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RADIO WORLD

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The First and Only National Radio Weekly

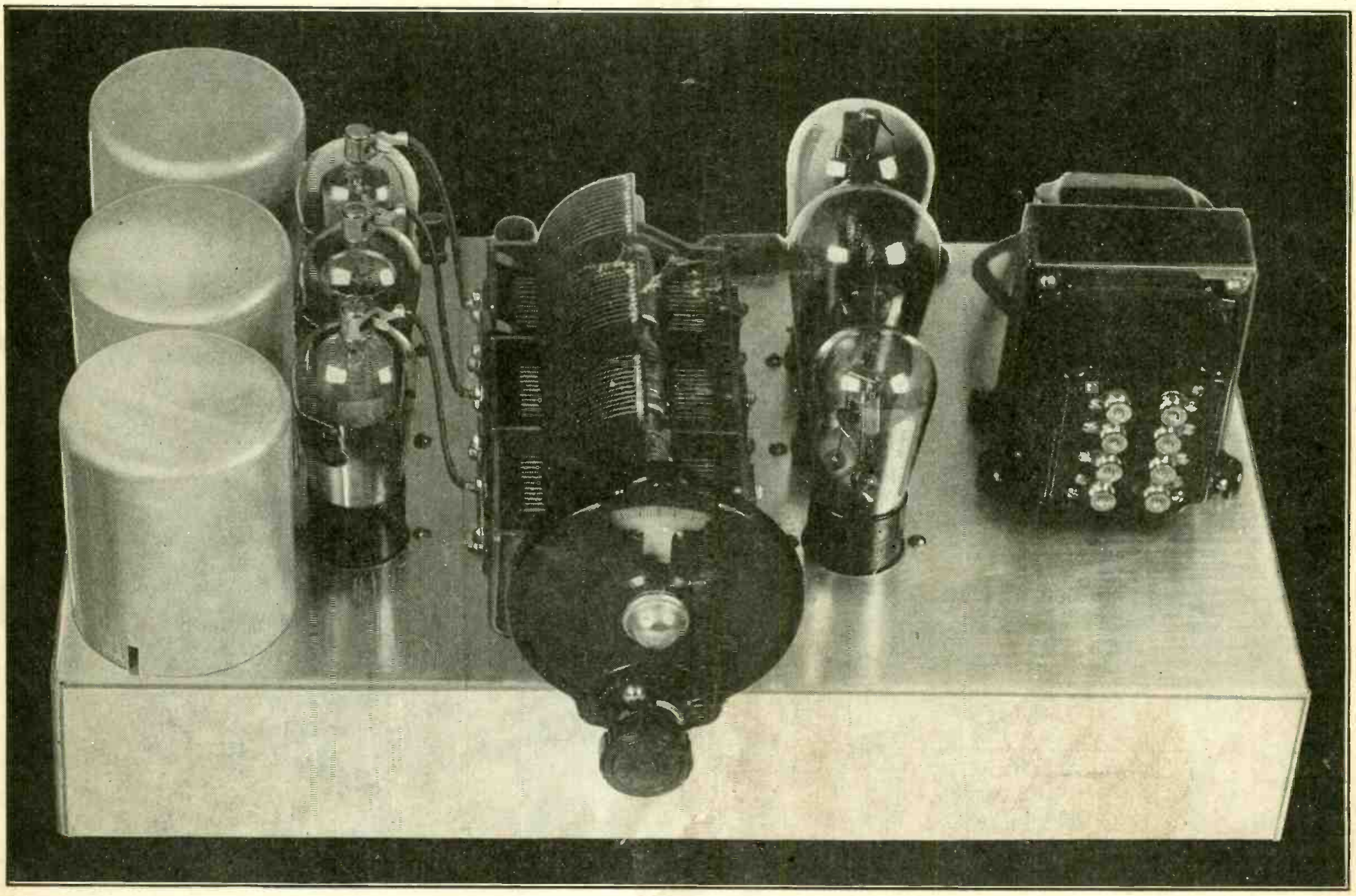
476th Consecutive Issue—TENTH YEAR

237 Automotive Tube Analyzed

Oscillators for Testing Intermediates

Midget B Supply

THE PENTODE DIAMOND



Three tuned circuits afford sufficient selectivity, using two variable mu tubes as radio frequency amplifiers in the Pentode Diamond, which has a 247 output tube. See article on pages 3, 4, 5.

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Latest Circuits and News

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The Pentode Diamond

Two New Tubes, 235 and 247, Are Featured in DX Set

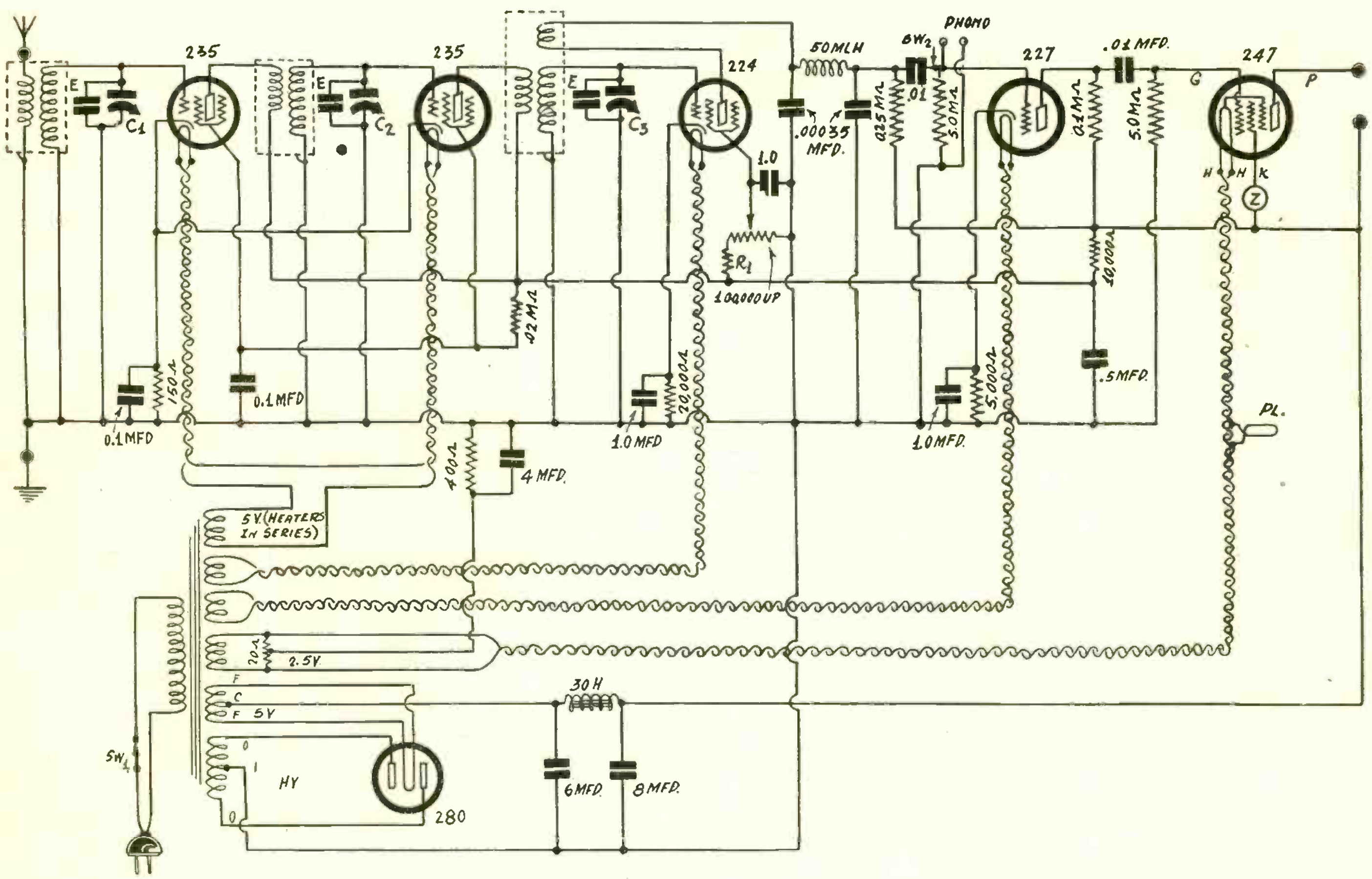


FIG. 1
Two new tube types are used in the Pentode Diamond. They are the 235 (or G-51) variable mu tube and the 247 pentode power tube. More selectivity, less interference and greater volume result.

A CIRCUIT containing "all the latest tubes" would afford a fine catch-phrase, but new tubes have been raining in on us, and of different filament or heater voltage requirements, so it is hardly practical to incorporate "all the latest tubes," in one circuit. However, a circuit with some of the newest tubes is practical, and here it is (Fig. 1), the Pentode Diamond.

The output tube is the new power pentode, 247, while the two radio frequency amplifiers are the screen grid variable mu tubes, either the 235 or the G-51, these two designations representing tubes of somewhat different characteristics, but to the same general intent.

One of the first points any one will notice who has been following recent circuit designs is the absence of the doubly tuned circuit ahead of the first tube. This twice-tuned adjunct was introduced by many designers as a means of minimizing cross-modulation, but as the variable mu tube accomplishes this to capably, the double utning method may be eliminated, and also such makeshifts as local-distance switch and dual or compound volume controls. The defects they sought to remedy are taken care of by the variable mu tubes.

These new tubes actually improve the selectivity, and they improve it most when the improvement is most needed, that is, on the strongest signals. That is how the variable mu comes in. The function of the tube is such that it is as effective as a chain of tubes of various amplification factors, with the highest mu tube cut in when the signal is weakest and the lowest mu tube when the signal is strongest.

By this process of variation of amplification factor or mu inversely with the signal strength, the tube remains exclusively an amplifier, and does not become a stray detector, as does the 224 tube, by what may be called detection by shock excitation. Since it is exclusively an amplifier, the variable mu tube will not do as a detector, so a 224 tube is used as detector, being the most suitable for a resistive plate load.

