are connected together by means of a positive mechanical link with no backlash, and all three are tuned by the single right hand "Station Selector II" dial.

All radio frequency circuits are completely shielded, the radio frequency lead from one stage to the other passing through the small crevice between the stage compartments in slots provided in the shields for that purpose, and being insufficiently exposed to cause signal pick-up.

In fact, so thorough is the shielding of the 630-SG receiver that it is practically impossible to pick up even a powerful

## ACCESSORIES

**The accessories required consist of the following parts:**

**Three UX222, CX322 or Shieldplate 122 tubes.**

**Three UX112 or UX112A tubes (or two UX112 and one UX171 where not over 135 volts of B potential is available).**

**One 6 volt, 90 ampere hour storage battery—or equivalent Abox, Balkite, or other 6 volt, 2 ampere, A power unit.**

**One 4½ volt C battery.**

**One C battery of voltage recommended for the last audio stage tube employed, and for the B voltage used.**

**One set heavy duty B batteries providing 135 volts or more—or, preferably, an S-M type 652 or 652A power unit.**

**One Belden 7-lead battery cable.**

**One Western Electric cone loudspeaker or Temple "18" drum speaker—or other equally high quality, high-grade loudspeaker.**

local signal with the antenna removed; and with the two leads from the antenna coil socket to the antenna switch removed entirely, the shielding becomes completely effective. So sensitive is the receiver, however, that simply placing one's finger upon the antenna binding post is sufficient to bring in stations, frequently over a radius of two hundred miles with good loudspeaker volume, using only the body as an antenna. In fact, the use of a metal bedspring as an antenna will provide extremely satisfactory results.

**Resistors for Filament and Bias**

The filament voltage for all tubes is regulated through the used of fixed resistances which definitely establish the filament voltages within correct ranges and don't allow excessive potentials to be applied to the tubes. Three separate 10 ohm resistances are used on the UX222 tubes and the voltage drop across each of about 1.32 volts is utilized for grid bias. A 2 ohm resistor, common to the filament circuits of all UX222 tubes, prevents the filament voltage ever rising above 3.4 volts, while the volume rheostat of 20 ohms allowed it to be turned down to a value as low as to reduce volume to practically zero.

A .57 ohm rheostat, mounted upon one rheostat binding post, regulates filament voltage for the detector and two audio amplifier tubes. A "C" bias of 3 volts is used upon the detector tube (it may be increased to 4½ under certain operating conditions) and upon the first audio tube. The use of this low bias is to improve low note reproduction and handling capacity for strong signals, and for a like reason a plate voltage of 135 volts is employed upon the first audio stage with an optional plate voltage of from 135 to 180, 200, or even 450 on the last audio stage if a UX210 output tube is used.

Looking down upon the chassis with the panel to the front, the stage compartments are A, B, C, and D, from left to right, and the radio frequency portions of the circuits are physically located as in the schematic diagram. Behind these compartments is the audio amplifier, progressing from right to left, with the second audio in the left rear tube socket. The detector C bias and plate bypass condensers are contained in the detector stage compartment as is the detector and audio amplifier filament resistance.

The 10 ohm filament resistances for the RF amplifiers are contained in the A. B. and C compartments, and in each compartment is located, of course, a tube socket, coil socket, and coil, and variable condenser. Beneath the chassis are fastened the .2 ohm and .57 ohm resistances and the two 1 mfd. bypass condensers connected between the metal chassis and the "plus 45" and "plus 135" leads. The metal chassis is grounded to the negative side of the RF amplifier filament circuits and at its left end is a terminal strip carrying the loudspeaker tipjacks and connection screws, and connection terminals for all battery and antenna and ground lead wiring.

Through the use of interchangeable coils, the wavelength range of the 630-SG receiver is from 200 to 3,000 meters. Employing the standard A range coils, it is from 200 to 550 meters, and a suitable coil set consists of one 116A antenna coil and three 119A R F transformers. For operation from 500 to 1,500 meters, one 116D antenna coil and three 115D transformers are employed; while, for operation from 1,400 to 3,000 meters, one 116E and three 115E RF transformers are employed. D and E range transformers are not provided with selectivity adjustment taps since there is little congestion of stations in these higher wavelength ranges.

**Inspection Is Advised**

Before starting the actual assembly of the receiver, each part should be examined with the utmost care to make sure that it has suffered no damage in transit or handling before being received by the builder. The following points should be observed most carefully:

The rotor plates of the 316A and 316 B variable condensers should inter-leave centrally in the spaces between the stator plates, at all points throughout their arc of movement. There should be no play in the bearings, either side or lengthwise. Side play is automatically taken up by the spring bearings. End play may be taken up by locking the collars on the front of the shafts more tightly against the spring washer held between them and the front end plates.

The 119A and 116A coils should be carefully examined to see that they have suffered no physical damage and that their contacts make satisfactory contact with the 515 coil socket springs.

The 511 tube sockets should be tried with vacuum tubes to make sure that proper contact is effected between the socket springs and the tube pins.

The type 632 link motion should be examined to see that the long bars are not bent. The tip jacks, battery switch and antenna switch should be examined to make sure that proper contact is made.

The balance of the parts need not be examined except to see that they appear to be mechanically undamaged, as there is little chance of trouble arising with them.

**Assembly of the Kit**

The assembly of the 630-SG receiver will be quite clear upon careful inspection of the photographs which indicate the placement of all parts above and below the chassis. The two tipjacks should be fastened in the two large holes of the terminal strip which should, in turn, be fastened at the left end of the chassis as seen in the photographs using two machine screws and nuts. The 20 ohm rheostat should be mounted in the hole in the projecting lip in the center of the front edge of the chassis using the insulating washers provided to positively prevent any metallic contact between the chassis and the rheostat frame. The antenna and battery switches should be mounted in the holes in the front edge of the chassis, and the 3 spring antenna switch at the left, and the 2-spring battery switch at the right.

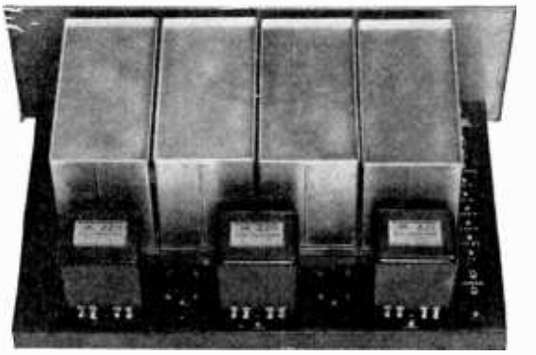
The photograph should be carefully studied and the parts in the stage shield compartment fastened down as indicated, with care being taken to scrape bright the portion of the chassis falling beneath the stage shield pans to provide good metallic contact between shield pans and chassis. The six 511 tube sockets should be mounted as seen in the photographs with the arrows of all except the detector socket pointing to the rear. The detector socket arrow should point to the front. The .57 ohm resistance should have one mounting foot bent at right angles and fastened to one terminal of the .20 ohm rheostat.

The .002 and .5 mfd. Carter condensers should be mounted in the detector stage compartment in the holes provided, using machine screws and nuts. Thus, one connection of each condenser is automatically made to the chassis which is represented in the schematic diagrams by a ground symbol.

**Fastening of Resistors**

The three .10 ohm resistances should be mounted one in each of the RF amplifier stage compartments A, B, and C. One end of each resistor should be fastened to the E minus terminal screw of the tube sockets, and the other end fastened with a machine screw and nut to the chassis as illustrated.

The audio and output transformers are to be mounted in the positions shown, as should the variable condensers, placing the two long-shaft 316B condensers in the extreme end compartments A and D. On the bottom of the chassis, a soldering lug should be placed on the front mounting screw of the 221 transformer, and under the rear mounting screw of the left hand A section 316B condenser, these lugs to be used for ground connections to the chassis.



REAR VIEW OF THE RECEIVER

Under the front mounting screw head of the B section 316A condenser, one end of the .2 ohm Carter resistance should be fastened, the other end of this resistance being soldered to a lug on the binding post of the Carter .20 ohm rheostat. The two mounting screws of this same B section variable condenser serve to hold one Fast 1 mfd. condenser in position, while the two mounting screws of the left rear, or second audio tube socket, hold the second Fast 1 mfd. condenser in position.

The coil sockets in the various compartments should be put in and elevated above the chassis by means of the long mounting screws and studs provided, taking care that terminals 3 of each coil socket projects directly to the right.

**Wiring Up the Parts**

After all parts have been mounted upon the chassis, but before the front panel has been attached, the wiring should be put in place. All wiring is done with flexible insulated hook-up wire, excepting only the three wires shown as very heavy lines in the schematic circuit diagram which consist of lengths of bus-bar in spaghetti. In making the connections, the bus-bar should be cut to length and put in place with proper size lengths of insulating spaghetti tubing slipped over it. A flexible hook-up wire should be cut to length and the ends of the insulation pushed back in order that the wire may be fastened under terminal screws or soldered to soldering lugs.

**Soldered Connections**

A soldering iron, well heated and with a well-tinned tip, is required, in addition to a small can of non-corrosive soldering paste, and several lengths of rosin-core solder. Every joint to be soldered should have the wire and lug separately tinned, using the tiniest pin-point of soldering paste and an amply large drop of rosin-core solder. The wire end and lug may then be joined together, using a hot iron with a drop of solder.

The detail of the placement of all wiring in the receiver is not given textually, for it is clearly illustrated in the various photographs and diagrams. The actual position of all battery wiring beneath the chassis is of little importance, though the wiring should be kept as neat as possible. Certain leads in each stage compartment must be carefully handled as follows: The right stator lug of each variable condenser should be connected to terminal 3 of each tube socket. In the detector stage assembly, this post 3 of the coil socket and post G of the tube socket should be joined.

(*Continued on page 20*)

# Stations' Angry Waves

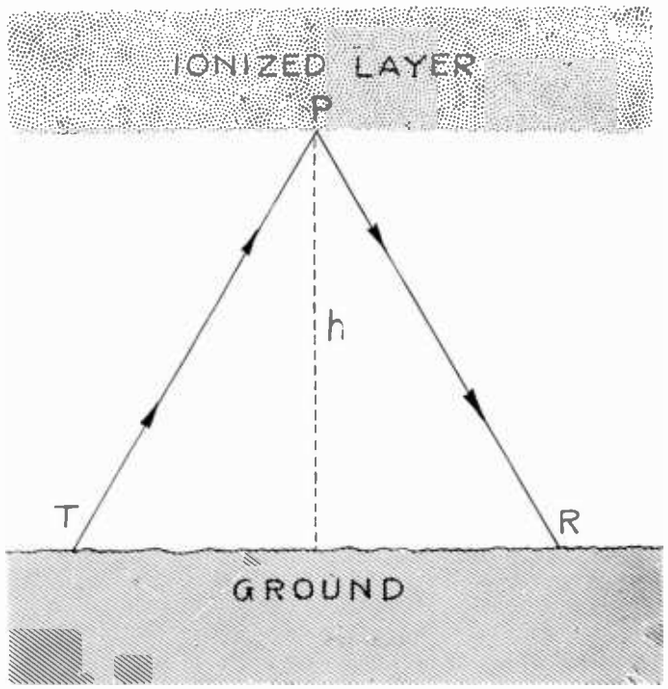



FIG. 1
THIS ILLUSTRATES HOW THE RADIO CEILING OR IONIZED LAYER CAUSES REFLECTION OF WAVES AND THE DOUBLE RECEPTION OF THE SAME SIGNAL, ONE ALONG THE GROUND TR AND ANOTHER BY WAY OF TPR.

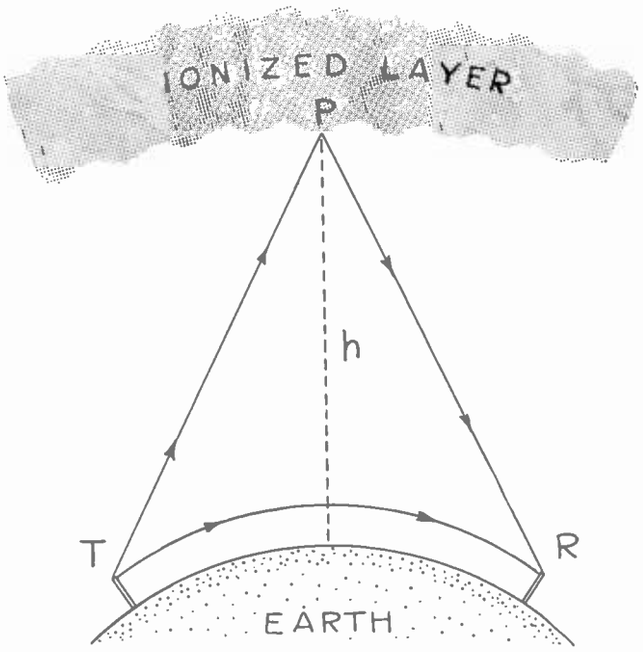



FIG. 3
IF THE IONIZED LAYER IS VERY FAR ABOVE THE GROUND THE REFLECTED WAVE MAY COME DOWN AT A REMOTE POINT OR IT MAY MISS THE EARTH ENTIRELY.

IT would seem that when a broadcasting station hurls its harmony-laden radio waves out into free and boundless space they would travel on forever never to return again. But that is not always so. At times they return, not to the exact spot whence they were projected, but to some other place on the surface of the earth. Perhaps they return once, bounce off again, only to come down at some other point still farther away from the transmitting station. In fact, a radio wave may execute a long series of hops, skips and jumps.

What prevents the wave from leaving the earth for good when it is shot skyward and there is nothing apparent to stop its progress to the Milky Way? Is there an attraction which holds it to earth, a repulsion in the upper atmosphere which forces it back to earth, or is there a radio ceiling through which the wave cannot pass and which hurls it back to the surface just as the ceiling in an auditorium hurls sound waves back?

### Attraction Appeases

An attraction between the earth and the radio wave would explain many phenomena in radio in an acceptable manner. Just the word "attraction" suffices in many instances to appease an inquiring mind, because the term has been used countless times in explanation of phenomena not understood by anybody. We shall tentatively accept attraction as an explanation of the return to earth of radio waves and then proceed to investigate repulsion as a possible explanation, in the hope that that will give us a greater peace of mind.

Nobody ever got any satisfaction out of being repelled. Repulsion therefore has an unpleasant connotation. Hence even if it can be used to give a reasonable explanation of a phenomenon, the explanation would be psychologically unacceptable. Our peace of mind would be agitated continually by the question: "What does the repelling?"

Algebra comes to our rescue. We know from that that repulsion is only the negative of attraction. That reduces the two possible explanations to a common denominator and makes us feel doubly secure in making our tentative acceptance permanent. We are so appeased that we take a restful nap on that.

### Hit the Ceiling

Then in the midst of our peaceful slumber somebody arouses our minds and our ire by suggesting boldly that there is a radio ceiling above our heads, and that this hurls the waves back when they strike it. But we can't see it! Oh, no, it is too far up for that. And we can see the sun and the stars through it! Oh, surely it is transparent like a dome of crystal glass. And meteors come right through it without doing any damage! Because the ceiling is made of extremely

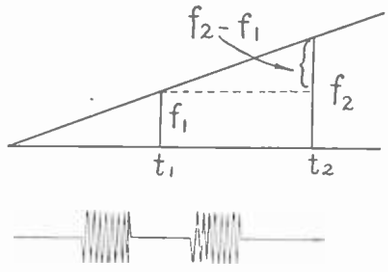



FIG. 2
THE PATH DIFFERENCE BETWEEN DIRECT AND REFLECTED PATHS IS DETERMINED BY MEASURING THE TIME DIFFERENCE OF ARRIVAL OF THE SIGNAL OVER THE TWO PATHS. THE TRANSMITTED FREQUENCY IS WOBBLED SO THAT THE SIGNALS RECEIVED AT ANY INSTANT OVER THE TWO PATHS WILL HAVE DIFFERENT FREQUENCIES. THE BEAT NOTE IS MEASURED.

tenuous and self-mending stuff. It is made of a layer of electron-laden air, or ionized air, of very low pressure.