(*Continued on next page*)

How to Connect and Use

25 Times as Much Volume as Co

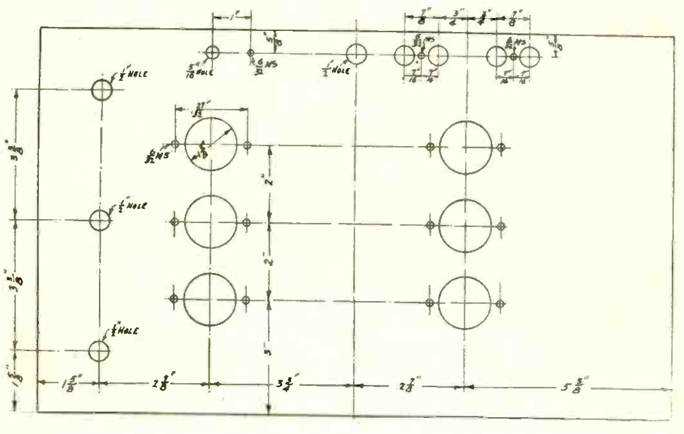


FIG. 2
The chassis top, diagrammed herewith, is 16 inches wide by 10 inches front to back, with 3 1/16 inch flap all around. The 1/2 inch holes at left are for leads from the three shielded coils.

(*Continued from preceding page*)
The detector circuit may be sensitized, as diagrammed, by variation of the voltage applied to the screen. The variation is so great that the signal may be cut off entirely, hence this same sensitivity control serves also as a volume control. In other systems, where the sensitivity control does not come anywhere near killing off the signal, two controls must be used, one for sensitivity, the other for volume. It is handy and desirable to combine the two functions in one, and it may be done even with a pre-selected low-volume for one extreme setting.

The Limiting Resistor R1

It is suggested that the combined sensitivity-volume control be a potentiometer of 100,000 ohms resistance or more, so that the bleeder current through the potentiometer, and the small detector screen current, will have negligible effect on the plate voltage on the two radio frequency tubes. The bleeder through the potentiometer comes through the 10,000 ohm resistor in the maximum B plus lead, eventually to grounded B minus.

The actual resistance will be more than the potentiometer's total resistance, because a limiting resistor, R1, is included. The value of this limiting device will depend on the preference of the constructor for minimum volume level. Some will not want to be able completely to cut off the signal with the volume control, but will want to adjust the range of the control itself, so that when the potentiometer arm is at minimum setting there will be a certain strength of signal from the loudest local, and R1 will accomplish this.

The inclusion of the limiting resistor in part takes care of difference in tapers, or rates of resistance change, by offering a compensating device that fixes what may be regarded as the minimum volume of the potentiometer setting, on the strongest local. It is suggested that .02 meg. (20,000 ohms), be tried here, if the potentiometer itself has a total resistance of 100,000 ohms or more, or, whatever the value of the potentiometer, that the limiting resistor be no less than one-fifth the value of the other.

The Audio Circuit

The variable mu tubes as radio frequency amplifiers, with only three tuned circuits required for all-sufficient selectivity, constitute the new feature of the radio frequency side of the circuit.

On the audio side we have two stages of resistance coupled amplification, used in such a way that the gain will be excellent, and the quality second to none. The quality is good enough to work television with a short-wave converter or receiver.

It is even practical to omit the intermediate stage of audio amplification, which incorporates the 227 tube, because loudspeaker operation of locals will be sufficiently loud, but the stage is included so that distant stations will come in with much volume (subject to easy control), and also that short-wave converters may be worked with this receiver with good audibility even on European, Asiatic and other foreign signals.

This high volume, previously denied to two stages of resistance coupling, results from the inclusion of the new pentode output tube, which has an amplification factor of 95, as compared with an amplification factor of a little less than 4 (normally, 3½) for the 245 tube that it replaces.

Twenty-five Times as Loud

So the volume output from a given signal input is about twenty-five times as great, with the new pentode, as compared with the 245. An actual gain of 25 per stage of audio is fairly high, so that explains why a stage of audio otherwise required for a satisfactory volume may be omitted. Here the omission results in a two-stage channel where otherwise a three-stage channel would be required.

The pentode is different from any other output tube also in the fact that it has five base prongs (for UY socket). It is a screen grid tube, but without any grid cap on top. The extra element, or screen, is brought out to a prong in the tube used in other hookups for other tubes as the cathode. That is, where you would connect for cathode of a 227, 224 or 235 tube, you now would connect for the screen of the pentode.

The screen (K prong) takes 250 volts, the same as the voltage applied to the load on the plate of the tube. But 250 volts is the absolute maximum for the screen, even though for some reason higher voltage than 250 volts is applied to the plate.

Explanation of "Z"

The letter "Z" in a circle (Fig. 1) represents a resistance that may be used in the event the output device in the loudspeaker, or the magnet windings of the speaker itself, have an appreciable DC resistance. In that event the voltage on the plate of the pentode would be less than the applied voltage by an appreciable amount.

Suppose the DC resistance were 800 ohms. Then the drop would be about 25.6 volts, and then the effective plate voltage, if 250 were applied, would be only 224.4 volts, and the screen voltage then should be no higher. A resistance should then be included to reduce the effective screen voltage to the effective plate voltage.

If the resistance of the plate load is high, then introduce a resistor in the screen circuit that has four times as much resistance as the other, or, if you have an accurate voltmeter (resistance, 1,000 ohms or more per volt), you can make the adjustment by actual measurement of the voltage. Also, with accurate meters you can determine the DC resistance of the plate load by measuring the voltage drop across the plate load impedance and measuring the plate current, computing the resistance (which is the voltage in volts divided by the current in amperes).

In most instances, however, the DC resistance of the primary of an output transformer serving dynamic speakers will be found to be considerably smaller than the 800 ohms specified, and no account need be paid to the situation if the difference in voltages is only 10 volts or so.

When the Plate Voltage Is Excessive

It was suggested in the foregoing that the plate voltage may be higher than 250 volts for some reason, and the reason is that nearly all power transformers built for the 245 tube provided an output voltage of 300 volts DC at some specified drain, say, 80 milliamperes, which would be apportioned, 50 volts for negative bias of the power tube, and 250 volts for application to the plate load.

The new pentode, however, requires a negative bias of only 16½ volts, and if this amount were apportioned for bias, there would be 33½ volts more in the plate circuit, or a total of 283½ volts. This is not so serious, but the rule regarding equality of the two voltages, for screen and plate of the pentode, would not apply, and we would not under any circumstances use more than 250 volts on the screen. The difference might be taken up by an additional resistor in the plate circuit of the pentode, of 1,000 ohms, or, to bring the DC output of the rectifier down to 226½ volts a resistor may be put in series with the high voltage lead from the rectifier itself.

Socket Connections Recapitulated

The control grid connection for the output pentode goes to the G spring of the socket, the screen grid connection to the K spring otherwise used for cathode, the filament connections correspond to heater connections, while plate connection is standard.

The fact that the filament has a screen at center, inside the tube, need cause no concern, since no external connection is affected thereby.

The biasing resistor required for the pentode at the recommended voltages, 2.5 filament, 250 plate, 250 screen, and minus

the New Power Pentode

mpared with Use of 245 Output

16½ control grid, would be 418 ohms, but the nearest commercial value is 400 ohms, so that is selected. If you have a resistor of 450 ohms you may use that, particularly if you are to use a filament transformer intended for the 245 tube (300 volt DC output) instead of the 266½ required for the output pentode.

The plate resistance is 38,000 ohms, which is pretty high, compared with other power tubes.

The power transformer diagrammed shows the connections for the particular make used in building the laboratory set, but if you have another kind of power transformer, all you need do is follow the usual connections for that, rather than abide by the transformer circuit as shown in Fig. 1.

However, high capacity should be used in the rectifier, together with a good-sized choke, to assure excellent filtration.

Identification of Condensers

The condenser block used in the laboratory model had two sections of high capacity, one 6 mfd., the other 8 mfd., and also had two 0.1 mfd. capacities and one 0.5 mfd. These smaller capacities were used for bypassing the biasing resistor of the first radio frequency tube, the screens of the two radio frequency tubes, and the 10,000 ohm resistor that reduces the maximum voltage to the desired plate voltage for the radio frequency tubes. The three 1.0 mfd. bypass condensers and the 4 mfd. bypass condenser (this one an electrolytic) are separate units.

Mounting of Parts

The tuning condenser is mounted flat on the chassis top, at right angles to the front panel, so that a flat type dial is required. To the left of the condenser (Fig. 2) are the tuner sockets, back to front, first and second radio frequency amplifiers and detector. To the left of the sockets are the shields that contain the coils. Rubber grommets are put in the three ½-inch holes and coil leads passed through the grommets. The grid clips to caps of the three tuner tubes are at the end of leads that run from the tuning condenser. The trimmer condensers are mounted with their lugs bent to a right angle, to afford easy access from the top. To mount thus it may be necessary to snip off the extension screws on the condensér.

The 5/16-inch hole at left rear is for a fibre washer, so the antenna binding post will be insulated. The adjoining hole is for the conductive ground post connection. The center rear ½-inch hole is for a larger insulator for the phonograph switch. The paired holes at right rear are for the "phono" and "speaker" twin binding post assemblies.

At right the sockets, front to back, are first and second audio and rectifier. To the right of this line of sockets goes the centered power transformer, underneath which is mounted the B supply choke, using flat-head screws. The other large part underneath is the condenser block, consisting of five capacities in one case. The black lead is common and goes to grounded B minus (chassis). White is the 6 mfd. connection, orange is 8 mfd., the two maroon leads are 0.1 mfd. each, while green is 0.5 mfd. A mounting bracket is built into the condenser case, which has an aluminum finish.