This layer of ionized and rarefied air is a part conductor of electricity, and any conductor of electricity is a reflector of electromagnetic waves. The better the substance conducts electricity the better it reflects electro-magnetic waves. For that reason polished silver is the best light reflector. Silver is the best conductor and light consists of electro-magnetic waves, just like radio waves, but very much shorter.

### The Dilemma

Isn't that amusing? A mirror away up in the sky which stops the radio waves on their journey to the Milky Way and hurls them back to earth. And if the earth, which is also conducting, should send them up into the sky again, the ionized layer will hurl them back a second time. Thus the earth and the electron mirror will toss a radio wave between them just as the sides and ends of a billiard table will toss a ball around.

This conducting layer would be an excellent explanation of the effect if it were not for the fact that light waves get through it from the other side. If this layer reflects electro-magnetic waves so well, why can we see the sun and the stars? Why does the light get through the mirror? Oh, yes, the electron-laden layer is transparent! But if it is transparent, why do not the radio waves pass through it as well as the light waves?

That is a question that must be answered before the peace of our minds will feel disturbed by the new suggestion. The idea does seem a bit funny and many a laugh has been enjoyed over it.

### A Determining Factor

But the facts that light gets to us through the supposed electron-laden air layer and that radio waves cannot get through it but are reflected back to earth by it are not contradictory at all. Optical theory and

# Hit the Ceiling,

*By Trocadora Brumridpa*

experience tell us that this anomaly is the normal thing to expect.

Whether an object is transparent or opaque depends not only on the nature of the material of that object but also on the wavelength of the light or other radiation falling on it.

It may be transparent to red light and opaque to blue, or vice versa.

Or it may be transparent to red and opaque to all other visible colors.

This is true of colored glasses or solutions which look red when held against a white light.

Some substances are opaque to visible and ultra violet light but are transparent to infra-red and heat waves. Hence the supposition that the ionized layer is transparent to the short light waves and relatively opaque to radio waves is reasonable.

The opacity was spoken of above as relative. The transparency can also be relative. Not all the light that comes from the sun gets through the conducting layer. Some of it is reflected, some of it is absorbed. Likewise not all the broadcast radiation is hurled back to earth. Some of it gets through the ionized layer and some of it is absorbed by it.

### Sensible Feeling About Ceiling

Now our minds are restive. It seems there is some degree of sense in this radio ceiling idea. Come to think about it, the attraction explanation never was satisfactory. But let's have some more about the ceiling.

There seems to be no other way of proving the existence of the ionized layer, better known as the Kennelly-Heaviside layer, than to send radio waves up to it and then try to catch them as they return to earth, if they do return. If we can detect the returned waves we have strong evidence for the existence of the layer, and if we can study the returned waves and note what changes they have undergone we can gain some information about the layer.

That the layer exists has been established during the last few years by abundant evidence. Even the height of the layer above the surface of the earth has been measured approximately. And it has been demonstrated that the distance to the layer varies from time to time, depending mainly on solar radiation.

### Wobbulation

The method used by R. A. Heising and the Bell Laboratories for measuring the height to the Kennelly-Heaviside layer is interesting. It is based on the fact that a signal from a transmitter to a receiver can travel over at least two different paths. Thus it can travel the direct path, which is the shortest distance between the two points. It also can travel up to the ionized layer and be reflected to the receiver as shown in Fig. 1. The short path is TR and the reflected path is TPR. The height of the ionized layer above ground is indicated by the distance h.

If we assume that the ground and the ionized layer are parallel at P then it is a simple problem in geometry to determine the value of h in terms of the sides of the isosceles triangle TPR. We can measure the base TR with a surveyor's chain. Then if we can measure the sides TP and PR by some method we know the value of h.

The method used by Heising for measuring the sides of the triangle involves the velocity of radio waves and depends on the measurement of the small time interval between the arrival of a wave over the reflected path and the direct path. If this time interval is known the distance by which the long path is greater than the direct is known also. Hence h can be calculated.

The system employed for measuring the time interval is ingenious and simple. The signal from the transmitter was sent in dashes 1/16 second long. The frequency of the radio wave was not constant during this dash, but varied in a definite and predetermined manner. The frequency variation was linear, that is, such that in equal time increments the frequency change was the same at any point in the dash.

### Wave Beats With Itself

The beginning of a given dash reaches the receiver by the short path first, say at time t1, Fig. 2. The frequency is then f1. An instant later, or at time t2, the signal also arrives by way of the long path. But by the time that arrives the receiver is entertaining a frequency f2 arrived by the short path. The receiver is then entertaining two slightly different frequencies f1 and f2 at the same time. A beat frequency results, and this is given by f2—f1.

If the beat frequency is measured accurately and then compared with the known rate of change of the frequency at the transmitter, the time difference t2—t1 is known. If this time difference is multiplied by the velocity of light, the path difference also is known. Since the direct path is known by measurement all sides of the isosceles triangle are known, as well as the altitude h of that triangle.

Suppose that the frequency of the beat note heard in the receiver is found to be 2000 cycles per second and that it is known that the frequency of the radio wave is changing at the rate of 1,000,000 cycles per second. Hence it takes the signal .002 second longer to travel over the long path than over the short path. The velocity of light is 186,000 miles per second, so that the path difference is 372 miles.

### Effect on Quality

If the distance between the transmitter and the receiver is 60 miles, the sum of the other two sides of the triangle is 60 plus 372, or 432 miles. Hence the length of each of the equal sides is 216 miles, the hypotenuse of a right triangle of which 30 miles is one of the legs and h the other. Thus h, the height to the Heaviside-Kennelly layer in this assumed problem, is 214 miles. The values of h found by Heising and his co-workers varied from about 100 to 500 miles.

This frequency wobbulation has a direct bearing on the quality of broadcast reception. Most musical sounds are not held constant in frequency while sounding. The pitch varies, sometimes noticeably, sometimes imperceptibly, but not unpleasantly unless a beat appears as a result of the presence of a slightly different frequency. This frequency may arise from another instrument or voice, or from an echo in case the pitch of the instrument is gradually changing. The sound wave must arrive to the ear by two paths of different lengths if an echo is to interfere in this manner. This is not exactly the same type of interference that is usually considered in connection with reverberation.

If a broadcast wave reaches the receiver by two or more paths of different lengths the same effect may occur as was shown above for one changing frequency. This will give rise to distortion in the received signal. Whether the echo will reach the receiver far enough behind the direct signal to give rise to a noticeable disturbance depends on the path difference.

### Reason for Fading

The fact that the ionized layer rises and falls as the position of the sun changes gives rise to fading and associated phenomena. The rising and falling also account for the vast difference between daylight and night reception.

Radio communication over very long distances is made possible by the ceiling. This can be illustrated by Fig. 3. The ionized layer is supposed to be very high. Signals along the surface TR are quickly absorbed in the ground and have very little effect at R. But the signals which go up to the ionized layer along the path TP and return by the path PR are but slightly absorbed and therefore when they arrived at R they are of sufficient strength to affect the receiver. Signals traveling half way around the earth, or all the way round, suffer several reflections between the ionized layer and the earth before they reach their objective or are completely absorbed.

## Being Up in the World Helps WWNC Succeed

Asheville, N. C.

Does a high altitude add to the carrying power of a radio station? Engineers of WWNC think that it does.

WWNC is located on the highest point east of the Rocky Mountains, more than 2,400 feet above sea level. The station, which uses 1,000 watts, is regularly heard in forty-five of the forty-eight states, as well as in the southern provinces of Canada, Guatemala and Canal Zone.

The recent Atwater Kent audition proved the remarkable carrying power of the station. The resulting vote from the radio audience of this station, from which the State Audition of North Carolina was broadcast, was twice as great as that of other stations at lower altitudes where state auditions were also held.

### GREETING CARD RADIOED

Radio was popular in the transmission of Christmas and New Year greetings across the Atlantic. One photoradioed greeting card was received.

## Fenway for DX, Inc., In New, Larger Place

Leo Fenway for DX, Inc., is now completely installed in its new and spacious quarters at 831 Eighth Ave., New York City, opposite Madison Square Garden. The corporation is making tremendous strides with Leo Fenway's latest creation in receiver design, the four tube all-electric Contertrola that operates from the light socket and requires no batteries.

A copy of the Concertrola manual will be mailed without charge to all who write to the above corporation and mention in their request that they read about the manual in RADIO WORLD.

Mr. Fenway says that as he is opposite Madison Square Garden where the next Radio World's Fair will be held he intends to run a rival fair at the same time, but "on a somewhat smaller scale" with the inducement that visitors to his establishment can hear as well as see receivers, a combined privilege that, he points out, scarcely will prevail at the other fair.

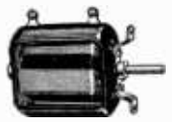
A laboratory containing advanced testing apparatus, much of which is of Mr. Fenway's own ingenious design, is one of the high spots of the elaborate new quarters.

# Glimpses at the Counter

*By Bramhall Torrence*

THE new radio generation knows little about a variometer. Mention by name such an instrument to an individual belonging to this generation and he may stop a moment before smiling recognition. He may think you are speaking English with a Chaucerian accent. He may even ask you of what quantity "veri" is the unit of measure, and he may demand that you give a description of the meter by which it is measured.

Oh, a variometer is not a meter at all and "vari" is not a unit of measure. Then why is the instrument called a meter? Nobody knows. No doubt it came about through a popular misconception of what it was all about, and an urgent need for a name for the thing.



A Variometer

But what is a variometer? It is nothing but a continuously variable inductance. When it is calibrated in henrys or its sub-divisions it becomes an inductometer. But uncalibrated it is just a convenient means of continuously and blindly varying the inductance in a circuit, just as a tuning condenser is a convenient means of continuously varying the capacity in a circuit.

And what is it good for? At present it is of little use but to the former radio generation it was an object of great utility, as can be attested to by any radio fan who is a survivor of the former generation. It was used in almost every regenerative receiver for "tuning the grid circuit" or for "tuning the plate circuit."

### A Prophesy

And the variometer will regain some of its former usefulness. New circuits will be developed in which the tuning is done with a variometer as it was of yore. Such circuits are even now in the process of development, and it will not be long before they will be given to the public. This prediction is based on the development of the screen grid tube and its properties and requirements. Old experimenters already are rooting in their radio junk boxes for their old and discarded variometers, and when they find them they try them in the various new circuits which they have been planning.

Many of the present generation do not remember back to the variometer era in radio development. They will have no old variometers to retrieve, and perhaps they will not have any circuit arrangements in mind for trying the variometer with the screen tubes. They should not despair, for excellent variometers have been on the market all these years and equally excellent circuits will be published in the very near future. The new generation will have the delights that go with the enormous amplification obtainable with the screen grid tubes.

The variocoupler was once as popular as the variometer but now it is not used much. But it never ebbed so low as the variometer. This device also is staging a strong comeback, and it comes as a result of the development of new tubes.

A Vario-Coupler

The variocoupler is a radio frequency transformer with variable coupling between the windings. It can be used for a volume control in many circuits where other and better known volume controls are unsuitable. One particular application is in receivers employing AC tubes. The volume cannot be varied in these by varying the filament current and the method using a variable resistor in the plate circuit of a tube to control the plate voltage is also unsuitable. Hence a variocoupler is now often used to control the volume.

### Substitution Easily Made

Short wave transmission and reception are daily assuming greater importance. Amateurs all over the world are communicating with each other by short waves, airplanes in flight are keeping in touch with stations on the ground below or behind them with the aid of short waves; many broadcast stations are radiating their programs on short waves as well as on the medium waves; commercial radio companies are communicating with stations on the other side of the globe by means of short wave beams; and television experiments are constantly being carried out on short waves. The near future will see tremendous development in short wave radio communication.

To listen in on these short waves is to participate in the development, just as listening in on the broadcast of a football game is equivalent to taking part in the game. And the average radio fan does not have to equip himself with a large number of radio sets attuned to the short waves to enable him to listen in. All he needs is a suitable receiver with interchangeable coils in his one receiver. He can procure coils which will cover any desired wave band. For example, one set of coils may cover the broadcast band, another set from 200 to 100 meters, another from 100 to 50, and still another from 50 to 25, and so on.

These coils are available for purchase, or they can be made by the listener-in himself if he so desires.

Efficient little tip-jacks and sockets especially made for this coil substitute system can be procured at a small cost and all that is necessary is to mount them on the coils and on the receptacles. Of course, it is much more convenient to buy the coils and receptacles ready made, and the cost will not be much. One of the tip-jacks and one of the sockets are shown herewith.

Tip-Jack and Socket

### A Good Investment

A good loudspeaker costs from $25 to $50. If the armature winding in any speaker is burned out that speaker is not worth a nickel until the winding has been replaced. The replacement may cost several dollars in cash and a severe inconvenience for several days while the speaker is at the repair shop.

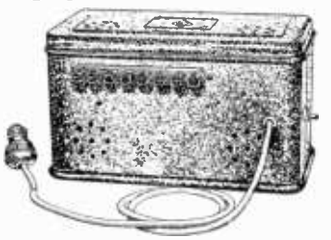
An Output Filter

If a good reproducer is connected to a low power set the speaker is not endangered by the radio set, though it may be by the distracted listener. But good speakers are now almost always used with high power, high quality sets. There is danger of serious damage to the speaker in such cases unless a guard is put between the two. That guard may be in the form of an output choke and condenser or in the form of an output transformer. In either form it costs just about the same as one repair bill for a burnt-out speaker would be.

### A Compact Eliminator

A dependable B supply is a highly desirable accessory to every high powered radio set. But it must give results comparable to the results obtained with a dry cell B battery.

Whether or not a B battery eliminator compares favorably with batteries depends on the design of the unit and the load that is put on it. It is entirely possible to design an eliminator so that it will give satisfactorily steady and continuous power over long periods when it is used to drive any one of majority of receivers. The cost of operation will always be less than battery operation for equal high power and current drain.



A Well-Designed B Supply

The ventilation of the eliminator is an important feature in its construction, and its performance depends largely on that. The eliminator illustrated herewith is adequately taken care of in this respect as well as in the other important features of the assembly.

The unit is provided with eight binding posts for connection to the various terminals on the radio receiver. All of the usual voltages are provided for and every section is adequately by-passed.

The eliminator illustrated employs a gaseous rectifier which supplies a steady current at suitable voltages to operate any ordinary radio receiver.

A Gaseous Rectifier

A variable resistor having an absolutely smooth and uniform resistance variation over a wide range is a convenient device to have around the laboratory. It can be used in series with the antenna circuit to control the input to the tube and thus to control the volume of output. This is particularly useful in receivers employing AC tubes. The same device can also be used for varying the grid bias if it is suitably placed in the output of the eliminator, or it can be used to vary the plate voltage by placing it in series with the eliminator output potentiometer.


A Variable Resistor of Many Uses

Severe cases of motorboating have been cured by placing a variable resistor in series with the B plus lead to the first audio stage and adjusting until the trouble is stopped.

# Meter Range Extensions

*Col. Warren Drape Emport*

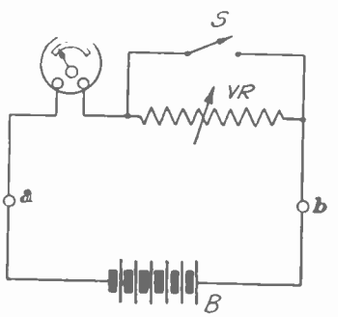



FIG. 1

**A DIAGRAM SHOWING HOW THE CONNECTIONS SHOULD BE MADE FOR EXTENDING THE RANGE OF A VOLTMETER.**

MANY radio fans often feel the need of meters for measuring currents and voltages which are beyond the available meters. The fans usually dismiss the matter with a wish that they had the necessary meters. Sometimes the wish is accompanied by a resolution to the effect that "some day I'll get another meter."