The metal chassis is 16½ inches wide, 10 inches front to back, and has a flap all around 3 1/16 inches high.

[Other Illustration on Front Cover.]

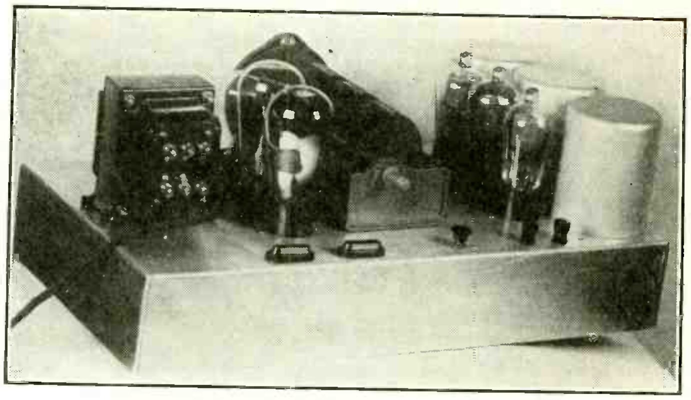


FIG. 3
Rear view of the Pentode Diamond assembly.

LIST OF PARTS

Coils

One shielded antenna transformer, 15-92.
One shielded screen grid transformer, 25-92.
One shielded three-circuit transformer, 25-92-20.
One power transformer.
One 50 millihenry copper shielded radio frequency choke coil.
One 30-henry B supply choke.

Condensers

One three-gang .00046 mfd. condenser with brass plates and ¼-inch reducing coupler.
Three 100 mmfd. equalizing condensers (E).
Two .00035 mfd. fixed condensers.
Two .01 mfd. fixed condensers.
Three 1.0 mfd. bypass condensers.
One 4.0 mfd. electrolytic condenser, with bracket.
One condenser block, consisting of 6, 8, 0.1, 0.1 and 0.5 mfd., 350 volts DC continuous duty rating.

Resistors

One 150-ohm flexible biasing resistor.
Three .02 meg. (20,000 ohm) pigtail resistors (one used as R1 with potentiometer).
One potentiometer, 100,000 ohms or more (insulate from chassis).
One 0.25 meg. pigtail resistor.
One 0.1 meg. pigtail resistor.
Two 5.0 meg. pigtail resistors.
One 10,000 ohm resistor, 5 watts
One 5,000 ohm biasing resistor.
One 400 ohm resistor, 5 watts.
One 20 ohm center-tapped resistor.

Other Parts

One flat type dial with pilot lamp and bracket.
One 16½ x 10 x 3 1/16 inch metal chassis, with principal holes drilled.
Six rubber grommets.
One antenna binding post with small fibre insulator and flat insulating washer.
One ground binding post.
One phonograph switch (S2) with two large fibre insulators.
One AC shaft type switch (SW1).
Two knobs.
Five UY sockets and one UX socket.
One "phono" twin binding post assembly.
One "speaker" twin binding post assembly.
One roll of hook-up wire.
Two feet of shielded wire to run to caps of screen grid tubes.
Two dozen 6/32 round head machine screws and two dozen nuts.
Four 6/32 flat-head machine screws, four nuts.
Three grid clips.

Frequencies to Be Used by Wilkins on Nautilus

The re-christened and remodelled submarine Nautilus, which Sir Hubert Wilkins intends to use on his trip under the Arctic ice, will be equipped with short-wave radio apparatus.

The call letters, as given in the United States Radio Service Bulletin, are K 7XI—(Trans-Arctic Submarine Expedition, Inc.) The frequencies to be used are: 6,100; 9,530; 11,710; 15,160 and 17,780 Kilocycles. These correspond to wavelengths as expressed in meters, as follows: 49.18; 31.48; 25.62; 19.79 and 16.87.

There will be a vast army of amateur radio operators and other listeners using short-wave receiving sets on the hear-out for signals from the Nautilus.

Radio Warning System To Prevent Plane Collision

The Bureau of Standards is working on a radio warning system to avoid the possibility of a collision between airplanes in flight during bad weather.

The idea is a high frequency transmission of low power, with a receiving set on the plane as well. As two planes approach, the signals will become strong and both pilots manoeuver to reduce the intensity, thus avoiding collision or any possibility of a collision. The antennas used are directional. This method is in the experimental stage at present, but is evidently in line with a future need, in the increased use of the airways of our country.

Characteristic Curves of

Output Tube, Worked at 6.3 Volts on Heater, Typif

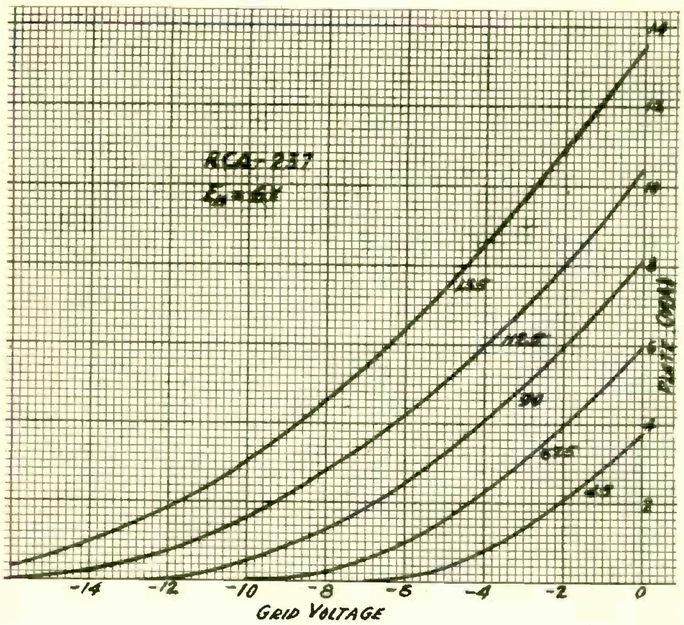


FIG. 1

Five grid voltage, plate current curves for a particular RCA-237 tube for five different plate voltages as indicated. The heater voltage was maintained at 6 volts.

LAST week we gave curves for a sample RCA-236 tube, both with no load resistance in the plate circuit and with a load of 100,000 ohms. Herewith we present plate current, grid voltage curves for a sample RCA-237 tube for plate voltage from 45 to 135 volts in steps of 22.5 volts. The tube in question is an experimental one and should not be regarded as an average of the type.

With 135 volts in the plate circuit the grid bias should be minus 9 volts for a typical tube of this type. At this bias the plate current should be 4.5 milliamperes, but the curve shows a current of 3.75 milliamperes. We suspect that this sample tube has an amplification factor greater than 9 so that the current drops more rapidly as the bias is increased. Let us see whether we can obtain the amplification factor for this sample tube.

The amplification factor is defined as the ratio of the change in plate voltage to the change in the grid voltage that produces the change when the current in the plate circuit is the same in the two cases. It should not make any difference what the plate voltage or the plate current is since the amplification factor is a geometrical property of the tube.

Computation of Amplification Factor

Let the change in the plate voltage be from 45 to 67.5 volts and let us take the current 3.2 milliamperes. On the 45 volt curve we note that the grid bias is 0.6 volt when the current is 3.2 milliamperes. On the 67.5 volt curve we note that the grid bias is 2.85 volts. Hence for a change of 22.5 volts in the plate voltage we have to change the grid bias by 2.25 volts to maintain the current at 3.2 milliamperes. Therefore the amplification factor is exactly 10.

Let us try again. Take the current 2.75 milliamperes. At 45 volts in the plate circuit this current is given at zero bias. On the 67.5 volt curve the current is 2.75 at 2.2 volts. Hence in this case the amplification factor is 22.5/2.2, or 10.2. The difference is well within experimental error. Now let us determine the amplification factor between 90 and 135 volts and let us take the current 8.2 milliamperes. On the 90 volt curve we find this current at zero bias and on the 135 volt curve we find it at 4.3 volts. Therefore the amplification factor is 45/4.3, or 10.45. Again is is well within the accuracy of the experiment. We are safe to conclude that the amplification factor of the tube is 10 or slightly greater than that.

Mutual Conductance

The mutual conductance of the tube can also be determined from the curves. This varies with the grid bias and the plate voltage. The tube is listed as having a mutual conductance of 900 micromhos at 135 volts in the plate and 9 volts on the grid. Now the mutual conductance is defined as the change in the plate current for a change of one volt in the grid bias.

At 10 volt bias the current on the 135 volt curve is 3.05 milliamperes. At 8 volt bias the current is 4.55 milliamperes. Therefore a change in the grid bias of 2 volts changes the plate current by 1.5 milliamperes and therefore one volt will change it .750 milliamperes. Therefore the mutual conductance is 750 micromhos. It is less than the listed value but that was to be expected since the amplification factor was found to be greater.

It would seem that the best operating bias for this sample tube is 6 volts. Let us find the mutual conductance there. At 5 volts the current is 7.45 milliamperes and at 7 volts it is 5.45 milliamperes. Hence a change of two volts in the grid voltage changes the plate current 2 milliamperes. One volt, therefore, changes it 1 milliampere and the mutual conductance is 1,000 micromhos. It would be still greater if we took it at a lower bias for the curves become steeper as the bias is reduced, and the mutual conductance is the slope of the curves.

With 90 volts in the plate circuit the tube is supposed to be operated with a bias of 6 volts and the plate current is supposed to be 2.7 milliamperes. The curve gives a current of 2.5 milliamperes. The mutual conductance at this point is supposed to be 780 micromhos. Let us check it for this sample tube. At 7 volts the current is 1.85 milliamperes and at 5 it is 3.25 milliamperes. Therefore two volts change the plate current by 1.40 milliamperes, and one will change it .70 milliamperes. Hence the mutual conductance is 700 micromhos.