But in most cases the high current or voltage can be measured while you're waiting for your resolution to take effect. Any sensitive meter can be extended to include almost any range.

Suppose we consider voltage for the moment. We may further assume that a voltmeter having a range of 0-150 volts is available. The voltage output of the eliminator in the set may be so high as to throw the needle of that meter off the scale. The voltage may be 500 volts. How can that be measured with the meter the range of which is only 0-150 volts?

### Extending the Range

Suppose now that the voltmeter had a range of 750 volts. Then the voltage of the eliminator could be measured. The voltmeter is only a milliammeter in series with a high resistance. Suppose that we put an extra resistance in series with the meter, externally, so that when it is put across the 750 volt source the reading is just 150 volts, that is full scale. When the extended voltmeter is put across the 150 volt source the reading will only be 30. That is, the range of the meter has been increased by a ratio of 5 to 1.

If we put it across the output of the eliminator we can get a reading which is on the scale. For 500 volts the reading will be 100. To get the correct voltage, then, it is only necessary to multiply the reading by 5.

In the same way we can extend the range of the 0-150 volt meter to any desired range. We might double it, for example. To do that it is only necessary to put in series with the meter a resistor which is equal to the internal resistance of the meter. For example, if the internal resistance of the meter is 10,000 ohms, the external resistor should have the same value. With that in series voltages up to 300 can be measured with the instrument.

The exact resistance in a voltage is rarely known; and if it were known, there would not be a resistance handy which had the exact value required to extend the meter to the desired value. Then what? Well, there is usually a variable resistor around, one which has a range perhaps of 500 to 50,000 ohms. Put that in series with the meter and then hook the extended meter across a known voltage. Increase the variable resistance until the reading is just half of what it is with the variable resistor short-circuited. The range of the meter is then doubled and it will read from 0 to 300 volts.

Increase the variable resistance until the reading on the meter is 1/3 of what it is with the variable short-circuited. The range of the meter has been extended to 0-450. And so on to as high voltage values as the experimenter cares to handle.

### The Calibration

The calibration by means of the variable resistor should be carried out immediately before the measurement of the higher voltage because the resistance varies with temperature and other conditions.

Fig. 1 shows the calibration circuit. B is a battery the voltage of which can be measured with the meter M when resistor VR is short-circuited by closing switch S. S is opened and VR increased until the reading on the meter has been reduced to the desired value. Then the meter is ready for use on higher voltages. Points a and b are connected across the unknown high voltage.

Just as the range of a voltmeter can be extended so can the range of a milliammeter be extended, but in this case the variable resistance must be put in shunt with the meter.

Suppose we have a milliammeter which reads 0-1 milliampere. The plate current in a vacuum tube may be five milliamperes. To measure that current with the 0-1 meter it is necessary to put a shunt around the meter and adjust its value so that 4 milliamperes flow through the shunt and one through the meter. If other ranges are required the shunts used must have suitable values.

For example, if it is desired to double the range of the meter a shunt the resistance of which is just equal to the resistance of the meter must be connected across the terminals of the meter. If it is desired to extend the range of the meter so as to read from zero to 50 milliamperes it is necessary to put a shunt across it which will take 49 of the total 50 milliamperes.

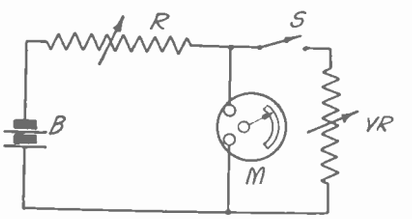



FIG. 2

**A DIAGRAM SHOWING HOW THE RANGE OF AN AMMETER OR MILLIAMMETER MAY BE EXTENDED TO READ HIGHER CURRENT VALUES.**

### Experiment Will Tell

It is best done by experiment with a variable shunt such as a rheostat. The calibration circuit can be like that delineated in Fig. 2. B is a battery of low voltage. R is a resistor chosen so that the current through the meter when the switch S is open is 1 milliampere, or any other convenient value. Then S is closed and VR adjusted until the reading is cut down to a desired value. If the reading is cut down to one half its original value the range of the meter has been doubled. If the reading has been cut down to one fifth the range has been multipled by five, and so on.

It may be necessary to try various rheostats for VR as all meters do not have the same resistance. Also when the range is extended to include high currents the resistance must be low and it is necessary to have a low value rheostat in order that an accurate adjustment may be effected.

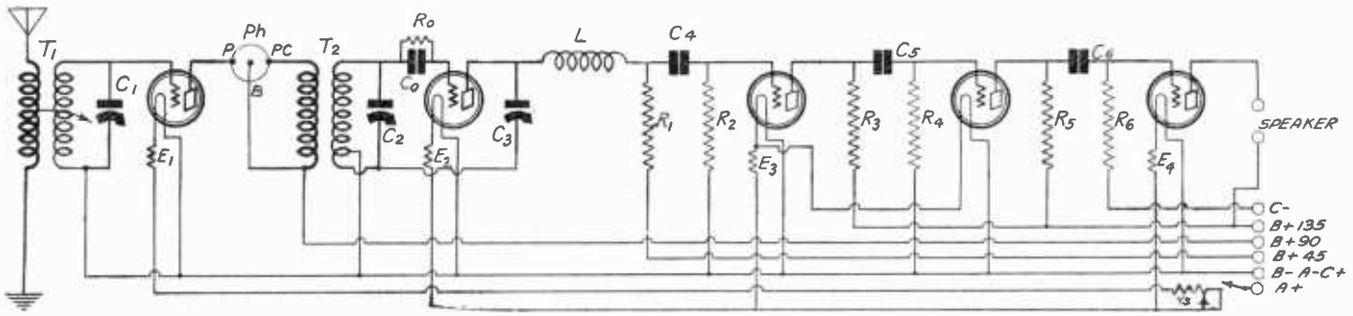
# Raytheon's New H Tube 125 Mils at 500 Volts

The latest addition to the steadily increasing family of gaseous rectifiers is Raytheon H, a full-wave rectifier with the necessary increase in working voltage to supply the plate requirements of the —10 power tube. In general appearance, it is not unlike the other Raytheon gaseous rectifiers, except in size. It is about the size of the BA, with a large enough glass bulb to dissipate the heat adequately. Furthermore, there is little heat generated, because of the low voltage drop in this tube.

The output voltage is 500 volts at 125 milliamperes, not only sufficient for operating the usual large power tube, but also for operating two such tubes in push-pull as well as supplying all the other plate requirements of the most elaborate radio receiver, in line with the trend of the day. The input voltage is from 500 to 550 volts, supplied by an approved transformer with the usual split and balanced secondary and the electrostatic shielding for best radio power unit practice.

The Raytheon H now brings the advantages and simplicity of the gaseous rectifier to the higher voltage radio power units and high-power amplifiers. It is no longer necessary to use two B or BH Raytheons in series for obtaining the necessary high voltage. Furthermore, Raytheon H has ample output to take care of whatever developments may take place in the field of multiple-tube amplifications, with push-pull tubes for every stage, as well as in the way of higher wattage power tubes.

# Two Cents an Hour




**THE CIRCUIT DIAGRAM OF THE FIVE TUBE, RESISTANCE COUPLED UNIVERSAL. SENSITIVITY, STABILITY AND QUALITY ARE OF A HIGH ORDER IN THIS RECEIVER.**

## Model of the Universal Uses Lynch Deck, Including Resistance Coupled Audio

TWO musical critics heard the reproduction by this set of the singing of Emilio de Gogorza and the playing of a combined band and orchestra during a General Motors Hour. Ordinarily these critics are super-critical, extremely hard to please. But during this program they entirely forgot their propensity toward adverse comments in their obvious enjoyment of the music. Between numbers they commented on the music just finished but not one of the comments was adverse, all remarks were highly laudatory.

"That is the best radio reproduction I ever heard," said the man.

"It is marvelous," said his wife.

"Yes," said I, "the receiver is faithful to the original music to a high degree. The design of the audio amplifier is largely responsible for the fidelity."

### Critic's Interest Aroused

At this stage a male member of the critical family was interested.

"I don't know much about radio," he said, "but I should like to have one of those sets. Do you suppose I could build one myself?"

"I see no reason why you could not," I replied. "The construction of the receiver is extremely simple. The layout precludes your going astray while assembling, and half of the work is already done."

On the strength of this he went out and procured the necessary parts, according to a list which I made out for him, and which is published herewith for the convenience of others who may be interested in realistic reproduction.

At this time this gentleman is busy assembling his first receiver during the few moments he can snatch from his regular work. And as he has not yet sent out an SOS it appears that he has had no difficulty assembling the set. And there is no reason why he should have any.

But his wife is worrying about the electric bill.

"I understand that it costs a great deal to operate high quality receivers," the critic's wife observed one day. "If the cost is proportional to the faithfulness of the reproduction, we won't be able to enjoy the set my husband is building more than once or twice a year."

### Operating Cost Low

"You'll be running that set all the time," I assured her, "and you won't detect any difference in your monthly electric bill. If you operate the set on batteries the cost will only be a few dollars per year. Resistance coupled circuits are that way. They do not consume much current. You need not worry about the cost of operation."

And why should any one worry about a cost of one or two cents an hour?

The set brings out the frequencies around 50 cycles per second as well as those around 5,000, and neither of these is brought out one bit worse than the frequencies around 1,000 cycles. This equality of response accounts for the startling realism in the reproduction.

One of the cardinal features of this Universal is the deck upon which most of the parts are arranged. It contains five Eby sockets for push type tubes and the requisite number of mountings for condensers, plate coupling resistors and grid leaks, as well as drilled holes for all necessary binding posts. The layout is compact and is calculated to make the wiring of the set as simple as possible. These parts are furnished with the desk, in fact come mounted on it.

While mountings for filament ballasts, or equalizors, are not on the deck as it is procurable, there is ample room on the deck to mount as many of them as are required in the circuit built around the deck.

One of the five sockets is used for the RF amplifier, one for the detector, two for high mu audio frequency amplifier tubes and one for the output tube. The RF tube is in front and center while the others are in a row at the back. The detector is at the right, where the power tube is ordinarily placed, and the amplifier runs from right to left, so that the power tube is next to the antenna and ground binding posts. This flexing of the radio receiver makes it possible to use very short leads between the detector tube and its tuner.

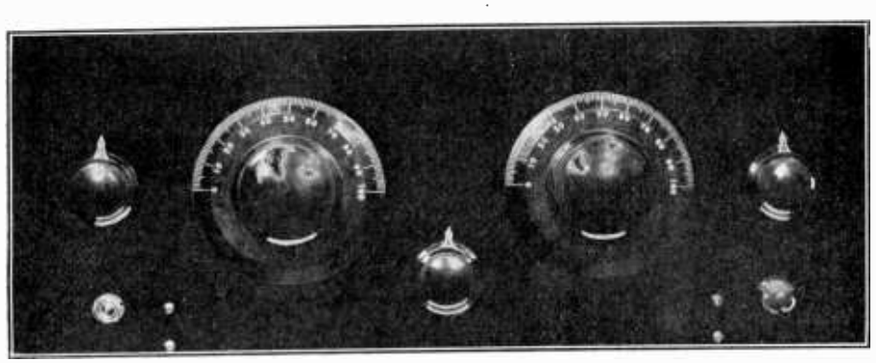
### The Mountings Hold Firm

The resistor and condenser mountings employed on the deck deserve special mention. In ordinary mountings the contacts are dependent on the thrust exerted by the end springs. Unless these are phosphor bronze or equal, the pressure usually decreases with time, allowing the contacts to become uncertain. Noise in the signal is the result.

The mountings used in the deck employ not only the end thrust but also side thrust to make contact, and the springs fit into grooves cut in the ends of the resistors or the condensers. The contact is so firm and positive that there is no possibility of deterioration or corrosion. In fact the contacts are so firm that some difficulty may be experienced inserting the condensers and the resistors, but when they are once in there will be no difficulty in keeping them there.

The size of the coupling condensers is .006 mfd., a value which is consistent with good design.

The oscillation of the audio circuit depends largely on the type of B voltage supply used, as well as on the by-passing that has been done. It is only on B battery eliminators which have been inadequately by-passed that any trouble occurs, and then it can be remedied by a by-pass



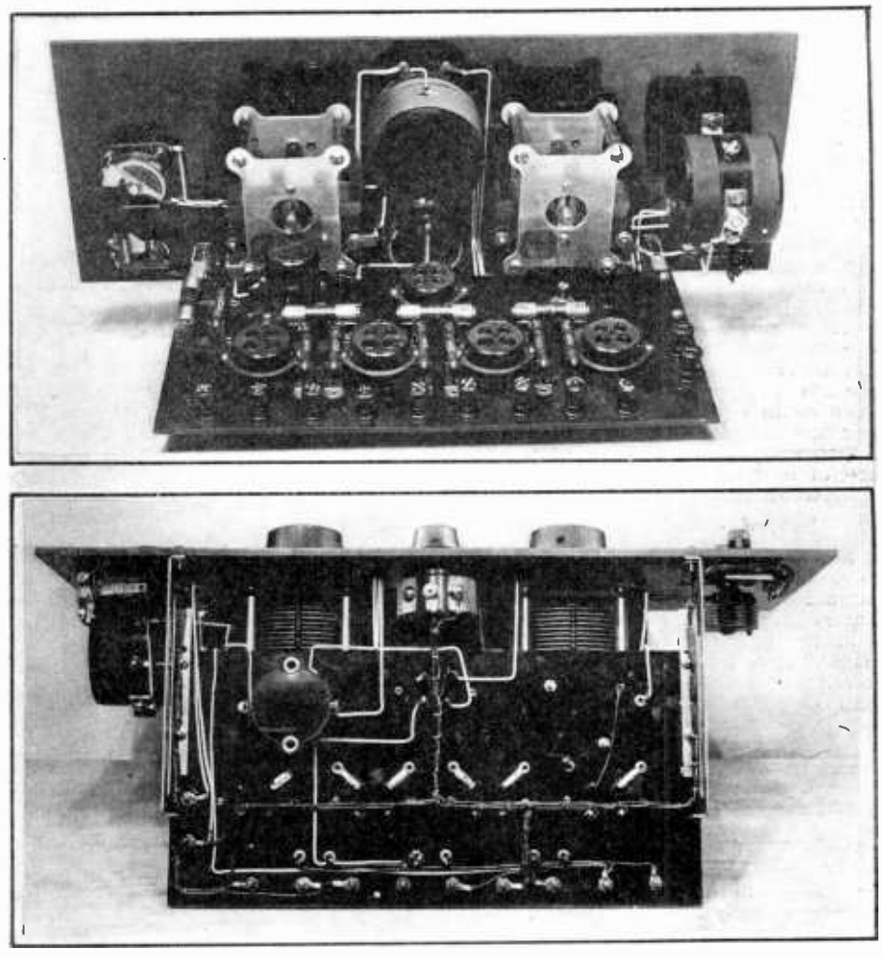
**PANEL VIEW OF THE FIVE TUBE RESISTANCE COUPLED MODEL OF THE UNIVERSAL. THE VARIABLE PRIMARY IS ACTUATED BY THE KNOB AT LEFT, THE TICKLER CONDENSER BY THE KNOB AT RIGHT. AT LOWER CENTER IS THE RHEOSTAT.**

# Runs This Set

*By Capt. Peter V. O'Rourke*
Contributing Editor

**LIST OF PARTS**

**T1—One General Radio variocoupler (for .0005 mfd. condenser).**
**T2—One General Radio RF transformer (for .0005 mfd. condenser).**
**C1, C2—Two General Radio Type 334 .0005 mfd. condensers.**
**C3—One General Radio Type 368, 50 mmfd. condenser.**
**L—One General Radio Type 379, 60 millihenry RF choke coil.**
**Ph—One Electrad Phasatrol.**
**E1, E2—Two Lynch Equalizors No. 4.**
**E3, E4—Two Lynch Equalizors No. 2.**
**YS—One Yaxley 10 ohm rheostat.**
**One switch.**
**One single open jack.**
**Ten Eby binding posts.**
**One Lynch amplifier deck comprising: C4, C5, C6—Three Lynch .006 mfd. stopping condensers; Co—One Lynch .00025 mfd. grid condenser; RO—One Lynch 2 megohm grid leak; R1, R2, R3—Three Lynch .1 megohm plate resistors; R2, R4, R6—Three Lynch .5 megohm grid leaks; five push type Eby sockets; one 6x12 Micarta sub-panel drilled for 10 binding posts.**
**One CeCo type A tube, one CeCo type H, two CeCo type G and one CeCo type. J-71.**
**Two National Velvet Vernier dials.**
**One 7x18 inch Micarta front panel.**



**UPPER—INSIDE VIEW OF THE FIVE TUBE RESISTANCE COUPLED UNIVERSAL, SHOWING CLEARLY THE MOUNTING OF THE COILS, CONDENSERS AND THE LYNCH DECK.**

**LOWER—THIS IS A VIEW UNDER THE DECK OF THE SAME RECEIVER SHOWING CLEARLY THE METHOD OF CABLING THE FILAMENT AND OTHER LOW FREQUENCY LEADS.**

condenser of generous capacity across the B voltage supply.