A better operating bias for this particular tube would seem to be 4.5 volts, at which the plate current is 3.68 milliamperes. Let us find the mutual conductance between 3.5 and 5.5 volts. At

Questions and

Distortion in Detectors

IN LAST week's issue you showed the form of the output current of a grid bias detector and it is very unsymmetrical. If the output wave is of this form how is it that the quality is as good as it is? It seems to me that the curve cannot be correct or else that a great deal of wave form distortion does not matter. —W. E. B.

The curve published is the form of the carrier current wave, not the form of the audio frequency wave. The audio wave results from a variation in the amplitude of radio current wave. It takes very many waves such as that shown in the graph to make up one cycle of the audio wave. The by-pass condenser in the plate circuit of the detector smooths out the radio frequency fluctuations in the audio wave so that the audio output is practically a pure audio wave. If there is any distortion in the audio wave most of it occurs in the subsequent audio frequency amplifiers.

* * *

Input to Short-Wave Set

IN MANY short-wave receivers the antenna is connected through a small condenser to the stator plates of the tuning condenser ahead of the first tube and in others the antenna is coupled to the tuned circuit by means of a winding on the coil. Which of these methods is the better? I presume that the same type of input should be used for converters as for complete short-wave receivers.—W. H. K.

There is very little difference, if any, between these methods of coupling. The direct coupling is probably used more than the transformer method. About the same results should be obtained with both provided the coupling in the two cases has the same value. If the condenser in series with the primary is variable there is the advantage that the coupling to the antenna may be varied to suit

Stations Gain Laurels By

To assure a minimum of interference and "heterodyning" between broadcasting stations, the Radio Division of the U. S. Department of Commerce keeps accurate check on the operating frequencies of the stations. The stations are not permitted to deviate more than 500 cycles from the designated frequency, but most stations make every effort to make a better showing than this.

The Division reported taking 7,934 measurements during the month of January, on 365 American broadcasting stations. The same station was measured several times at different hours of the day and night.

The tests show that 54 of our stations were "off frequency" less than 100 cycles (one-tenth of a kilocycle) and 102 deviated less than 200 cycles. Measurements made in February showed even better results. The locations of the measuring stations of the

the Automotive Pentode

ied by Small Current Drain and Good Performance

3.5 the current is 4.5 milliamperes and at 5.5 it is 2.45. Hence the mutual conductance is 1,025 micromhos. It is not to be expected that this is accurate because of the uncertainties of reading the curves.

Bias Detection With Tube

As a bias detector the tube does not appear to be well suited, although it is better for this purpose than a tube having a lower amplification constant. With 135 volts in the plate circuit the bias should be 15 volts. At this point the current is 0.6 milliampere and if a resistance is to be used to establish the bias it should be of 25,000 ohms. In that case the applied plate voltage should be 15 volts greater, namely, 150 volts. This bias resistor assumes that the DC load resistance is negligible. It does not apply for cases when the tube is followed by a resistance coupler, but only for audio transformer or audio choke.

If the bias is 15 volts the signal voltage amplitude that may be impressed is just 15 volts and a comparatively large output may be obtained, enough to load up a power pentode tube if there is a transformer between the tubes.

Plate Current, Plate Voltage Curves

In Fig. 2 is a family of plate voltage, plate current curves for this sample tube. Three loads lines are drawn across the curves, one for 10,000 ohms, the internal resistance of the tube, another for 20,000 ohms, twice the internal resistance of the tube, and a third for 100,000 ohms.

It appears from these curves that 10,000 ohms is the resistance which gives the greatest output. The conclusion that 10,000 ohms gives greatest output for this particular tube is based on the fact that the 10,000-ohm load line crosses the curves at nearly right angles. The 20,000 ohm load gives greatest undistorted output.

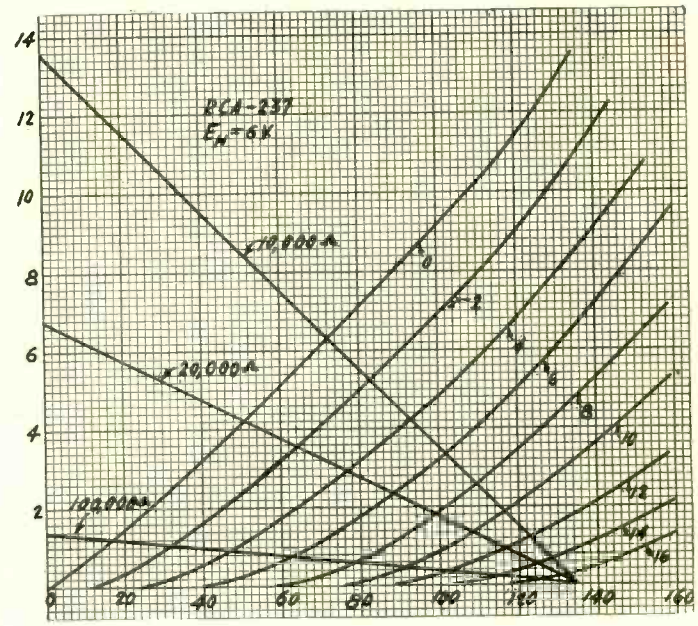


FIG. 2

A family of plate voltage, plate current curves for the sample RCA-237 tube with three load lines drawn across the curves for resistances as indicated. The recommended load at 135 volts on the plate is 12,500 ohms and at 90 volts on the plate, 14,000 ohms.

Let us see how the figures come out. Let the bias be adjusted so that the grid voltage swings between zero and 16 volts. At 16 volts the plate current is .25 milliampere and the plate voltage is 132.5 volts. At zero bias the current is 6.35 milliamperes and the plate voltage is 61.5 volts. Hence the current change is 6.1 milliamperes and the voltage change is 71 volts. Hence the power is 54.1 milliwatts, which is obtained by multiplying the current and voltage changes and dividing the product by 8.

Output on 20,000 Ohms

On the 20,000 ohm curve the current is .2 milliampere at 16 volts and the plate voltage is 130 volts. At zero bias the current is 4.25 milliamperes and the plate voltage is 50. Hence the current change is 4.02 milliamperes and the voltage change is 80 volts. The product of the two is 321.6, whence the power is 40.2 milliwatts.

The 100,000 ohm load line is drawn for the purpose of estimating the voltage amplification in a resistance coupled amplifier with tube working into 100,000 ohms. Again let us adjust the grid bias so that the grid voltage swings between zero and 16 volts. At 16 volts the plate current is .1 milliampere and the plate voltage is 124.5 volts. At zero bias the plate current is 1.15 and the plate voltage is 17.5 volts. To get the amplification we only need the voltage change, which we divide by the grid bias change. The plate voltage is 107 volts and the grid voltage change is 16 volts. Hence the amplification is 107/16, or 6.69 times. That is about 70 per cent of the amplification constant of the tube.

At a later date curves showing the variation in the output voltage with grid voltage variations will be published. When such curves are taken with a resistance in the plate circuit they show directly the voltage amplification in an amplifier with the same value of resistance in the plate circuit of the tube.

Transformer Output Operation

When a transformer is used after the tube the voltage on the plate is higher than that indicated by the load lines in Fig. 2 because the DC drop in the transformer is much smaller than the drop in a pure resistance equal to the load resistance of a transformer. For this reason a larger grid swing is permissible and a greater output will be obtained. But this tube is not a power tube and we shall not pursue this subject any further. It is not large enough to operate a loudspeaker, but it will deliver plenty of power for operation of a headset.

Answers

circumstances. Of course, a variable condenser could also be connected in series with the antenna when a transformer is used, and its effect would be about the same. For high sensitivity is not always the only consideration. Selectivity must also be taken into account.

* * *

Why Plate By-pass Condenser Is Used

IF a tube will not detect without a by-pass condenser in the plate circuit how is it that signals can be received when there is no by-pass condenser? Is there not a discrepancy here between fact and theory?—S. G. C.

If there is a discrepancy it is confined to the question. Why should a tube not detect without a by-pass condenser? And when the signal comes in without a condenser, are you certain that there is not sufficient stray capacity to make the circuit work? No test has been made to determine whether a capacity is absolutely necessary, but it is well known that if a condenser is added to the distributed capacity the detecting efficiency goes up.

* * *

Effect of Changing Bias

WHAT would be the effect on the curve in Fig. 3, May 2, 1931, issue of changing the operating grid bias to a higher value, say 3 volts negative? Would the shape of the curve change?—W. G. N.

It would not change if the signal voltage amplitude were increased to 2 volts at the same time. The heavy line would simply be moved down to zero, or very nearly to zero, since at 3 volts the current is very small. If the bias were simply reduced the positive peak of the output current would not be so great as it is and the negative would be practically zero. The detecting efficiency would be less.

Careful Frequency Adherence

Department are as follows: Boston, Baltimore, Atlanta, New Orleans, Chicago, Detroit, Grand Island (Neb.), Los Angeles, San Francisco and Portland (Ore.). As there are over 600 stations in operation, it is evident that many other stations will take places in the 100 cycle or less class when they are reached in the tests. The "steady" stations are recognized at once as those of the popular stations which are operated with extra care.

Accuracy of frequency, maintained by crystal control and other means not only makes possible such a large number of broadcasters operating at once with only moderate interference (mostly on the shorter broadcast waves) but in addition, permits still further efforts to operate more than one station on the same frequency, with the same program. This is now being done successfully in several cases.

Oscillators for Lining Up

By J. E.

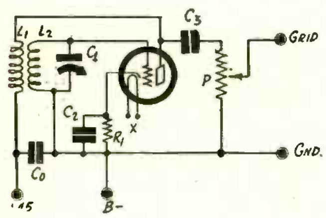


FIG. 1
Tuned grid oscillator for heater type tubes and adjustable output for tuning intermediate frequency amplifiers.

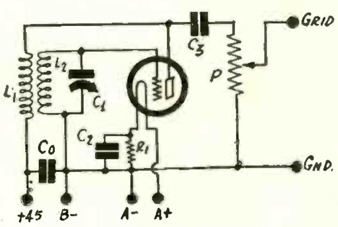


FIG. 2
The same circuit as in Fig. 1 but arranged for use with battery type tubes. The ballast R1 to be chosen for tube used.