E1 and E2, are the filament equalizors of such a value that they drop the voltage 1 volt when a current of ¼ ampere flows through each. E3 and E4 are equalizors of just twice the conductivity of the others, that is, they drop the voltage 1 volt when the current through each is ½ ampere.

As will be osberved on the diagram, a variocoupler T, is used to input the receiver. This is an important feature. Formerly the variocoupler was used in most sets and then it went out of style. It never lost its virtues and advantages; it simply was displaced by new parts, not by better parts. Perry S. Graffam, designer of the receiver, recognized the merits of the variocoupler above the present day clamor, and used it to a good purpose.

The variocoupler is an excellent volume control and incidentally it is a selectivity variant. When selectivity of a high order is not necessary it can be reduced and there will be a noticeable gain in the reproduction of the higher notes.

Besides the volume control afforded by the variable coupling between the antenna and the secondary of T1 and by the variable feed-back through C3 additional control can be obtained through the rheostat YS which is in series with the filament of the first tube. If the total resistance in this rheostat is 10 ohms that alone will furnish an adequate control at least as far as cutting down volume is concerned.

The filament switch is mounted on the rheostat so that in turning the knob a little the filaments go on. In turning the knob a little more the rheostat takes effect as a volume control.

### RF Oscillations Suppressed

RF oscillation might occur in this double tuned circuit unless special precautions are taken. A Phasatrol Ph is used to suppress the oscillations. This is a commercial stabilizing device invented by John F. Rider and manufactured by Electrad, Inc., which can be put into any oscillating RF amplifier with satisfactory stabilizing results.

The second tuning coil, T2, is an RF transformer, the secondary of which tunes with a .0005 mfd. condenser C2. The secondary winding of this transformer must be tapped at 15 turns from the low potential side. This tap is connected to the minus end of the filament circuit for the grid return. The low potential side of the tuned circuit is connected to a midget condenser C3, which is also connected to the plate of the detector tube. C3 is the regeneration control and its maximum capacity is 50 mmfd. This method of controlling the regeneration is exceptionally smooth and gradual, and it is one of the reasons why this receiver is unusual in distance getting ability.

A General Radio 60 millihenry is put into the plate circuit of the detector to prevent any radio frequency current from entering the audio frequency amplifier. It does this effectively yet it does not suppress the high audio frequency currents to any appreciable degree. At 10,000 cycles the suppression is less than 1%, and at lower audio frequencies it is still smaller.

A small amount of transmitted radio frequency current does no harm for high frequencies are not amplified by the resistance coupled amplifier. When the plate resistors have high values the effective input capacity between the grid and the filament is quite large, and amounts to a short circuit to the radio frequencies. But the capacity is not large enough to have any effect on the essential audible frequencies. Hence the amplification against frequency characteristic is a straight line.

The first tube in the circuit should be of the general purpose variety like the CeCo type A, or one especially designed for radio frequency amplification, e.g., CeCo type K. The second tube should be of the special detector type, on which requires a negative grid return. The first two audio tubes should have a high amplification constant.

For greatest volume two high mu tubes should be used (CeCo type G).

The last tube should preferably be a J-71 power tube, but a CeCo Type F will give very good results if it is powered properly. The J-71 requires an output filter of some type while the F (or 112) can be connected directly to the speaker.

### Plate Voltages

The plate voltages on the various tubes should normally be as follows: RF 90 volts, detector 45 volts, and on the amplifiers 135 volts. Under certain conditions, however better results will be obtained if the detector voltage is higher.

# The Needs B Batteries

*By E. E. Horine*

**National Carbon Company, Makers of Eveready Radio Batteries**

IF I were to judge the radio power situation solely by the superficial evidence which meets the casual eye, I would conclude, along with the man on the street that the B battery is doomed to early and complete extinction.

Conversely, there is considerable evidence available, which, taken alone would justify the conclusion that socket power devices are no good, never were any good, and never will be any good.

The truth of the matter of course lies somewhere in between these two extremes.

We cannot afford to analyze so important a phase of radio reception as the power supply device, merely on hearsay evidence, or on the statements of several over-enthusiastic fans.

### Swayed by Emotion

It is a trait of human nature that we are easily swayed by enthusiasm, and if the enthusiastic statements of our acquaintances parallel our own experiences, we are all the more likely to jump to the conclusion that our little particular case is truly representative of the general state of affairs, whereas, a broad survey of the situation might easily reveal exactly contrary conditions.

This explains why one jobber recently expressed disgust at the mention of socket power devices, saying they were failures and declaring his intention of never handling another one as long as he lived, while a competitor of his, located less than two blocks away, was bubbling over with enthusiasm for them, saying most emphatically that they were an unqualified success, and giving the impression that he was going to concentrate the remainder of his natural life to the noble task of installing one on every set within the sphere of his activity, for the satisfaction they would bring his customers.

### Not Representative

Neither of these men was right. One had had a phenomenal run of bad luck with socket power devices—the other an equally phenomenal run of good luck. Neither's experience was truly representative of the general state of affairs.

In an effort to get a true picture of the radio power situation, the company I represent has tapped practically every available source of information on the subject; it has even gone into the homes of radio users here, there and yonder, to find out what they are doing now and what they plan to do in the future relative to their radio power plant; it has surveyed this country up and down and crossways, not once, but several times, with the result that it has a large fund of information on the subject which is most valuable.

### Result of Survey

And if my remarks seem to paint the future of the B battery in brighter colors than some might think warranted, believe me it is not because the wish is father to the thought, but because a cold blooded analysis of the situation justifies it.

One of these surveys was conducted among radio set owners who had at one time or another purchased and used a socket power device. It was a representative survey, covering individual users in over 600 cities and towns. It brought to light two interesting and highly significant facts. First, that the dissatisfaction with socket power was more prevalent and more widespread than had been thought to be the case, and, second, that this dissatisfaction was more with the socket power idea itself than with any particular make or type of socket power device.

Ninety per cent of those interviewed had previously used B batteries, and therefore were in position to make comparisons.

The four outstanding arguments which persuaded these people to buy socket power devices were, in the order of their effectiveness: (1) greater economy; (2) more convenience; (3) more uniform power and (4) improved reception. You will note that these are all comparative virtues—things socket power is supposed to do better than B batteries. In more than half the cases—and please bear in mind that this was a comprehensive survey—socket power failed to live up to the expectations of its purchasers.

This does not argue that socket power devices are all faulty, or that the socket power idea is all wrong. Far from it.

### Where They Can't Compare

But what it does show is there is a class of receiver in use and for sale today, on which socket power devices, in their present form at least, cannot compete with B batteries. Socket power cannot cover the entire field of radio like a blanket. Neither can B batteries. There is a field for each; a goodly proportion of the radio using public is better off with B batteries. The rest need and should employ socket power.

The B battery possesses certain inherent advantages not duplicated in socket power devices. It is the only source of pure DC we have and without pure DC the receiver is handicapped in its effort to produce the utmost in tone quality.

B battery power is independent of all the external influences which sometimes interfere with the steady delivery of power by wire. There are many such advantages, but the owner of a super-deluxe 8 or 10 tube set finds the inconvenience of battery power burdensome, so he resorts to socket power, and rightly so. He needs it.

And, fortunately, this type of radio owner usually can afford the outlay necessary to secure the kind of socket power device that most closely approximates the pure DC of batteries in its output.

### Another Misfit

It is just as much of a misfit to apply socket power to an economical, light drain receiver, as it is to attempt to obtain satisfaction from B batteries on a 10 tube set drawing 60 to 70 milliamperes in the plate circuit. One is just as productive of dissatisfaction as the other, and as time goes on we will see a line of demarkation between the two classes of receivers begin to define itself, with a good market for B batteries on one side, and another good market for socket power devices on the other.

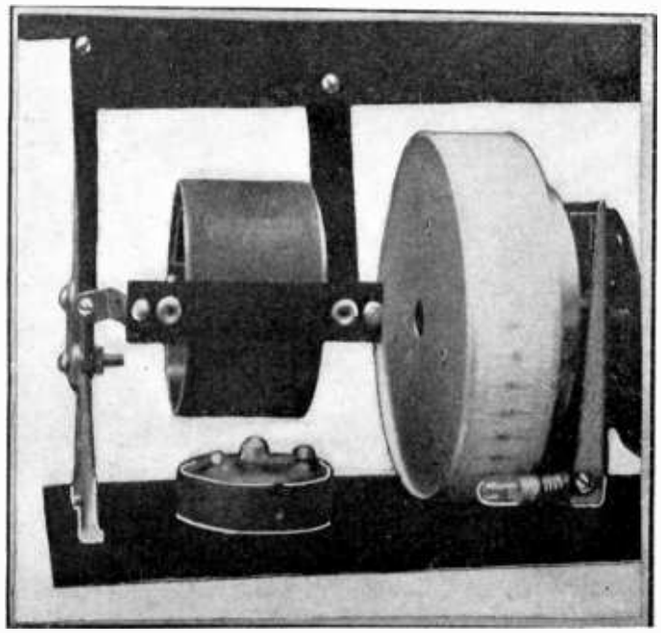
Judging by the volume of socket power advertising and publicity matter which daily greets the eye, one would naturally conclude that there is a decided and rapid drift on the part of the radio public toward socket power, but a careful study of the situation which goes deep down to the very heart of the matter reveals that this is not the case.

We find that socket power is going more and more into those homes where it is needed and where, because it is needed, it can live up to the claims made for it.

### Demand to Continue

There is now, and will be, a large proportion of battery operated receivers which will continue to demand B bat-

## ANTENNA COIL MOUNTING



**A SPLENDID WAY OF MOUNTING A COIL SO AS TO KEEP IT AWAY FROM ENERGY-ABSORBING BODIES. A BAKELITE STRIP FASTENED TO THE SUBPANEL HOLDS ONE END OF THE COIL, BY MEANS OF A LONG SCREW PASSED THROUGH AN 8/32 TUBING.**

# and Power Devices Fill

teries. And while the demand for B batteries will not increase from year to year in the truly phenomenal manner we have become accustomed to, there is no reason to believe that it will ever decline from its present high level.

In predicting the continued demand for B batteries, I am not confining my thoughts to those receivers located on farms, or other places where power is not available. A large part of the market for B batteries will be in cities and towns, just as it is today, but the rural market will doubtless become a more important factor as time goes on, not alone in B battery sales, but in radio in general.

So far, I have confined my remarks to the B battery and B power supply units, mainly because this phase of radio power supply has, until recently, received the most attention from manufacturers and the public. But the need for a successful A power supply device is just as great, if not actually greater than for a B unit.

### Filament Problem

The problem of running the filaments of vacuum tubes from the house current is infinitely harder to solve than that of the B end of the set, and this is doubtless one of the reasons why we have so many B devices on the market and so few A's.

There are at least four different ways of driving the filament circuit from AC: the high voltage rectifier-filter with series filament connections; the low voltage rectifier-filter with parallel filament connections; the use of raw AC on the filaments of specially constructed tubes, and the indirectly heated AC tube.

Each of these methods has its advantages, and its disadvantages. Examples of all four of these methods of AC filament drive are to be found in this season's crop of "all-electric" sets.

### "One or Two Will Emerge"

As time goes on and experience accumulates, it is probable that one or two of them will emerge as the most satisfactory around which the "all-electric" set of the future will develop. It is too early now to predict which will survive, and I would be the last to venture into that treacherous realm at the present moment.

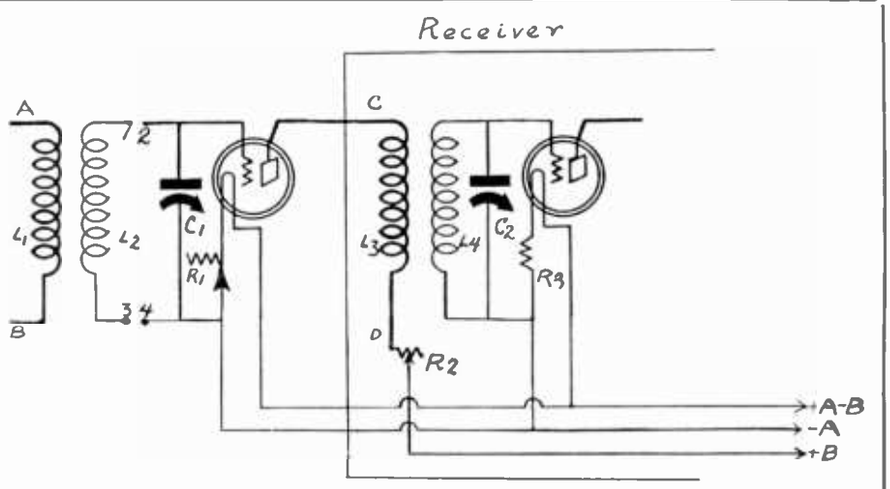
There is a great public interest in the "all-electric" set, and many will be sold this season and in the seasons to come. There is a large, untouched market for such receivers, consisting of people who have been waiting all these years for a set that hooks into the light circuit, and while the sale of these receivers will doubtless encroach to a certain extent on the market for B batteries and B socket power units, it is my opinion that, in the main, they will go to individuals who could not be reached and interested in radio in any other way.

### No Quarrel

I have studied this radio power situation long and carefully. It is a part of my job. And it is my honest conviction that the three principal types of power supply devices, the B battery, the B socket power device and the "all-electric" set, have no quarrel with one another, nor are any one or two of them going to force the other out of business.

There is a need for each, and each covers a field and reaches a market inaccessible to the others.

The total radio power business is now being split three ways, instead of only one or two, as formerly, and with radio as big as it is, and growing as fast as it is, there is plenty to go around, and then some.




HOW AN EXTRA STAGE OF RF AMPLIFICATION, WITH PROVISION FOR A LOOP, CAN BE ADDED TO YOUR PRESENT RECEIVER. R1 IS 20 OHMS, WHILE R2 IS 2,000 OHMS.