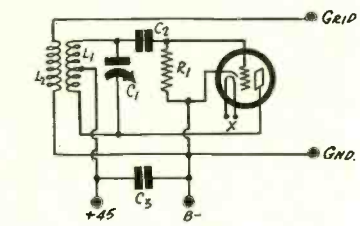


FIG. 3
A Hartley type oscillator arranged for heater type tubes. The output is taken off by means of a second winding on the oscillator.

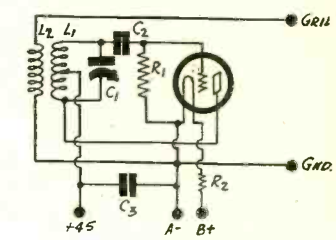


FIG. 4
The same circuit as in Fig. 3 but arranged for filament type tubes. An output potentiometer may be connected as in Figs. 1 and 2.

WHEN intermediate frequency amplifiers in superheterodynes are tuned to the desired frequency it is very convenient to use an oscillator previously adjusted to that frequency. There are many oscillators suitable for this purpose and it is only necessary to select one that fits the tube and power supply available. Any general purpose tube, filament or heater type, may be used. Whether the oscillation is to be modulatd depends on the type of detector that is to be used in determining resonance. We shall give a number of oscillators and show how they are to be used and how to be adjusted to the desired frequency.

In Fig. 1 we have a simple, unmodulated oscillator of the tuned grid type using a heater type tube. This tube may be a 227 or a 237. The voltage across the X terminals should be 2.5 volts for a 227 and 6.3 for a 237, and for either it may be either AC or DC.

The Coils

The two coils L1 and L2 may be the same as to the number of turns and inductance, and for a 175 kc oscillator the 800 turn duolateral coils now available for 175 kc transformers may be used. These coils should be coupled just as closely as the wooden cores permit when the cores are in the same direction. That is, the two short ends should be toward each other.

The tuning condenser C1 may be any variable condenser having a capacity of about 100 mmfd. The least expensive is a little trimmer condenser having a minimum capacity of 20 mmfd. and a maximum of 100 mmfd. However, this condenser may not have sufficient variation in all cases to give the desired frequency, except when the intermediate transformers are made of the type of coils as L1 and L2 and when the same trimmer condensers are used for tuning them.

A better condenser for the oscillator would be a regular tuning condenser of 125 mmfd. If this is used provision should be made for locking the dial when the oscillator has been adjusted to the desired frequency so that the frequency will not shift during the process of adjusting the intermediate frequency amplifier.

Suitable values for the other parts in the circuit are as follows: C0 and C2, each 0.1 mfd.; C3, .001 mfd.; R1, 1,000 ohms, for either the 227 or the 237 tube; P, a 500,000 ohm potentiometer. The plate voltage indicated is 45 volts but this may be increased if oscillation does not take place with the low voltage. It is inadvisable to use more than 90 volts.

Calibrating Oscillator

The oscillator is calibrated to the desired frequency with the aid of a broadcast receiver and broadcast stations. The oscillator should be coupled to the broadcast receiver in some manner. For example, the oscillator may be placed close to the input of the receiver, or a small condenser of not more than 100 mmfd. may be connected between the antenna and the plate of the oscillator, or the terminal marked "Grid" may be connected to the plate of the first tube in the receiver, or to the screen of that tube, with the terminal marked "Gnd" being grounded. The object of the coupling is simply to obtain a squeal in the output of the receiver when the condenser C1 is adjusted.

Now if the frequency of the oscillator is to be 175 kc the broadcast receiver should be tuned to a station operating on 700 kc, the fourth harmonic of the 175 kc frequency. As the condenser on the oscillator is adjusted a number of points will be found where there is a squeal. Most of these will be beats with carriers near the 700 kc frequency. If the broadcast receiver is tuned accurately to 700 kc and if it is selective, the squeal with the 700 kc carrier will be the loudest. If there is a strong station operating near the receiver on a frequency differing slightly from the 700 kc, the beat squeal with this may be equally loud, or even louder. If it is not practical to suppress the interfering carrier by means of the tuner or with a wave trap, it is possible to identify the position of the proper beat by a knowledge of the frequency of the interfering carrier. Suppose, for example, that the interfering carrier is 710 kc. The two squeals will then be very close together on the oscillator condenser, and that from 710 may be the stronger. In that case the squeal for the 700 kc carrier will have a slightly higher capacity setting than that of 710 kc. This situation arises in New York and vicinity where the signals from WOR, Newark, N. J., operating on 710 kc, are strong compared with those of WLW, Cincinnati, operating on 700 kc. With a selective receiver, however, it is possible to make the squeal with WLW stronger than that with WOR.

A check-up can be made by squealing with a 1,400 kc station, the eighth harmonic of 175 kc.

Making Use of Oscillator

Having fixed the frequency of the oscillator we are ready to use it in the adjustment of an intermediate frequency amplifier. The connection to the control grid of the first detector is removed and the terminal marked "Grid" of the oscillator is connected in its place. The terminal marked "Gnd" is grounded to the chassis or connected to B minus. This done, the first tuned circuit in intermediate frequency amplifier is adjusted for maximum output. Just how maximum output is determined will be discussed. When the first tuned circuit has been adjusted the next is similarly adjusted, and so on until all tuned circuits have been adjusted for greatest output.

It may be that the signal from the oscillator will be so large that the tubes in the circuit will be overloaded. For this reason the potentiometer P is in the oscillator circuit. As the signal increases the slider is moved toward ground so as to impress a weaker signal.

Detecting Maximum Output

If the signal from the test oscillator is not modulated a milliammeter should be used for measuring maximum output. If the second detector in the circuit is of the grid bias or power type, it is only necessary to put the milliammeter in the plate circuit and make adjustments on the tuning until the deflection on the meter is maximum. If bias detection is not used, the detector should be converted to this type temporarily by applying a suitable bias and by shorting the grid condenser. The bias should be made so high that there is practically no deflection on the milliammeter when no signal is impressed on the tube. As the signal is impressed the deflection will depend on the strength of the signal.

If the oscillation is modulated the most practical detector of maximum output is the loudspeaker. Just adjust for loudest sound.

In Fig. 2 is the same oscillator circuit as in Fig. 1, except that it has been wired for battery tubes. All the constants except those pertaining to the filament circuit are the same.

The tubes that may be used in this oscillator are 199, WD12, 230, 201A, 112A. For the 199 the filament battery voltage should be 4.5 volts and R1 should be 20 ohms. For the WD12 the battery voltage should be 1.5 volts and R1 should be 1.5 ohms. For the 230 the battery voltage should be 3 volts and R1 should be 16.7 ohms. For the 201A or the 112A the battery voltage should

Intermediate Channels

Anderson

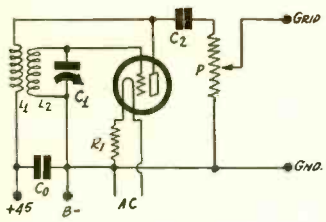


FIG. 5
A modulated oscillator similar to that in Fig. 2. AC is put on the filament and a modulating voltage introduced elsewhere.

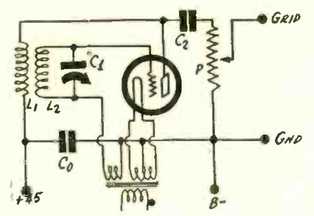


FIG. 6
In this circuit a modulating voltage is introduced into the grid circuit by means of a low voltage winding on the filament transformer.

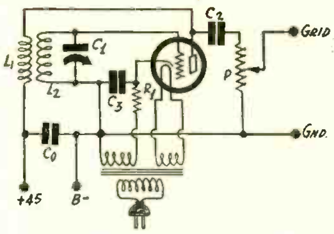


FIG. 7
When a heater type tube is used the oscillator in Fig. 6 assumes this form. The winding may also be connected in the plate circuit.

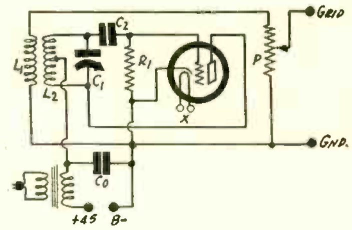


FIG. 8
This is a Hartley type oscillator in which an alternating voltage is introduced into the plate circuit for modulation.

be 6 volts and the ballast resistance 4 ohms. As in the preceding case the plate voltage may be increased to 90 volts.

Hartley Type Oscillator

In Fig. 3 is a simple Hartley type oscillator for AC tubes and in Fig. 4 the same oscillator for battery type tubes. The same tubes as were used in Fig. 1 may be used in the circuit in Fig. 3 and in Fig. 4 the same as were used in Fig. 2.

The oscillating coil L1 in either Fig. 3 or Fig. 4 may be the same type of coil as was recommended for the circuits in Figs. 1 and 2 except that there should be a tap near the center of the coil for the plate return connections. The grid stopping condenser C2 should have a capacity of 0.01 mfd. and should have a mica dielectric. The grid leak R1 should have a value of between 10,000 and 50,000 ohms. C1, the tuning condenser, and C3, the by-pass across the B battery, should have the same values as the corresponding parts in Figs. 1 and 2. No grid bias is provided for the oscillators in Figs. 3 and 4 because the grid leaks and stopping condensers maintain the grids at the proper operating bias.

The second winding L2 one either of these oscillators is used for picking off the oscillation. L2 may be a smaller winding than L1 or it may be the same size and type. The intensity of the oscillation across the terminals "Grid" and "Gnd" may be varied by varying the coupling between L1 and L2, or the utilized portion of the output may be varied with a potentiometer in exactly the same way as in Figs. 1 and 2. In the oscillators in Figs. 3 and 4 the ground side of the output coil is connected to B minus. If some application of the oscillator demands it, the connection may be left open.