# Current Drain Is Basis of B Power Selection

**From Diamond Electric Corporation**

The music that floods your home when you turn on the radio is not, as sometimes supposed the music that is played in the studio of the broadcasting station, but a recreation or a copy of that music. Whether this copy is a good one or a poor one, depends largely on your B power supply, for every sound issuing from the loud speaker has had its origin in either the B batteries or B eliminator supplying the set with plate current.

Consequently, the problem of B power supply is one of very great importance to every owner and prospective owner of a radio receiver. There are at present three sources of B power available: socket power devices, storage batteries, and dry batteries. Due to the fact, however, that storage batteries require close attention and frequent charging, the choice of the prospective buyer of B power will probably lie between one of many socket-operated devices and dry batteries.

### Questions to Decide

At first blush, perhaps, it would seem an easy matter for the set owner to be governed in his choice by the number of tubes that must be supplied with plate current. For example, he may assume that a receiver having five or more tubes can be operated most economically from an eliminator. Such, however, is not always the case, especially as many of the most popular five-tube sets have been designed for economical operation from B batteries.

Then, again, in certain types of multi-tube receivers, particularly those employing three stages of impedance or resistance coupled amplification, freedom from motor boating can be obtained through the use of B batteries, or through the combination of batteries and eliminator. This tendency toward motorboating is due to audio regeneration caused by the high impedance of the socket power device. Again, some sets, having but two stages of audio amplification, give decidedly inferior results when used in connection with an eliminator, because, in this case, the regeneration, while insufficient to produce motorboating, results in serious distortion.

Generally speaking, the selection of B power should be made on the basis of current drain and not on the number of tubes to be supplied with plate voltage.

### What Tests Show

Tests made on B batteries show that in the case of the three-tube regenerative receiver, operating with 22½ volts on the detector and 90 volts on the two unbiased amplifier tubes, the current drain will draw 7.7 milliamperes. A medium-sized battery would render 550 hours of service at this current drain.

Now, when a 4½-volt C bias is applied to the two amplifying tubes, the plate current drain will be cut to 3.3 milliamperes, with a service life of approximately 1,500 hours for the medium-sized battery and 500 hours for the small battery.

The most popular receivers in use today have five tubes and are of the tuned radio frequency type. These sets, when operating on 90 volts, without C bias, draw about 15 milliamperes. A medium-sized B battery will render approximately 200 hours of service, while a heavy-duty battery will give 600 hours of service. In this case, a heavy-duty battery is preferable, as it gives three times the service of the medium size, while costing only half again as much.

### Reduced Plate Current

With 4½ volts C bias on the two audio amplifier tubes, the plate current is reduced to 10.7 milliamperes, and the useful life of the medium-sized B battery increased to about 360 hours and that of the heavy-duty, to 940 hours.

In this type of receiver it is not feasible to place a C bias on the radio frequency amplifier tubes, but a great saving in B battery consumption, without any sacrifice in sensitivity, may be had by applying only 67½ volts to the two radio frequency tubes.

The total current, assuming the grid of the audio tubes are biased, will then be but 7.3 milliamperes, or 600 hours of service from a medium-sized B battery.

# Radio University

A FREE Question and Answer Department conducted by RADIO WORLD for its yearly subscribers only, by its staff of Experts. Address Radio University, RADIO WORLD, 145 West 45th St., New York City.

When writing for information give your Radio University subscription number.

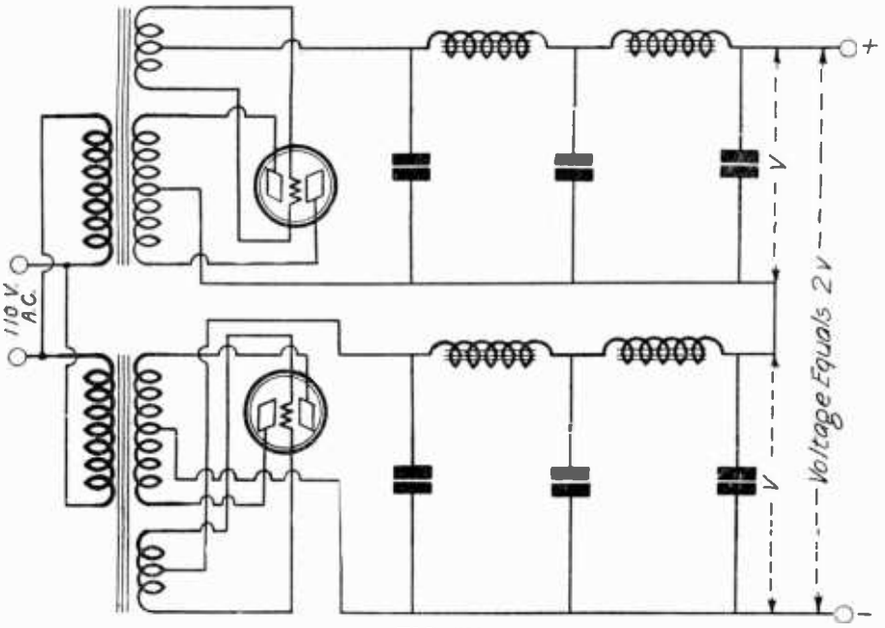



FIG. 589
HOW TWO ELIMINATORS ARE CONNECTED IN SERIES.

**PLEASE SHOW** how to connect up two B eliminators, using double wave rectifiers in each, in series, so as to obtain twice the voltage.—HERMAN POSMAN, Madclia, Minn.

See Fig. 589.

* * *

**IN THE** January 23 issue of RADIO WORLD, which I am informed is out of print, appeared a complete discussion of all types of batteries by Lewis Winner. An explanation of primary and secondary cells appeared in the article. Would you be kind enough to reprint this explanation?—ROBERT BUTGER, Seattle, Wash.

Herewith are the explanations: "A primary cell is one in which the production of any electrical current takes place when a diluted solution of some acid or alkali acts upon two elements, dissimilar to each other and connected in electrochemical series. That is, only when a chemical action takes place between two plates of dissimilar characteristics, which are connected as described due to the action of an acid solution, will a current be derived. A cell of this type requires no preliminary charging, and is commonly known as the dry cell, although the cells really contain a liquid solution, absorbed by a blotter.

"A secondary cell is one in which an electromotive force will be obtained when an electric current is passed from one set of elements through an acid electrolyte to the other set of elements. The action that results, causes the plates to have dissimilar characteristics. At the same time a difference of potential is set up between the plates of the cell. As soon as these elements are joined by a conductor, an electric current flows."

* * *

**I HAVE** a radio frequency transformer, containing a 25 turn primary wound in a slot 3/8 inches wide and deep, on a 3 inch tubing, and a 50 turn secondary space wound, in 1/16 inch slots. No. 26 single silk covered wire is used for the primary, while No. 24 double cotton covered wire is used for the secondary. I was thinking of building a stage of tuned radio frequency amplification using this coil and adding it to my present set which is a 5-tube tuned radio type, the entire unit to be placed in a metal cabinet, 8 inches high, 6 inches wide and 8 inches deep. Would this work out all right?

(2)—What capacity condenser would you suggest shunting across the secondary winding?—MERTON F. KELLY, East Pittsburgh, Pa.

(1)—Yes.

(2)—.0005 mfd.

* * *

**IN MY** workshop, I have the following parts, which I would like to incorporate in a three stage tuned radio frequency and non-regenerative unit: One .0005 mfd. variable condenser, hooked up to a single drum; three .0005 mfd. variable condensers hooked up to a single drum; a 20 ohm rheostat; three 1A Amperites; two 200 ohm grid suppressors; a 4 megohm grid leak; a .00025 mfd. fixed condenser with clips for mounting the leak; a filament switch; a .0005 mfd. fixed condenser; five binding posts; a 1 mfd. fixed condenser; a spool of No. 22 double cotton covered wire; four 3-inch diameter, 6 inch long tubings, and a baseboard, 15 inches long and 8 inches deep. Will you please show the circuit diagram of such a unit.—FRED MARKSTON, Los Angeles, Calif.

Fig. 590 shows the circuit diagram of this unit. T1T2T3 and T4 are tuned radio frequency transformers. The primaries for these transformers, consist of 10 turns, while the secondaries consist of 45 turns. Each primary and secondary is wound on a

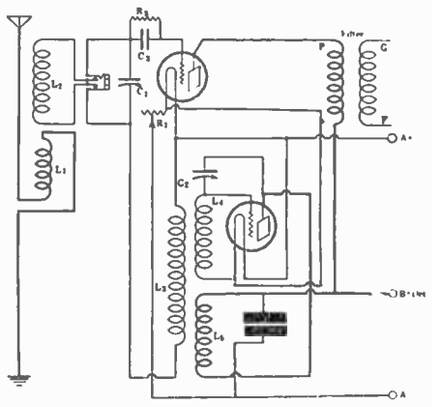


FIG. 591
HOW TO HOOKUP AN OSCILLATOR AND DETECTOR.

separate tubing, with a 1/4 inch between them, using the wire you have. R1 is the rheostat. R2, R3 and R4 are the Amperites. R6 is the leak, while C5 is the condenser. Three of the binding posts are used for the batteries, while the other two are used in the output. R5 and R6 are the grid resistors. The dotted line indicates the drum controlling the three condensers. C6 is the .0005 mfd. fixed condenser, while C7 is the 1 mfd. fixed condenser. The plates of the three radio frequency tubes and the detector are all connected to a common B post. You can experiment, here, by trying a separate voltage on the first radio tube, say 67½ volts. Any kind of audio may be hooked on to this unit. It is advisable when building this unit, to place the coils at right angles to each other.

* * *

**I HAVE** a standard 3 stage intermediate frequency amplifier, with a filter transformer, and detector unit. I would like to build a unit which will enable me to use this amplifier in a Super-Heterodyne fashion. The circuit diagram showing such an arrangement would be appreciated. I would like to use a loop.—LESTER JUTNER, Jersey City, N. J.

Fig. 591, shows the diagram. L1 and L2 are the primary secondary of a tuned radio frequency transformer. C1 is a .0005 mfd. variable condenser. L3 is the primary of a 3-circuit tuner. L4 is the secondary, while L5 is the tickler. C2 is also a .0005 mfd. variable condenser. It will be necessary to remove about fifteen turns off the tickler winding. R1 is a rheostat having a resistance of 15 ohms. A .0001 mfd. fixed condenser and a 3 megohm grid leak, C3 and R3 respectively, are used. The plates of both tubes are brought to a common post. Between this post and the minus A post, a 1 mfd. bypass condenser is inserted. This is indicated by the two heavy black lines, between these two points in the diagram. The connections for the A battery are run along to the leads from the amplifier and the detector unit. That is, it is not necessary to use a separate battery. So that you can use a loop or an antenna, a double circuit jack has been hooked in the secondary circuit of the tuned radio frequency transformer. The grid return of the detector

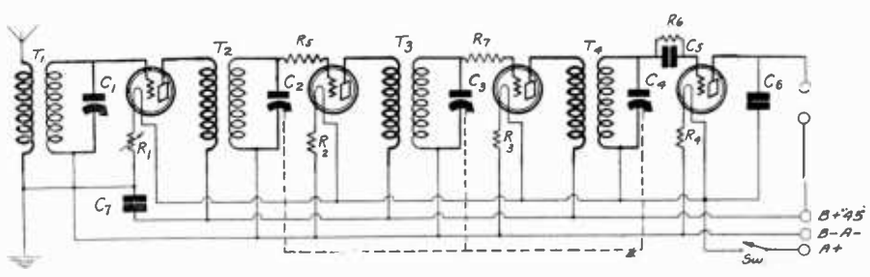



FIG. 590
THE THREE STAGE TUNED RADIO FREQUENCY AND DETECTOR UNIT

tube is made to plus A, while that of the oscillator to the minus A.

**MY COUSIN** and I built a six tube set last week, containing a tuned radio stage, two untuned radio stages, a detector and two transformer audio stages. The detector is coupled by an untuned radio transformer. The first stage is wired up so that either a loop or an antenna may be used, via a double circuit jack. I can hear signals when I use the antenna and ground, but not a sound with the loop. I tested the loop, which is 3 feet square and contains 12 turns of No. 18 wire, spaced one quarter inch, and found it to be all right. Could the trouble be in the plug? What would you suggest doing?—JAMESON GRADY, South Bend, Ind.

The trouble may be in either the jack or the plug. Suggest you run the loop leads direct to the stationary and rotary plates of the variable condenser shunted across the secondary of the tuned radio transformer. The leads from this winding to the condenser should preferably be disconnected, when doing the above.

* * *

**I HAVE** just been informed by your subscription department that the June 11 issue of RADIO WORLD, containing the circuit diagram of the push-pull resistance coupled amplifier as described by J. E. Anderson, is out of print. Will you, therefore show the circuit diagram again, and give the constants. I am going to use a crystal detector.—SAMUEL MELTZ, Houston, Tex.

The circuit diagram of this amplifier appears in Fig. 587. The stopping condensers have a capacity of .5 mfd. The grid resistors have a resistance of 1 meghoms. The plate resistors have a resistance of .5 meghoms. R1 has a variable resistance of 100,000 ohms. R2 consists of two 1 meghom grid leaks and a 2,000 ohm potentiometer. The resistance leads of the potentiometer are inserted in between the two leaks, with the arm going to the filament circuit. Ch are 100 henry choke coils. Zs represent the impedance of the plate supply. * * *

**I WAS GIVEN** 2-stage push-pull power amplifier, tubes. Would like to connect it up to my present set, which is a 5-tube set, using three tuned radio stages, detector and two transformer audio stages. I am not certain, as just how hook it up, so please show a diagram.—K. W. FORMM, Portchester, N. Y.

How this is done is shown in Fig. 592. It is not necessary to use more than one stage of audio coupling, with this power amplifier. Either 45 or 90 volts can be applied to the first audio plate, this depending upon just how loud you want the signal. Of course, when you change the voltage, it is necessary to change the C bias.

* * *

**IN THE** December 31, issue of Radio WORLD, in the Radio University columns, there appeared a circuit diagram illustrating how to hook up a tube instead of a crystal detector. I wish to reverse this action. That is, I want to use the crystal. I would like to know, however, if I can add a three stage double impedance audio frequency amplifier to the output. It seems, according to the diagram, that only transformer coupled audio frequency amplification can be added. Will you please set me straight?—SEYMOUR KENTING, Albany, N. Y.

You can add the amplifier you have.

* * *

**I READ** with interest the series of articles on Fenway's Concertrola, which appeared in the November 5, 19, 26 and December 3 and 10 issues of RADIO WORLD. There are several questions that I would like to ask.

(1)—How long an antenna should be used?

(2)—Is it advisable to insert resistances in series with the cathode heater leads? —SOLLY KAZLOW, Brooklyn, N. Y.