These two oscillators are very simple and are particularly suitable for use when the builder makes his own coils. In a ready-made coil not designed for such an oscillator it is not easy to place the tap in the proper place.

Resistance R2 in Fig. 4 should have the same value as resistance R1 in Fig. 2 for the same tubes.

Modulated Oscillators

In Fig. 5 is an oscillator similar to that in Fig. 2 but AC is used on the filament of the tube. A resistance R1 is connected in one leg of the filament similar to a grid bias resistor. The object in this case is not to provide a bias but to impress an alternating voltage in the grid circuit. If the AC voltage across the terminals is made about one volt higher than the required filament voltage and R1 is chosen so that it will drop the excess, the AC voltage introduced in the grid circuit will be one volt, and that is enough to modulate the oscillation for the purpose of testing. The hum frequency will be 60 cycles per second, assuming that the line voltage is 60 cycles.

Since we have only a limited number of filament voltages in general use, we are somewhat limited in the type of tubes to choose. We have 7.5, 2.5,, and 1.5 volt windings on many transformers. If we use a 7.5 volt winding we may select 201A and 112A tubes for the oscillator, putting in a ballast resistance to drop 2.5 volts in the circuit. To drop 2.5 volts we need a resistance of 10 ohms, since the normal filament current is 0.25 ampere. An AC voltage of 2.5 volts is not excessive.

If we have a 1.5 volt winding available we might choose a WD12 oscillator tube. This requires only 1.1 volts and a current of 0.25 ampere. Hence the ballast should be 1.6 ohms.

A voltage of 5 volts and a 199 tube go well together in this respect. The tube may be operated at 3.3 volts, which leaves 1.7 volts for the ballast resistor. The value of this resistor should be 25 ohms.

A 2.5 volt winding and a 230 tube might be used together. There will be an excess voltage of 0.5 volt, which will be dropped by a ballast of 8.3 ohms.

Even if the voltage of the transformer winding is just right for the tube in question, a certain amount of modulation will be obtained if the grid of the oscillator is returned to one end of the filament. We well know the hum that is produced in amplifiers when the filaments are not balanced, especially in tubes having a high filament voltage like the 201A and the 210. The hum is accentuated by the oscillator.

Introducing Winding in Grid Circuit

If the filament winding is just right for the tube and there is an extra low voltage winding on the transformer, the extra winding may be connected in the grid circuit of the oscillator tube as is illustrated in Fig. 6. This is a good way of utilizing the 1.5 volt winding found on transformers designed in the era of the 226 tube. Another possibility is a 5 volt winding for the oscillator tube and a 2.5 volt winding for the grid circuit. There are many such transformers available, relics of the days when 171A power tubes were used after a 227 detector.

When a heater tube is used for oscillator and this method of modulation is desired the circuit may be arranged as in Fig. 7. In this case the resistance of the modulating winding is added to the grid bias resistance but the value added is so small that it may be neglected and the values suggested under Fig. 1 used.

Another method of modulating the output of the oscillator is to impress an alternating voltage in the plate circuit. A winding on a transformer giving a voltage from 5 to 25 volts may be connected in series with the plate battery. This should be connected so that the condenser Co goes from the low side of the tickler to B minus. That is, the AC winding should not be connected in series with the tickler winding, for in this position it would act as a choke and might stop the oscillation.

Still another method of obtaining a modulated output is to feed the plate from a B battery eliminator in which the filtering is poor. This, perhaps, is the simplest of all.

AC in Plate Circuit

In Fig. 8 is a Hartley type oscillator in which the modulating voltage is introduced in the plate circuit. A winding giving, say, 7.5 volts is connected in series with the 45 volt battery in such a manner that the AC is superposed on the steady voltage.

While it is possible to operate the oscillator with AC on the plate without any rectification or filtering, this is not recommended because the circuit will only function part of each cycle. It will not function at all when the plate is negative with respect to the cathode or the filament and it will not oscillate during that part of the other half of the cycle when the voltage is low. The modulation will be very rough. Any one of the methods suggested previously is superior to this one.

How to Wind the Coils

The coils must be shielded in aluminum or copper for the following coil data to apply: Antenna coil, 15-turn primary, 92-turn secondary. First interstage coupler, 25-turn primary, 92-turn secondary. Second interstage coupler, 25-turn primary, 92-turn secondary, 20-turn tertiary. The separation between primary and secondary is ⅛ inch. The diameter of the tubing is 1¾ inches. The secondary wire and antenna primary wire is No. 28 enamel. The wire on the other windings may be as fine as desired. All windings are in the same direction. Reverse connections to the 20-turn winding experimentally. This winding may be on a smaller form inside the other. The data are for .00046 mfd. For .0005 mfd. use 85 secondary turns instead of 92, the rest as stated. Do not try to use .00035 mfd. capacity. It will not cover the band with any shielded coil.

DX Tuner in AC Form

By Anthony Swale Waring

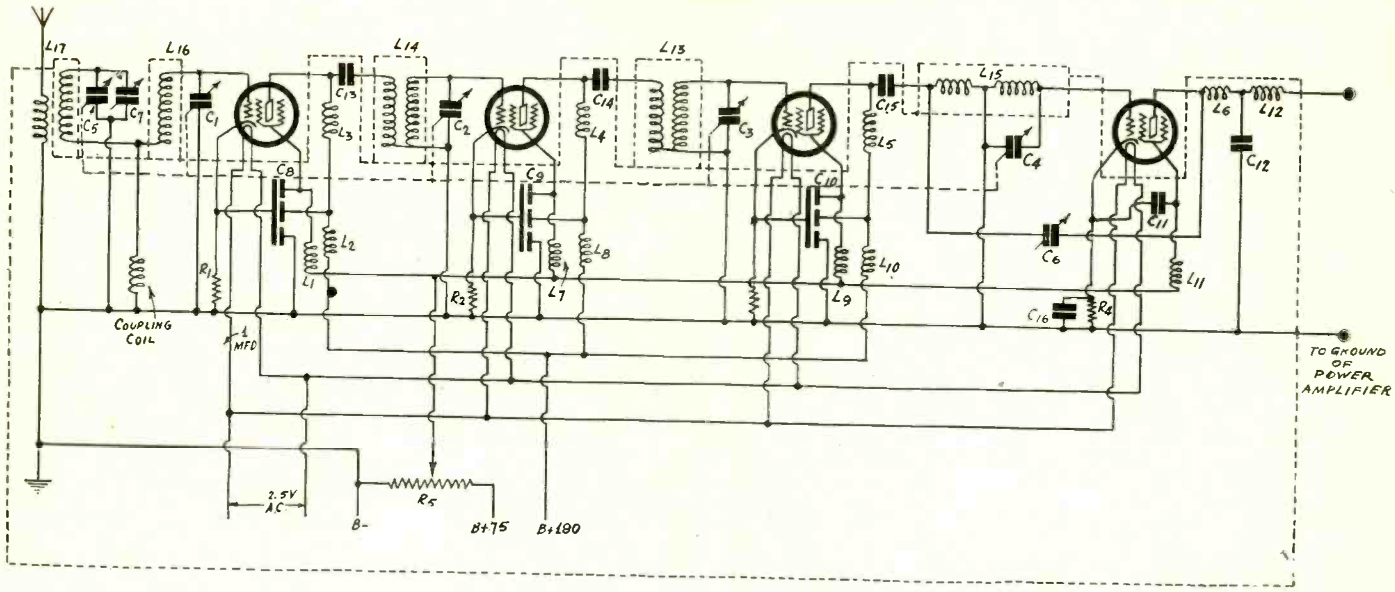


FIG. 4

Here 2½ volt AC tubes are used in the fundamental DX tuner, instead of the 2 volt tubes in the battery model. Power detection is used in this instance.

[A four tube battery model tuner was described and illustrated last week, issue of May 2d. The AC counterpart is published herewith. The circuit is an outgrowth of the Everyman Four and the Moore-Daniels, and is noted for distance reception.—EDITOR.]

THE model of the DX tuner known as the Da-Lite-R, diagrammed in Fig. 4, is gaited to high power and sensitivity, and has a credible distance-getting record that many regard as most remarkable, in view of the few tubes used—only four. Of course a power amplifier has to be used, in addition, for loudspeaker operation, and for furnishing the B voltage.

Radio Stages Stable

Sensitivity naturally attaches itself to a circuit like this, because there are three stages of tuned radio frequency amplification, using screen grid tubes.

One of the feats is to attain stability while the amplification is so high, and this is worked by the Chronophase system.

The input is twice tuned, so there are five tuned circuits, with no danger of crosstalk and other interference that can be eliminated by tuning.

The heaters are connected in parallel and are brought out to a filament transformer secondary, or to a suitable winding on a power transformer that provides all the required secondary voltages for tuner and amplifier. The B voltages to be fed to the outfit are 180 volts and 75 volts, the latter voltage subject to regulation or adjustment by the volume control potentiometer.

Tubes at Rated Voltages

The tubes are worked at their rated voltages, which helps sensitivity, while the selectivity is such that actual 10 kc separation is maintained throughout, yes, even at the higher broadcast frequencies.

The circuit has been used by many critical fans, especially in areas where DX reception is difficult, yet several reports of foreign reception on broadcast waves have been received.