(1)—The antenna can be from 30 feet

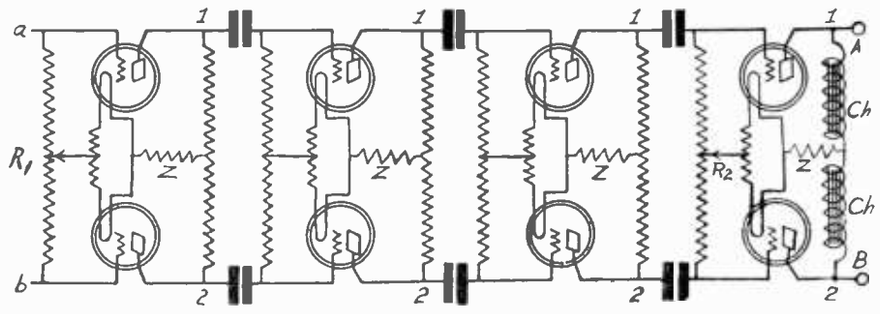



FIG. 587

**THE CIRCUIT DIAGRAM OF THE RESISTANCE COUPLED PUSH-PULL AMPLIFIER AS REQUESTED BY SAMUEL MELTZ.**

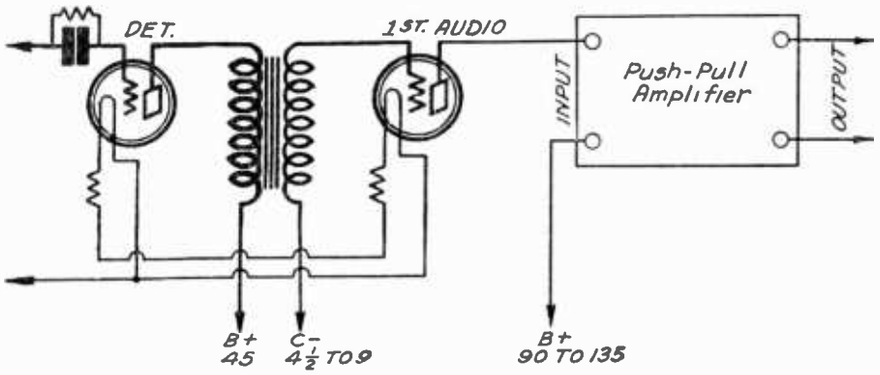



FIG. 593

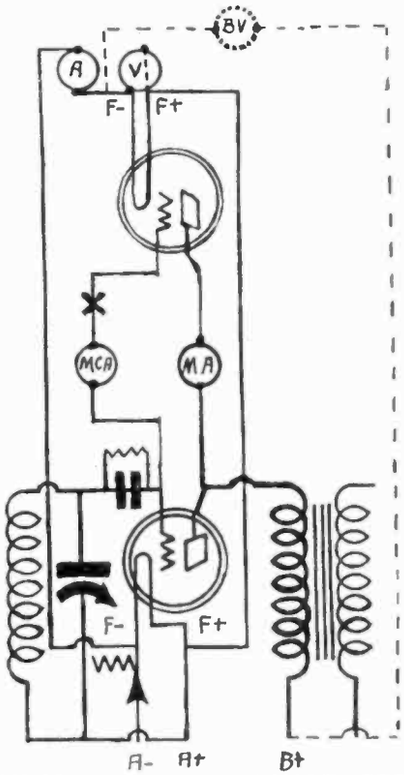
**CIRCUIT ILLUSTRATING HOW PUSH-PULL AMPLIFIER IS HOOKED IN TO THE AUDIO SECTION OF A SET.**

to 200 feet long, with a lead in, or lead down, of about the same length, it can be from 10 feet to 200 feet above the ground, and can be located either indoors or outdoors. If this aerial is shorter than 30 feet, the set will be critical in tuning, it will be super-selective, and there will be a loss of volume; if the aerial is over 100 feet long, and rather high, the set will tune broadly, that is, a station may come in over several degrees of the dials, and the volume of signal will be very great. The exact length of aerial to use with the Concertrola depends upon (1) whether you live on the ground floor or on the top floor of an apartment house, and (2) whether your location is classified as a good one for radio reception. The aerial is connected with No. 1 of the 368A coil, while No. 2 of the same coil is connected with "B"—the ground.

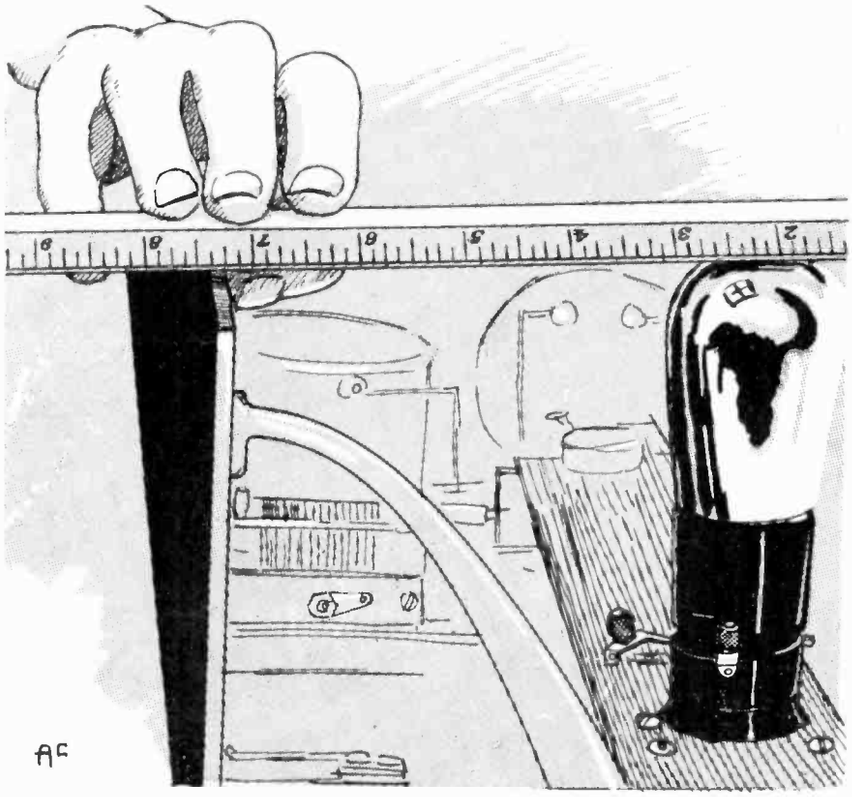
The ground connection is usually made to a water pipe, a steam radiator, a fire-escape, a light socket, or to rods driven into moist earth. With every form of aerial the ground lead is an essential part of the tuned circuit. If it has a high resistance, the signals reaching the detector will be weak, and the Concertrola cannot produce the results of which it is capable. While one side of the AC line furnishes a sort of grounded connection, it is wise to connect a heavy ground lead to a cold water pipe, taking care to have the surfaces clean and tightly clamped together.

(2)—It is advisable to insert two fixed resistances of 1.5 in series with the cathode heater supply leads of the detector tube. Operating the detector tube at reduced heater voltage (at approximately 2 volts) will increase the detecting efficiency and also eliminate undesirable line disturbances which sometimes occur. But the resistance used for this purpose must be of sufficiently large carrying capacity to prevent it from overheating. A General Radio rheostat, size 6 ohm, No. 214, can be taken apart and used for these resistances. In fact, if this rheostat is cut into three pieces, two of them can be used for the detector tube.

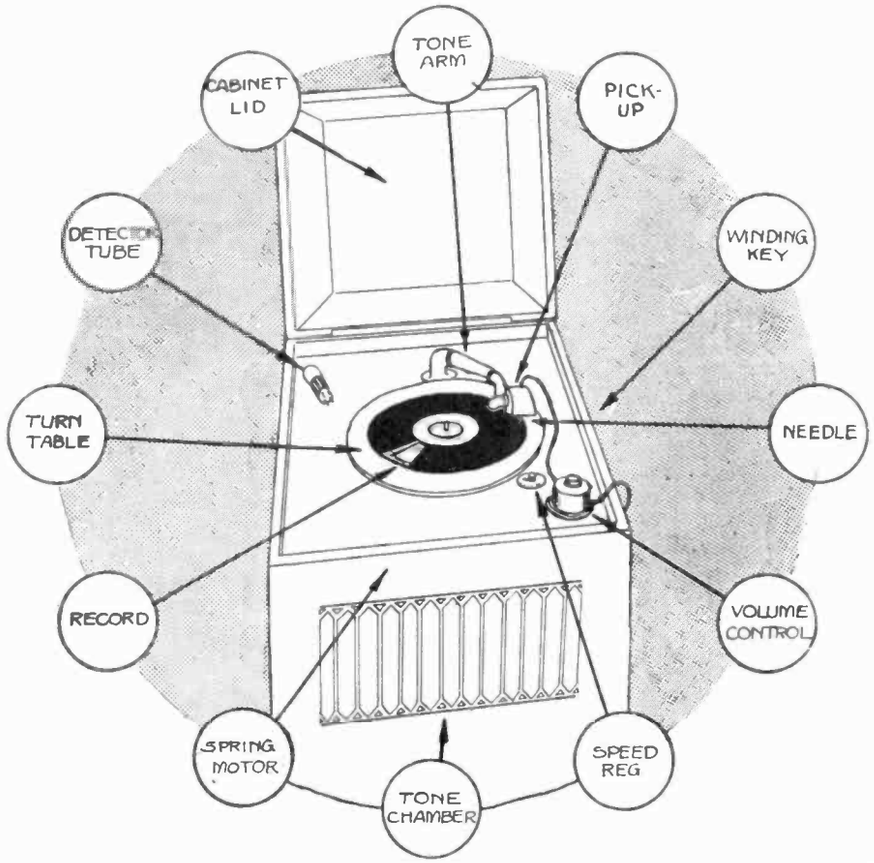
# Interesting Technical Illustrations



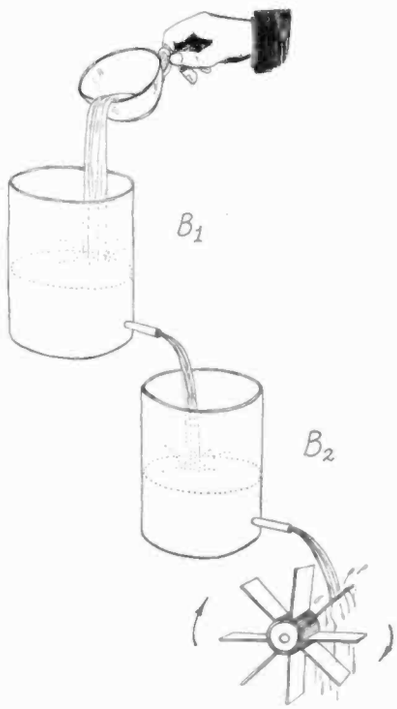

AN OLD TUBE BASE, A VOLTMETER OF THE HIGH RESISTANCE TYPE AND A MILLIAMMETER MAKE A HANDY TUBE TESTER. THE METERS ARE CONNECTED AS SHOWN ABOVE.



TAKE CARE WHEN INSTALLING ALTERNATING CURRENT TUBES IN ADAPTERS TO SEE THAT THE TOP OF THE TUBE ENVELOPE IS A BIT LOWER THAN THE TOP OF THE PANEL. OTHERWISE, WHEN THE SET IS INSERTED INTO THE CABINET, THE TUBE WILL BE SMASHED. WHEN INSTALLING POWER TUBES THE SAME PRECAUTION MUST BE TAKEN.




THE FEATURES OF THE PHONOGRAPH, WHICH SHOULD BE KNOWN BY ANYONE WHO IS CONTEMPLATING INSTALLING A PHONOGRAPH PICKUP.




THE OPERATION OF A CONDENSER IN A FILTER CIRCUIT IS SIMILAR TO A CUP OF WATER BEING SPILLED INTO CONTAINERS WITH OUTLETS. THE MORE CONTAINERS THE SMOOTHER WILL BE THE FLOW THROUGH THE OUTLET, VIZ., THE LARGER THE CONDENSER THE SMOOTHER WILL BE THE OUTPUT.

# The Radio Trade

# Karas and Carter Lead with AC Conversion Plan

The Karas Electric Company, 4040 North Rockwell St., Chicago, and Carter Radio Company, 300 S. Racine Ave., Chicago, have cooperated on adapting a DC set to AC operation. This method can be adapted by the set owner himself.

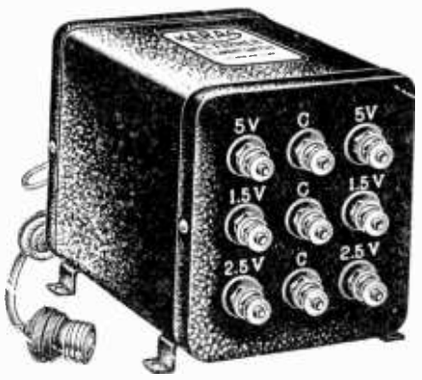
The Karas contribution to the combination is the AC-Former, an expertly designed step-down transformer having center tapped windings of 5 volts, 1½ volts and 2½ volts. Considerable experimental work lies back of this instrument, and it is reflected in the perfect balance obtained between the terminals of the windings with respect to the center taps. In this transformer the center taps are really the electrical centers of the respective windings. This means hum-free operation of the receiver to which this transformer is connected, provided that no unbalance is introduced outside.

### Carter's Contribution

The Carter contribution consists of the Carter adapter and the Carter cable harness. The adapters are inserted into the sockets of the old set, the cable harness is attached to the adapters and the AC-Former is connected to the cable harness and the conversion of the receiver is complete. Any good B eliminator may be used for plate supply.

The Carter Cable Harness has been so constructed that the balance of the windings is maintained and no hum can creep into the signal by this route. The wires in the harness is of adequate section to allow for the heavy currents which will be required for certain AC sets.

The AC-Former likewise is of ample proportions so that the voltage loss in the windings on heavy current will be very small and there will be no core saturation for any of the current drains recommended.




**THE KARAS AC-FORMER WHICH IS USED IN THE CONVERSION OF SETS USING DC TUBES INTO SETS USING AC TUBES, IN CONJUNCTION WITH THE CARTER ADAPTERS AND CABLE HARNESS.**

### More Data Available

Details of this combination AC converter are being prepared for publication in early issues of RADIO WORLD. Advance information may be obtained gratis by addressing Conversion Editor, Radio World, 145 West 45th Street, New York City.

There are two types of AC-Former. Type 12 is designed for 12 tubes and Type 13 for 10 tubes.

## Kauer of C. E. Mfg. Co. Honored by Independents

Ernest Kauer of the C. E. Mfg. Co., Providence, R. I., makers of CeCo radio tubes, has been elected to the Board of Directors of the Radio Protective Association. This is an organization of independent radio manufacturers formed to protect their rights against the invasion of the so-called radio trust. These larger independents, through their association, complain that the radio trust is trying to destroy its competitors and to drive all rivals out of business through its control of many radio patents.

A case is already in the Federal Courts, and United States District Judge Morris at Wilmington, Del., is to hear next month arguments on a plea for an injunction to stop part of the operations of the Radio Corporation of America, which a group of radio tube manufacturers (including the C. E. Mfg. Co.,) has sued for alleged violation of the Clayton and Sherman anti-trust laws.

### MOTHER EARTH .005 FARAD

It is not difficult to realize the tremendous size of a unit having the capacity of 1 farad, when one knows that a sphere the size of the earth has a capacity of about .005 farad.

## Power Supply Devices Offered by Sales Company

The American Sales Co. has acquired the entire supply of the well-known Timmons Combination Power Amplifier and B Supply and also the Timmons Power Amplifier, the Timmons Company desiring to devote all resources toward speaker development and manufacture. Both of these units are compact and sturdy, built to last, of the best materials. Both operate on the 216B or 381 type tube for rectification and the 210 type tube for super power distortionless quality of reproduction. Each unit is identical in performance as super power amplifiers, the commission, however, also furnishes all the necessary B current required and no output transformer is needed with either. They work on AC and each unit is tested and fully guaranteed, both by the manufacturer and the American Sales Co. This concern has also taken over the RCA Uni-Rectrons which are well known everywhere for quality reproduction. Those interested in super power amplification may obtain full details and particulars regarding special prices on these fine units from American Sales Co., 21 Warren Street, New York City.—J. H. C.

## Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

RADIO WORLD,
145 West 45th St., N. Y. City.

I desire to receive radio literature.

Name .....

Address .....

City or town .....

State .....

E. W. Pierce, 3201 Seventh St., St. Louis, Mo.
B. H. Bailey, 1306 Ridge Ave., Philadelphia, Pa.
E. W. Taylor, 207 North 8th Street, Allentown, Pa.
Bud Addis, 318 Second Street, South Brownsville, Pa.
L. P. Stevens, Route D, Box 20, Enid, Okla.
Charles Carroll, 2719 Georgia Ave., Washington, D. C.
J. Sanzone, 890 4th Ave., Brooklyn, N. Y.
John F. Shea, 35 Whitehall St., Cohoes, N. Y.
George A. Clark, Box 13-501, Represa, Calif.
W. I. Hamir, 341 Cemetery St., Jersey Shore, Pa.
R. J. Davies, 460 Spruce St., Middletown, Pa.
John E. Romer, 341 S. Colonial Ave., Richmond, Va.
J. K. Sullenbuger, 138 S. 13th St., Allentown, Pa.
Samuel M. Falk, 2760 Grand Concourse, Bx., N. Y. City.
Richard Miller, 928 Tiffany St., Bx., N. Y. City.
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G. F. Hopkins, 83 Woodville St., Everett, Mass.
C. N. Curtis, 217 Steuben St., Horseheads, N. Y.
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C. A. Bouffier, 532 East 172 St., Bx., N. Y. City.
H. M. Douglass, 1130½ Vernon Ave., Portland, Ore.
Peter Marfia, 601 East 14th St., N. Y. City.
R. A. Baumgardner, Box 964, Pulaski, Va.
George F. Randolph, 4455 Xavier, Denver, Colo.
John Cameron, 23 Norwood Ave., Schenectady, N. Y.
F. W. Blanchard, 253 Grenier Ave., N.D.G., Montreal, P.Q., Canada.
P. H. Smith, 404 N. Electric, Alhambra, Calif.
I. Weinstein, 1220 S. Avers Ave., Chicago, Ill.
Harry Quinn, 2022 West Opal St., Philadelphia, Pa.
Walter M. Crumb, 124 13th Ave., Seattle, Wash.
R. H. Sargent, 230 Main St., Nashua, N. H.
Frank Turoski, 264 Cowden St., Central Falls, R. I.
G. Johnson, Richmend, Utah.
Miles Lusk, Box 686, New Kensington, Pa.
Harvey Walseth, Clear Lake, S. D.
Henry Laraby, 56 Maiden Lane, Bridgeport, Conn.
John F. Engle, 7802 Pulaski St., Middle Village, L. I., N. Y.
P. B Thornell, P. O. Box 1081, Columbia, S. C.
Edward J. Hasson, P. E. Hospital, Philadelphia, Pa.
Alfred Kennedy, 109 Ouimet Ave., St. Laurent, Montreal, Canada.
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W. L. Reiher, 311 N. Lincoln, Hastings, Neb.
David W. Winner .252 Brooklyn Ave., N. Y.
Elsie Schonholtz, 2675 Valentine Ave., N. Y. C.
Leo Flaum, 1475 Grand Concourse, N. Y. City.
C. Comins, 1233 Boynton Ave., N. Y. City.
Sidney Greenstein. 828 Dawson St., N. Y. City.
L. Weber, 1088 Lydig Ave., N. Y. City.
H. Diamond, 3 Morgan Ave., Poughkeepsie, N. Y.
E. Wolfe, 451 Claremont Parkway, N. Y. City.
H. Stracks, 323 East 165th St., N. Y. City.
F. J. Bermert, 367 75th Street, Brooklyn, N. Y.

### NEW CORPORATIONS

Sol's Radio and Furniture Company, N. Y. City; $10.000. (Atty. S. Tullman, 1440 Broadway, N. Y. City).

Radio Art Corp., N. Y. City, 100 shares common. (Atty. A. J. Messing, 70 West 40th St., N. Y. City)

Brunswick Auto and Radio Supply Co., Bronx, N. Y. City; $25.000. (Atty. D. I. Auster, 175 5th Ave., N. Y. City.)

### A THOUGHT FOR THE WEEK

*WHERE'S the man who said that radio was a fad, that it would die out some night while we were asleep and who finally remarked that there wasn't much to the darned thing, anyway? Evidently he's joined forces with the chap who knew from the start that the automobile was a contraption of the devil and couldn't last and had a hazy impression that Einstein was a second-hand dealer in something or other. These gentry wabble along their spineless way, but science goes on forever.*

SIXTH YEAR

RADIO WORLD

*The First and Only National Radio Weekly*

Radio World's Slogan: "A radio set for every home."

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Paris, France: Brentano's, 8 Avenue de l'Opera

EDITOR, Roland Burke Hennessy
MANAGING EDITOR, Herman Bernard
ASSISTANT EDITOR, Lewis Winner
TECHNICAL EDITOR, J. E. Anderson
ART EDITOR, Anthony Sodaro
CONTRIBUTING EDITORS:
James H. Carroll, John Murray Barron and
Capt. Peter V. O'Rourke

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Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

# Synchronization
## *A Necessary Remedy for Whistles*

PEANUT whistles are fewer since the wavelengths were changed December 1, but there is still an abundance of them, and listeners easily could be educated to become total abstainers from whistle-hearing if given half a chance. The whole problem is not easy to solve at one sweep of the arm, but it is possible for stations operating on theoretically identical frequencies to synchronize. The fact that they are ordered to adhere to a given frequency—with 500 cycles tolerance, plus or minus—permits them to set up a beat note, even while obeying the order, so it is not surprising that disobedient ones cause worse growls and whistles.

A 500 cycle variation in opposite directions by two stations assigned to and legally operating on the "same" frequency may produce as nice a thousand-cycle note as any transformer curve runner would want to refrain from hearing. A station on a second harmonic of another station's fundamental may produce an electrical conspiracy the penalty for which is 2,000 cycles or no day in jail. Then there are all the frequencies between 30 and 2,000, which are possible and audible. This gives the spice of variety to the notes played by these good mixers. Synchronization is a station's adjustment to the identical frequency used by another station on the air at the same time on the same "assigned frequency." There is an actual difference, and the pitch of the beat note tells—all too often and too plainly—what that difference is.

Now as synchronization necessitates one station adjusting itself to the exact employed frequency of another, the question of doffing the hat comes up. "Now, just why should we trail that station every night like a prohibition agent?" says one station director, only 1,000 cycles off his wave. "Why doesn't the other fellow watch his wavemeter?"

The manager of the other station remarks: "There's no use of any listener logging that guy's station. You never can tell what wave he'll use one night to another. We're not going to play lady-in-waiting to that bunch."

So if the Federal Radio Commission would instruct stations to synchronize with others in the same channel, awarding the palm on the basis of standard frequency tests, the best-behaved could take things easy and the whistles would be fewer. As for those stations in the higher frequency belt, but lower plane, among which it would be hard to distinguish because so many are frequency-fickle, it would be a farce to make any one follow any other, and it is earnestly suggested that fervent prayers be offered beseeching that reform.

As for the better stations, occupying preferred waves, protect them by compelling simultaneous though distant channel-fellows to doff the hat.

### PHONES ON RUSSIAN TRAINS

Washington.

Passenger trains operating between Moscow and Leningrad in Russia, in the future will be equipped with radio telephones. It will then be possible for a passenger on such a train to call any telephone device in either city and talk with a subscriber.

# What Shall Be Done About Stations?

*What to do about congestion of the air is still as important a problem as ever. The Federal Radio Commission has declared in favor of the elimination of several hundred stations. Many listeners agree with this course despite its effect on established stations that have been regularly licensed, its blow to stations that some listeners like, and its throwing 1,500 or more people out of regular employment, not including performers. Here is a letter from one reader who favors elimination of stations. What do you think should be done? Write to Station Editor, RADIO WORLD, 145 West Forty-fifth Street, New York City.*

Editor RADIO WORLD:

Having read your article in December 17 issue relative to improvements made by the changing of wavelengths up to and including changes effective December 15th, I wish to express my personal opinion.

Your theory as well as the Radio Commission's may be correct, but when put to actual practice it is nothing short of a complete failure. On the map in this issue you show four channels which supposedly have been cleared. Let us take for example stations KFI, Los Angeles, and WRC, Washington. Difference of three hours and amount of power used are supposed to correct all heterodyning. This is not true.

Kansas City being approximately half way between enjoys neither program until one of them quits; nothing but squeals. Another example is KRLD and WRR at Dallas; KFNF, Shenandoah, and WCEA, Pittsburgh. Between the hours of 4 and 6 P. M. and sometimes later you cannot hear these stations to any satisfaction.

Should you have anything to say regarding any further changes, I am sure I voice the opinion of the listeners in this section in saying that elimination of about half the present number of stations will be the only solution.

We agree that the situation is greatly improved since taken in hand by the Radio Commission but urge that further action be taken to correct the situation above mentioned.

H. L. KENNEY,
4132 Tracy Ave.,
Kansas City, Mo.

# *They Say*

**JEROME H. LOUCHEIM, chairman of the Board, Columbia Broadcasting System:** "The other day I noticed a statement from an official high in radio broadcasting circles in which he said that 'the responsibility for better and more entertaining programs is entirely up to the listeners—what they want they will get.'

"To my mind, the responsibility rests with the broadcasters, not with the public. It's not so much what the public wants that counts. It's what have we got to give to the public which we know it will like!"

* * *

**BY GEORGE H. KILEY, vice-president, Farrand Manufacturing Co.**—"Programs announced for January 1928 by broadcasters in the United States represent an expenditure of money for artists in excess of the expenditures of all the other broadcasting stations in the world."

# A Set Builder's Narrative

*By Robert H. W. McCord*

I HAVE built 372 broadcast receivers and 47 short wave receivers, seventeen of the total for my own use, the other 402 for customers, as I am a professional set builder. As such I have a few problems—not many—and find business good. By using my skill as a set builder I have been able to support my family in better style and add nearly $3,000 to my income during the past sixteen months. My business has grown steadily. Besides I do some repair work, and this has contributed somewhat to the good-sized income I have derived from this calling which I unexpectedly entered.

At first I knew nothing about radio, although I was fascinated by its magic appeal. The joy of acquiring technical knowledge has been at its keen peak for me all the time, and I can say truthfully that now, with considerable knowledge to my credit, I am only the more eager to broaden and improve its scope. This knowledge was acquired largely from radio magazines, including RADIO WORLD, for which I have been a subscriber for three and a half years.

### Needs the Help

I find that a professional set builder needs the assistance and guidance of a weekly magazine like RADIO WORLD to keep pace with the fast-accumulating developments. For instance, although the shielded grid tube was announced only three months ago, and put on the market a month ago, already I have built six receivers utilizing this powerful amplifying valve, and my customers proudly exhibit and demonstrate their receivers, fearlessly comparing them with what are considered the finest standard sets.

I have had actual business dealings with 1,814 customers, by which I mean that number of persons actually paid me money for construction or repair work. My little shop is a rendezvous for radio fans who are technically inclined, including men and even a few girls who build their own sets, and who look to me for assistance. For such advice I charge a small fee. My theory, and it is a sound one, is not to work for nothing.

One object I have in setting forth my experiences is to encourage readers to become professional set builders, and in advocating this I would be rendering incomplete service if I did not include the warning that many folk look for free service which they have no right to expect, but which they will pay for if they find it necessary. In dealing with me they discover this necessity never disappears, as I pay my bills promptly, and discount them all, which I might not be able to do if I let people play fast and loose with my assets.

### Work Is a Pleasure

It is certainly gratifying to be able to spread so much happiness and appreciation over such a large clientele, and to teach the gospel that the custom-built set is a thing quite superior and individual.

Recently I brought this individuality to a fine point by constructing a model receiver, excellent for ordinary conditions of reception, and testing it out at a prospective customer's home to determine how much, if any, his location differed from the average. I was able to determine the selectivity requirements, how much amplification at radio frequencies was desired, due to appetite for distance, what kind of woodwork to use for the cabinet, what sort of panel to provide, what the nature of the controls should be, etc. Other points of individual taste were made the subject of inquiry.

After repeating this interrogatory at several homes I finally found it desirable to have a questionnaire printed. A prospective customer fills this out.

### What He Determines

I can therefore determine in advance just what is necessary so that the customer will be fully satisfied, and I have never met the complaint "no DX" since I resorted to the personal test of location as preparatory to the selection and construction of the circuit. This localization of requirements is impossible unless the builder is geographically close to the customer, which condition does not obtain where sets are built in quantity production.

One might think at first blush that a sensitive receiver with adequate audio amplification would be generally satisfactory to nearly all persons, but this is not true. One has to consider a great variety of tastes, desires and limitations, including financial restrictions. It is folly to sell a man anything that he cannot afford, so I avoid this scrupulously. Nor do I ever present the argument that the customer gets a receiver more cheaply by patronizing me. He does get a custom built set, one that will cost him more than a factory built set, yet one that will give him ever so much more. None of my customers is afraid to match his set in appearance or performance against the set of even the most boastful of his friends who comment with just praise on factory built receivers. For those to whom monetary economy is the outstanding consideration I suggest they make their own choice of factory built sets, but to the discriminating I offer my services, with the guarantee that the set will give them the performance and eye appeal they require.

Suppose a customer, who is a musician, wants a receiver that will reproduce the broadcast music faithfully and with fine volume. Suppose he has a Panatrope or an Orthophonic Victrola. I know at once that I must measure up to or exceed the tone quality of the phonograph music that he is used to, and that, even waiving these points, I would have to be very careful about tone, because my customer is a musician, and false notes will be discerned by him quickly. Do you think I am a bit afraid when I encounter such a "tough customer"?

Not in the slightest.

### Rule for Success

I know the value of by-pass condensers, the adequate capacities that are required for finest, smoothest filtration, and the heavy voltages that such condensers must withstand in a B supply that furnishes current for the receiver and for a stage of push-pull audio amplification feeding into two 210 tubes. I know my man is going to be satisfied—elated—for he is discriminating and, mark these words, so am I! Be just as discriminating as your customer wants you to be, or, better, be even a little more discriminating than he is likely to be, and you can be certain you will prosper.

And don't be afraid to tell him well in advance what the cost will be, and don't spend your money on his parts. Spend his money. That is a business precaution particularly applicable to professional set building. Under no circumstances violate it. If accessories or equipment, such as a speaker or a console, must be bought, buy them with his money, or let him buy them himself, otherwise you'll waste much time on collections that had better be spent on building.

### Who His Customers Are

My customers are a varied lot. A few are bank presidents and executives of commercial corporations or leading lawyers, doctors, etc. I find doctors particularly good customers. They favor the Super-Heterodyne, operated from a loop, often, if circumstances permit, with a power amplifier with a "big" tube or a pair of "big" tubes in the output. On the other hand, persons in modest circumstances, but with large desires in point of performance, may incline to the feedback circuits. The four-tube set is still popular, although in many quarters it is given little attention. Likewise it is still true that the average income in the United States is less than $50 per week, and not $250 a week, so that volume in the set building business is obtained by catering to the many, whereas the tendency of professional set builders is to cater to the few, because of the higher prices and better material that naturally follow.

I make sure to spread out my business so that I do not specialize in catering to any particular price class, but can produce a good receiver that will afford advantages over more generally procurable sets, at only a little higher price, but with much greater performance, dependability and longer life. I do all I can to produce long-lived receivers, B supplies, audio amplifiers, etc.

### Feels Different

You know, a man feels quite different in obtaining a receiver from me because he tells me in advance, often without quite realizing it, just what he wants, and I have trained myself so that I am able to give him that plus a little extra to boot.

I do not look for much repeat business from the same person, but do get a lot of business because of the recommendations of satisfied customers.

### A Hope and an Appeal

It is my expectation that more of the readers of radio magazines that feature parts will take up the work, or enlarge their present work, of professional set building. Those already doing such work are numerous. I myself have a list of several thousand of them, obtained from parts manufacturers.

The field is getting larger and larger and is becoming more and more important in the sale of radio parts, as well as requiring discussion of topics and problems of mutual interest and concern to professional set builders the country over. Experiences well might be exchanged.