LIST OF PARTS

(Battery Model)

Five condensers .00041 (C-1-2-2-4-5)
One set of Da-Lite-R coils (L-13-14-15-16-17 and coupling coil)
Nine RF choke coils (L-1-2-6-7-8-9-10-11-12)
Three RRF choke coils (L-3-4-5)
Three fixed condensers, .002 (C12-13-14)
Two fixed condensers .00025 (C-15 and detector)
One trimmer condenser .000025 (C7)
Three blocks of 0.1 mfd. condensers (C-8-9-10)
One block, 0.1 mfd. (C-11)
One Moore Da-Lite-R chassis including coil shields
One Moore Da-Lite-R drum dial
One panel 8 x 15 inches
Four tube shields and bases
Four grid clips
One 50,000 ohm potentiometer (R-5)
Five knobs
Seven binding posts.
Insulated washers and hardware
Two couplers for regeneration and tuning condensers
Two 1 mfd. condensers
Four tube sockets, wafer type
One resistor, 300 ohms (R-6)
One regeneration condenser, .00015 (C-6)

LIST OF PARTS

(AC Model)

One set of Moore Da-Lite-R coils (L-13-14-15-16-17, and coupling coil)
Nine RF chokes (L-1-2-6-7-8-9-10-11-12)
Three RF chokes (L-3-4-5)
Five tuning condensers, .00041 mfd. (C-1-2-3-4-5)
One regeneration condenser, .000015 mfd. (C-6)
One trimming condenser, .000025 mfd. (C-7)
Three condenser blocks, 0.1 mfd. (C-8-9-10)
One fixed condenser (C-11)
One fixed condenser, 0.5 mfd. (C-16)
Three fixed condensers, .002 mfd. (C-12-13-14)
One fixed condenser, .00025 mfd. (C-15)
Three 400 ohm resistors (R-1-2-3)
One 20,000 ohm resistor (R-4)
One 50,000 ohm potentiometer (R-5)
Two couplers for tuning condensers and regeneration shaft
Four tube shields and bases
Four UY subpanel sockets
One Moore chassis drilled, including coil shields
One Moore drum dial
Four grid clips
One 8 x 15 inch panel
Five knobs
Seven binding posts
Insulated washers and hardware

Reception in Summer

By Brainard Foote

THE conditions under which your radio set is operated change quite materially from Winter to Summer. These changes are both technical and utilitarian.

Because static interference may be present in warm weather, it is desirable to minimize static in proportion to broadast entertainment. An indoor wire will prove sufficient for local reception in most locations, about 40 feet of bell wire draped above the picture moulding, used instead of the outdoor wire. This will result in less static noise.

There are enough very powerful broadcasting stations in operation today to assure nearly all listeners of good reception throughout the Summer, even during static, except, of course, during an actual thunder storm. Broadcasting from the nearest station is usually strong enough to overcome static simply because it is received with more volume.

Use of a Phonograph Pickup

By all means provide your set with an attachment for playing phonograph records. It is cheap, simple to attach and gives remarkable results as to tone quality, regardless of the kind of turntable employed to rotate the records. Then, even during a thunderstorm, you may have uninterrupted entertainment or music for dancing (if you're in a mood for such during the excitement). The phonograph attachment may be installed in any radio set by means of a special adaptor which slips under the detector tube. A cord leads to the phonograph, where a specially constructed magnetic pick-up rides the record in place of the former tone head. A switch in the connecting cord or elsewhere disconnects the attachment when the radio is to be operated in the regular manner.

A lightning arrester is very cheap and is very simple to install. And yet for some reason or other many listeners put off getting one. Get yours! Erect it in accordance with directions furnished with it, or with directions that you can get through your fire insurance agent. You'll have more peace of mind when you know that your aerial is protected properly the same as in the case of the telephone wire leading to your home (which has a lightning arrester, usually in the basement).

How the Arrester Serves You

The principle of the arrester is that of a very tiny gap or air space between two sharp points. One of these points is connected to the aerial, while the other leads to earth. Static surges heavy enough to cause a spark will jump this gap rather than pass through the set.

Where neighbors are not so near so as to have their quiet disturbed, you'll enjoy using the loudspeaker on the veranda or lawn. Use an extension cord.

Radio sets are widely used by vacationists, campers and tourists. If your set operates from dry cells or a storage battery, there's no special problem other than the weight in taking the outfit along with you. A temporary aerial can be rigged up to a tree or pole at your camp or bungalow. A ground may be obtained in numerous ways. Where no piping or other possible contact exists, 100 feet of wire stretched on the ground operates as a ground by means of the counterpoise system.

Use of Car Battery

The car battery may be used, for ordinary daytime running keeps it sufficiently charged for evening entertainment. Use a long enough extension cord of twisted pair or other heavy wire. Clips will serve to make connection to the battery terminals, or one may be connected to the metal frame of the car and the other to one of the terminals on the ammeter. It may be necessary to reverse the wires to obtain the correct polarity so the set will operate.

The electric set is of course usable and even simpler to take with you where your summer home is provided with electricity.

Fight Between Press and Radio Renewed

Hostilities between a certain section of the newspaper press on the one hand, and broadcasting on the other, was resumed due to the attacks on radio made at the convention of the American Newspaper Publishers Association in New York City.

The Publishers Association resolved that commercial broadcasting had become a competitor for advertising and that radio stations should therefore pay advertising rates for the publication of their programs or they should be omitted. The adoption was by a split vote.

Also the New York State Circulation Managers Association discussed the topic. Most speakers agreed radio programs constitute news and should be published, regardless of advertising. In fact, the voted opposition to program elimination was unanimous.

* * *

Princeton, N. J.

In a speech before the School of Public and International Affairs, Merlin H. Aylesworth, president of the National Broadcasting Company, said:

"A study of the many statements already issued by the spokesmen of newspapers opposed to further co-operation of newspapers with broadcasting reveals three fundamental complaints: (1)—Radio news bulletins compete with the primary function of newspapers and take away from newspaper circulation. (2)—Radio programs now published as editorial matter should be treated as advertising copy and paid for by broadcasters or program sponsors. (3)—Radio advertising takes away from the advertising income of newspapers, thereby creating a definite threat to the financial welfare of the press.

"The primary function of both newspaper and broadcaster is to serve the public. That public demands news. It insists on hot news or news as soon after the event as possible and even while the event is in the making. Consequently, if radio broadcasting can serve hte public with certain kinds of news sooner than the newspapers, thereby solving the extra edition problem, are we to ignore the public's best interests for private gain or, more likely, fanciful gain?

Says Public Demands News

"If radio be a news competitor of the newspaper, why do we find many newspapers broadcasting news over radio stations?

"Although the printing of radio programs undeniably benefits the sponsors, such programs constitute news sought by readers, and for this reason should be published.

"A few newspapers from time to time have eliminated radio programs from their columns. Immediately they began losing circulation to other newspaper featuring radio programs. Obviously, radio programs are demanded by readers. Aside from the front page and the sports page, the radio page draws most readers. Hence the newspapers out of their own good judgment may be expected to serve their readers rather than to force radio sponsors into paying for radio program notices.

Names Symbolical

"We have never contended that newspapers should use the name of the product as such in publishing radio programs or should permit any description of a product. We have always contended, however, that a program often becomes symbolical of the product and its sponsor, and, therefore, we believe, such names as Lucky Strike Orchestra or Maxwell House Orchestra identify a certain type of entertainment. The reader to whom these programs appeals relies on these names as identifying marks.

Sponsors Use Newspapers

"A survey of radio advertisers by industries will show, I believe, that the largest users of radio are likewise the largest users of space; that an increase in radio appropriations has been accompanied by an increase in space appropriations in most instances; and that when radio is employed for the first time, its appropriation is not taken from space but rather from an additional appropriation."

* * *

Ban On Lotteries Asked by Publishers

Washington.

The Federal Radio Commission received a petition from the American Newspaper Publishers Association imploring the prohibition of broadcasting of lotteries, just as newspapers and periodicals are prohibited from printing lottery announcements or advertisements.

A brief filed by Elisha Hanson, attorney, cited the law prohibiting advertising of lotteries and charged that during the last few months radio stations throughout the country have been devoting more and more of their broadcast time to the broadcasting of advertising programs in which lottery and gift enterprise schemes predominate.

A Midget Supply fo

By Herma

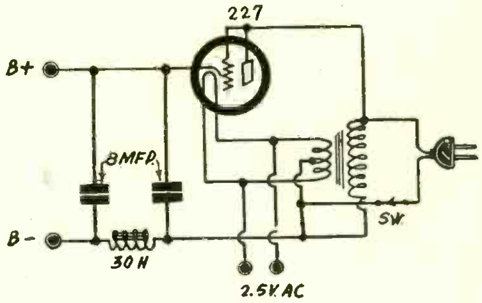


FIG. 3
Diagram of a simple B eliminator, requiring no special power transformer, but using a 2½ volt filament transformer.

A SMALL B supply has many uses. Here is one such device that does not require a conventional power transformer, but uses a filament transformer, taking the 110 volts from the AC line, and delivering voltages from 150 volts to 100 volts, depending on the drain and the actual AC voltage, which may vary. The circuit normally will afford about 110 volts at a drain of 20 milliamperes.

A 227 tube is used as the rectifier. If as much as 20 milliamperes are drawn the life of this tube will be reduced from the normal expectancy of 1,000 hours, and may be only 500 hours, but the tube is cheap enough, the new list price being only $1.25.

Uses for Small B Supply

This B supply may be connected to any set, tuner or short-wave converter, adapter or set that does not require in excess of 20 milliamperes.

Many persons possess short-wave converters that have no B supply built in, and are at a loss to ascertain how to obtain the correct voltage from the receiver with which the converter is worked. For them this B supply is a substitute for using B batteries, and needs no replenishment, except in the case of the tube.

The placement of the B supply choke in the negative leg, instead of in the more customary positive leg, was a conscious choice based on obviating short-circuiting of the AC line.