It is my fond hope that an organization of such custom-set builders be formed. I am eager indeed to help. I believe others would like to fall in with the plan by joining the organization without obligation. I am willing to start it if I can be convinced of co-operation from fellow custom-set builders.

I therefore ask all who are interested in becoming or uniting custom set builders to write me, and if enough interest is shown I will publish the names and addresses of these members in RADIO WORLD for their own benefit and for the benefit of those who desire to patronize them. Please address me as follows: Robert H. W. McCord, care RADIO WORLD, 145 West 45th Street, New York City.

# Good Back Numbers of RADIO WORLD

**The following illustrated articles have appeared in back issues of RADIO WORLD in 1927.**

**MAY 21.**—Part I of a three-part article on the Victoreen Portable receiver, by Capt. P. V. O'Rourke. Data on the new Raytheon cartridge.

**MAY 28.**—A three-tube reflex, using a special low pass filter system, by Edgar B. Francis. Part II on the Victoreen portable receiver with layout data, by Capt. P. V. O'Rourke.

**JUNE 4.**—Part III of a three-part article on how to construct an efficient portable Victoreen Super-Heterodyne, by Capt. P. V. O'Rourke. A complete discussion on the RCA AC tubes.

**JUNE 18.**—The six-tube Equamatic, a neutralized two-stage tuned RF, three-stage AF resistance coupled set, by Herbert E. Hayden. How to get the low notes with transformer or impedance AF, by Dennis J. O'Flaherty.

**JUNE 25.**—The Lindbergh Plane Speaker, an excellent cone type reproducer, by Herbert E. Hayden. A tube and set tester, by Herman Bernard.

**JULY 2.**—The Planofier 7, single control super-sensitive set using resistance AF by R. F. Goodwin and S. S. Bruno. Discussion on the new Freshman Equaphase, by Robert Sagala. Data on the six types of units used for loud speaker operation, by J. E. Andersen.

**JULY 9.**—How to build a DC A supply where the line voltage is 220 or 240, by Frank Logan. Important data on RF choke coils, by Horatio W. Lamson.

**JULY 16.**—How to use a voltmeter as a milliammeter, by D. Barretti. How to build a 4-tube, 2-control regenerative portable set.

**JULY 23.**—Building a 7-tube Super for your auto, using Victoreen IFT, by John F. Rider (Part I). How to build a 6-tube neutralized set, using three tuned RF, two transformer AF, by John F. Rider. Inside dope on motorboating, by J. E. Anderson.

**JULY 30.**—A 5-tube standard TRF set adapted to AC operation by the use of the QRS 400 mill rectifier tube, with the aid of series filament connections, by RF Goodwin and S. S. Bruno. Shielding the 11-tube Melo-Heald Super-Heterodyne receiver, by Clifford Denton. Part II of the two part article on the Super in the auto by John F. Rider. How to control volume in AC sets by D. Ferrup.

**AUG. 6.**—A three-tube regenerative portable with portion of the cabinet as the speaker, by M. J. O'Reilly. The Cashbox Unitune, an ingeniously contrived four-tube quality receiver by Wendell Buck. How to use AC tubes by C. T. Burke.

**AUG. 13.**—Hints on constructing a portable set, by Herbert E. Hayden. A seven-tube, two-control AC operated receiver by Capt. P. V. O'Rourke. Obtaining the C bias in an ABC unit, using the BA Raytheon 85 mill tube.

**AUG. 20.**—The Four AC, a four-tube regenerative set employing AC tubes. Tim Turkey's argument on why rheostats should not be used as volume controls. The Drum Powertone, a five-tube single control set, using resistance coupled audio.

**AUG. 27.**—Part 1 of a four part article on building the 1-Dial Witz, a single control, voluminous selective 5-tube set, by A. Irving Witz. A detailed explanation of the exponential type of horn by H. B. Herman. Details on the revolutionary Reisz condenser type of speaker. Constructional data on a special 5-tube, 2-dial regenerative set, with three stages of AF, by Tim Turkey.

**SEPT. 3.**—Part I of a four-part discussion on the new 1928 Victoreen Universal, a super-sensitive 8-tube Super-Heterodyne, by Capt. P. V. O'Rourke. Complete data on the three types of phonograph pickups, by J. E. Anderson. Part II of the 1-dial Witz, wiring hints emphasized.

**SEPT. 10.**—The Puratone AC set, a 6-tube duo-control receiver, using AC tubes, by R. F. Goodwin and S. S. Bruno. Part II of the 1928 Victoreen Universal, discussing the placement of parts. Part III of the 1-Dial Witz on the special placement of the coils.

**Any Copy 15c. Any 7 copies, $1.00 All these 16 copies for $2.00, or start subscription with any issue. Any 8 of these numbers sent as premium with NEW yearly subscription. No other premiums allowed. RADIO WORLD, 145 West 45th St., New York City.**

# The Shielded Grid Six

(*Continued from page 5*)

In the A, B, and C RF amplifier sections a 4¼ inch length of wire should be allowed to extend from terminal 3 of each coil socket, and to the far end of this wire should be fastened one of the three small clips accompanying the kit, these clips to be fastened to the top terminals of the UX222 shielded grid amplifier tubes. Terminal 6 of the three RF coil sockets should connect to a lug held between the nearest mounting screw and the hollow collar holding the coil socket above the shield, thus grounding this terminal to the metal receiver assembly. Three bus-bar leads are used in the receiver.

One is soldered to the plus 135 binding post lug of the terminal strip and carried straight across the chassis for a distance of 13 inches. To it at various points are soldered the leads from post 5 of the B, C and D coil sockets and from other portions of the circuit.

Another lead soldered to the 2 plus lug of the terminal strip is carried directly across the chassis for a distance of 14½ inches, and to this wire at various points are soldered the flexible hook-up wire leads from the 2 plus posts of all tube sockets. A third bus-bar lead soldered to the plus 45 lug of the terminal strip is carrier to the rear for 3 inches and then down the chassis for 15 inches, and to it at various points are soldered all plus 45 cir-



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cuit leads of flexible hook-up wire with as short connections as possible from terminal C of the 3 RF tube sockets to this bus line. The rear bypass condenser, which has one lug grounded to the chassis by means of a short wire, has its other lug soldered to this plus 45 bus.

The lead from post P of tube sockets A, B, and C should be a little longer than necessary and should terminate in a lug so cut that it may be slipped under terminals screws 1, 2 and 4 of the B, C and D coil sockets respectively to regulate selectivity.

The antenna and ground system may consist of a ground lead terminated in a ground clamp on a well scraped water, gas or steam pipe. The antenna may be a bedspring for medium range reception, or a 30 to 60 foot indoor or outdoor antenna, preferably the latter.

### Preliminary Testing of Set

Connect the antenna and ground leads to the antenna and ground binding posts upon the terminal strip. Connect the A battery to the A BAT post upon the terminal strip, using the two heaviest wires in the Belden battery cable. Connect the red, or plus, terminal of the battery to the PLUS A post of the receiver. Connect the black, or negative, post of the battery to the A MINUS post of the receiver. Insert all tubes in sockets, turn rheostat to left, and turn on ON-OFF switch. The detector and audio amplifier tubes should light to a cherry red if UX 112A tubes are used. The volume control rheostat should be turned to the right gradually and, when all to the right, the filaments of the UX222 tubes should glow with a bright yellowish color. All tubes should extinguish with the ON-OFF switch tuned to the off position. Remove the A plus lead and connect successively to all remaining battery posts upon the terminal strip.

In any of these positions the tubes should not light and should only light with the A battery properly connected.

Should the tubes light with any other connections, the receiver wiring is at fault and should be carefully checked. The 4½ volt C battery should have its plus lead connected to the black, or negative, lead of the A power unit. Its minus three lead should connect to the minus three binding post of the terminal strip.

The second higher voltage C battery for the last audio amplifier stage should preferably be of about 15 volts value when using a UX112A on 180 volts—an extremely satisfactory operating value for this tube. The plus lead of the C battery should connect to the C-AMP post of the terminal strip. If B batteries are used, they should first connect with the minus lead to the black, or negative, post of the storage battery, and the plus lead to the plus 45 post of the receiver. The second and third batteries should be connected in series, that is, plus to minus and the free minus post of one connected to the plus 45 post of the receiver.

The free plus post of the second should connect to the plus 135 post of the receiver. The fourth battery should have its minus post connected to the plus 135 post of the receiver, and its plus post to the PLUS AMP post of the receiver.



## *Radio World's* CLASSIFIED ADS *for Quick Action*

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**EVERY FRIDAY** evening, beginning at 5:40 P. M., a ten-minute talk on radio topics is delivered by Herman Bernard, managing editor of *Radio World*, from WGBS, the Gimbel Bros. station, New York. Listen in.

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**PIPE SMOKERS**, why be bothered with your pipe plugging, when for 10 cents you can prevent it? My pipe filter fits any pipe; use any tobacco. LUTTS SPECIALTY CO., Norwalk, Ohio.

**EDISON "A" BATTERIES**—Three-cell, 20-ampere-hour; in neat metal cases. Price, $3.50 each; ten or more, $3.00 each. Cash with order. Department "B," 25 East South Street, Indianapolis, Indiana.

**HOW TO BUILD RADIO WORLD'S** Four-Tube Universal Receiver fully described by Herman Bernard in the March 12, 19 and 26 issues of RADIO WORLD. Send 45c. RADIO WORLD 145 West 45th St., N. Y. C.

# The Big Thrill of DX, and at very Small Cost to You

Everybody who owns a radio set likes to tune in far-distant stations now and then because not only is there a thrill in hearing a voice or instrument thousands of miles away but one verifies the fact that he has a powerful receiver and that it is in good condition, if it is able to pick up these weak signals. Now that the broadcasting stations are more suitably distributed as to wavelength or frequency, fans are in a better position to tune in distance. Besides, the weather is in their favor these days. But what kind of a set shall be used? You know very well that if the set can tune in distance once in a while, you can develop sufficient skill to make it tune in far-distant stations very often, virtually every night. Then when you have visitors you need not boast about the DX qualities of your set but simply tune the receiver and let them listen to stations thousands of miles away. You must be sure to have a receiver capable of responding to your distance-getting desires. You also want this set to have delightful tone quality, so that your own critical ears cannot detect even a single flaw in the reproduction. Indeed, even music lovers who may be guests at your home will comment admiringly upon the bewitching tone of your receiver. Then you know you have something real. The ability to get distance and to reproduce the original music without distortion depends largely on the circuit design, and you will find that the Diamond of the Air, either the 4-tube or the 5-tube model, will live up to your highest expectations. How are you going to know which to build? Carefully inspect the textual data as well as the blueprints that fully expound the theory, operation, characteristics and amplification of these two outstanding receivers that differ principally in the type of audio amplification.

## The 5-Tube Diamond

Can be constructed in a couple of hours. The authorized blueprints that make this speed and efficiency possible are just off the press and will be shipped at once, together with the new booklet of full textual exposition of construction, including the winding of coils, how to connect terminals, what values of condensers and resistors to use, etc. The receiver consists of a stage of tuned radio frequency amplification, a specially sensitized detector, first stage of transformer audio and next two stages of resistance audio. It is easily adapted to playing phonograph records through the set and on your speaker. Get acquainted with this new delight.

## The 4-Tube Diamond

represents the most that is obtainable from four tubes. A stage of tuned radio frequency amplification, a specially sensitized detector and two stages of transformer coupled audio. Follow the blueprint to amazing success. Build the set from parts you have. Full instructions cover utilization of such apparatus. Thousands are eager to build an economical set of surpassing performance and amazing achievement and this one is the most economical, the most scientific, and the least expensive in cost of parts and upkeep. Works splendidly from batteries, either type 99 or type 1A tubes, and can be used with A and B eliminators, power packs, etc., with great success.

## Look over both of these

blueprints and read the text in both cases before choosing the receiver you are to build.

**Guaranty Radio Goods Co.**
**145 West 45th Street, New York City**

Please send me one newly-printed official blueprint of the 5-tube Diamond of the Air, one newly printed official blueprint of the 4-tube Diamond, and the textual data giving full directions for constructing these sets. Enclosed please find 50 cents to defray all expense.

Name .....

Address .....

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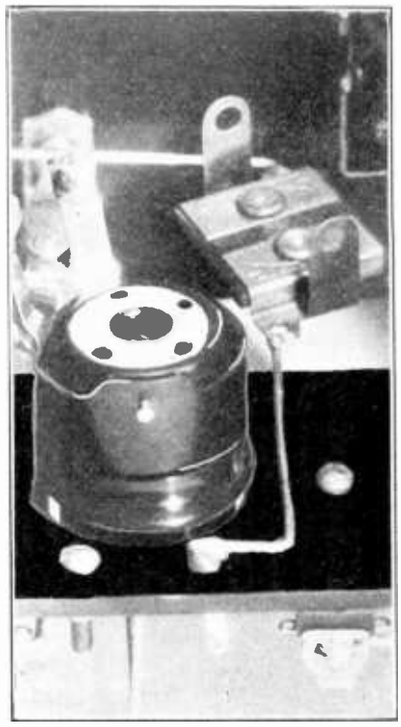
## Avoid Microphonism

It is very important that the grid condenser be mounted securely, not as shown in the photograph at right. When it is mounted in this flimsy way, the familiar microphonic howl will result, due to the constant vibration of the grid lead.



A VERY POOR WAY TO MOUNT A GRID CONDENSER



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## Muter Representative Is Host at Banquet

A very pleasant banquet was given recently by the Leslie F. Muter Company of Chicago to a gathering at the Hotel McAlpin, New York City. A very fine dinner was served, with all the incidentals, and Edward J. Beckley, the well-known Muter representative for this territory, acted as host. Among the radio luminaries present were E. Julian, president and treasurer of Radio Kit Co.; Blan, the radio man, the linguistic radio dealer of East 42nd street; Fred H. Ehlert, of the New York "Sun" Radio Section and creator of the "Everyman 4"; E. B. Moore, vice-president and secretary of Radio Kit Co.; Mr. Lasser of City Radio Co., Newark; Harry Geibe, of Geibe, Tremont avenue; Harvey Sampson, proprietor of Harvey's Radio Store, 43rd street and Sixth avenue, and Mr. Bogan of Stuyvesant Electric.

The remarkable success of the "Everyman 4," which is going even stronger than ever, was a point of discussion, and Beckley, of Muter, and Moore and Julian, of Radio Kit Co., received a standing vote of thanks for their efforts.—J. H. C.

## Polymet Officials Sail On European Trip

On the "New Yorker," which sailed recently, were Otto Paschkes and Nat C. Greene, president and vice-president respectively of the Polymet Mfg. Corporation.

With the increasing popularity of radio in Europe and the opening of several new high-powered broadcasting stations, Messrs. Greene and Paschkes envision a big market for the sale of Polymet radio essentials. They will study the European situation so as to be in a position to extend to European manufacturers and distributors the same standards of quality and service for which the Polymet organization is well known in this country.

Messrs. Greene and Paschkes will remain abroad about two months and after completing their business the balance of the time will be spent in traveling and enjoying the well-earned vacation.







### AEROVOX EXPANDS FOR 1928 BUSINESS

S. I. Cole, the energetic president of the Aerovox Wireless Corporation, 72 Washington Street, Brooklyn, N. Y., makes announcement that so rapid is the growth of this concern, that it has acquired the entire equipment of the Globe Art Manufacturing Company of Newark, N. J., to keep up with orders. The addition of this plant to the already immense establishment of the Aerovox Co. greatly augments their manufacturing facilities. This expansion follows the leasing of additional floor space at 72 Washington Street by the Aerovox Corporation, where they are operating three shifts a day.—J. H. C.

### TRANSFORMER RATIOS

Low ratio transformers have more turns on the primary than the high ratio type.



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