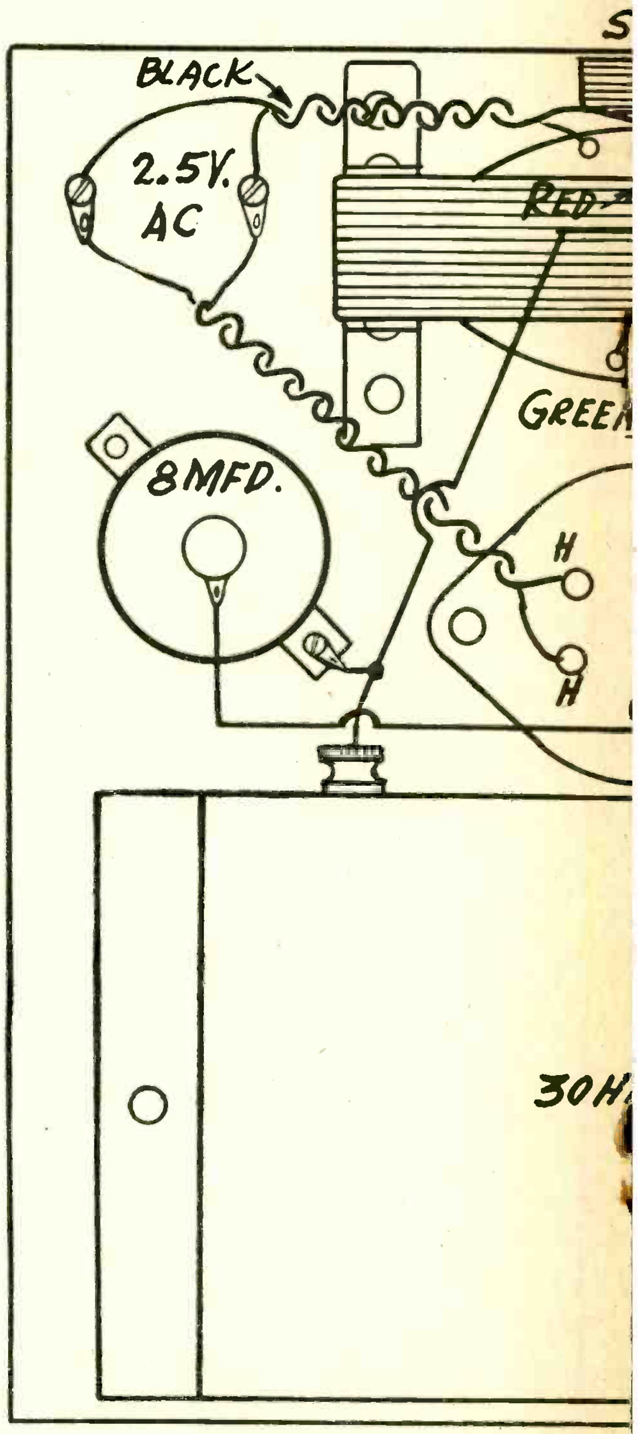
As can be seen from the diagrams, one side of the AC line is used as the negative lead of the rectifier. If a set, tuner, adapter or converter be hooked up to a B supply that has one side connected to the AC line, and if the set itself is grounded, a short-circuit of the AC line would result if the plug were inserted in the convenience outlet in one direction. However, the present location of the B supply choke, which is a husky one of 30 henries with 400 ohms DC resistance, prevents any such short, due to the choke serving as a load impedance if the plug is connected in what otherwise would be the wrong way. Therefore you may connect the B supply to any device requiring B voltage, and need pay no heed whatever to the direction of connection of the AC plug to the line.

Choke in Positive Lead of a Converter

This precaution does not have to be so carefully guarded against where the B supply is included in the tuning circuit assembly, so long as no ground is connected to the tuning circuit. As a precaution against violation, a small condenser may be used (Fig. 3), but the grounding then is not fully effective, due to the voltage across the condenser, although not large. In Fig. 3 the AC line is relied on for ground, since it is actually grounded usually, and the only connections to the short-wave converter in Fig. 3 are to aerial

LIST OF PARTS

One 2½-volt filament transformer; primary 110 volts, 60 cycles; secondary center-tapped.
Two 8 mfd. electrolytic condensers, with brackets.
One 30 henry shielded B supply choke.
One UY socket.
One AC cable and plug.
One AC toggle switch.
Four binding posts (one for B minus, one for B plus, and two for 2½ volts AC).
One 7x6½ inch panel.
One cabinet to fit.
One dozen 6/32 machine screws with one dozen nuts.
One roll of hookup wire.



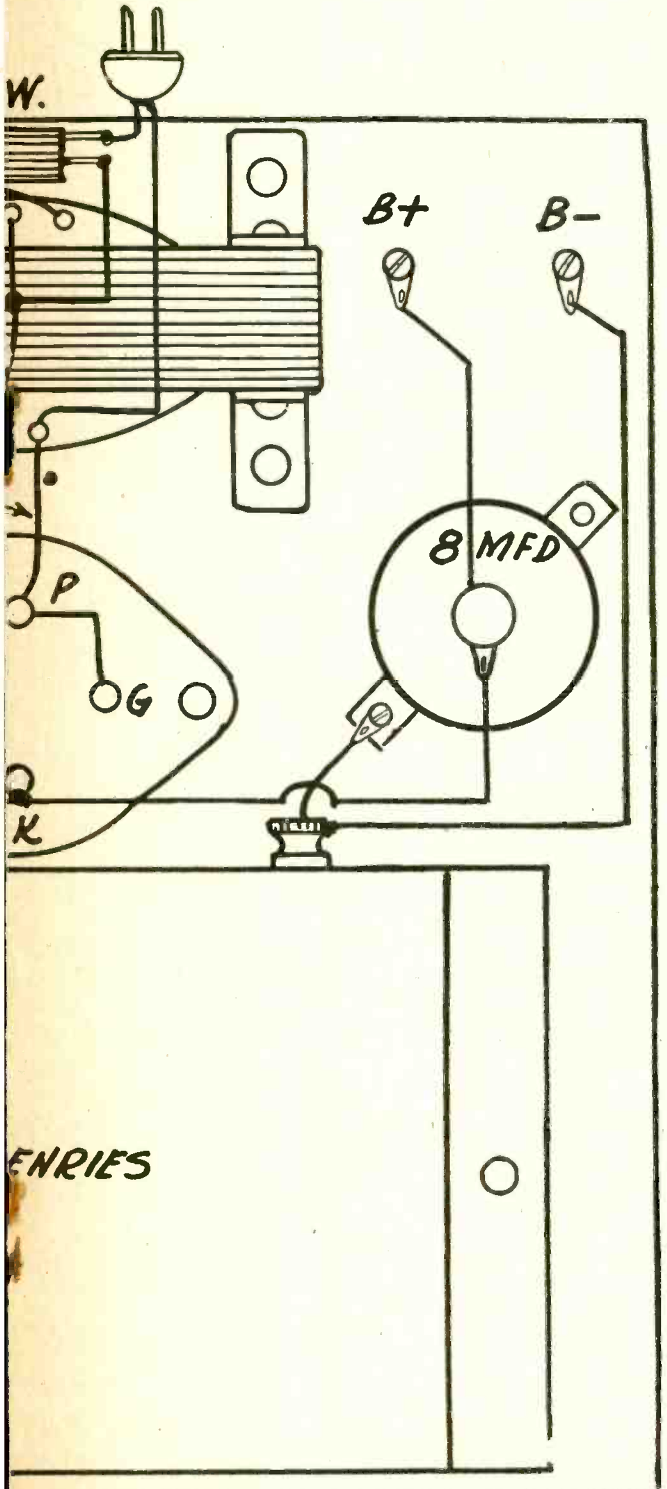
FI
Picture diagram of the wiring of the

and to set antenna post. However, the choke could be placed in the negative lead in that instance, too, if desired.

The filtration must be excellent even in so modest a B supply as the one under discussion. The principal reason is to preclude possibility of tunable hum. Sometimes you will build a set or converter that will not hum until stations are tuned in. Then with almost every carrier there is quite a hum. The principal reason is lack of satisfactory or sufficient filtration in the B supply. As even a small B eliminator such as this may be used with very sensitive tuners and converters, it is highly advisable to avoid the danger of producing hum by tuning, sometimes called resonance hum, due to

r a Variety of Uses

n Bernard



G. 2
midget B eliminator, shown actual size.

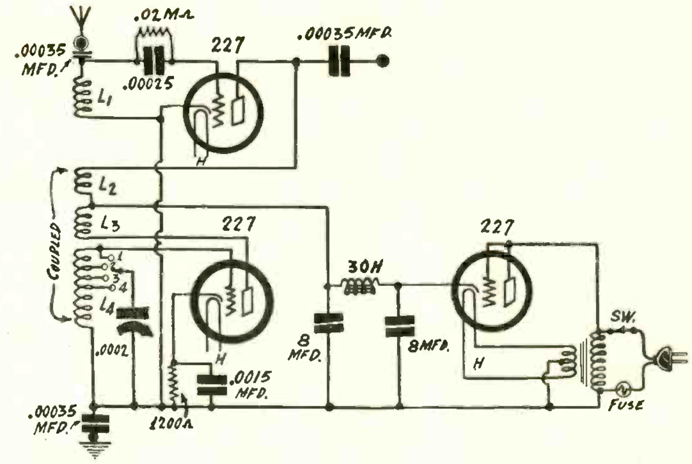


FIG. 3

A short-wave converter. L1 is an independent choke, 1/4 millihenry. Plate modulation is used, due to L2 and L3 being coupled. For 1¾ inch diameter L2 may consist of 25 turns, L3 of 15 turns. L4 may consist of 30 turns, tapped at (2) 10 turns, (3), 5 turns, (4), 2 turns. The range would be 15 to above 600 meters.

improperly filtered AC in plate supply to the receiver or converter modulating the incoming carrier.

Therefore two high-capacity condensers are used in conjunction with a sizable choke coil. Either wet or dry electrolytic condensers should be used, since these afford a large capacity compactly.

If the wet type is selected, the inverted model is preferable, as the high voltage caps are then sunk beneath the top or panel, and one is never in danger of even the slight shock resulting from touching the high-voltage side.

The inverted type of wet electrolytic is simply one that permits mounting the condenser with cap downward. All wet electrolytics must be mounted upright, whether the cap be up or down. Also, in all instances this cap, or top lug, called the anode, connects to positive. The can itself is negative, and may be contacted to either by a lug built into the can, as in the case of the Aerovox dry electrolytic, or to a lug held by the bracket screw, as in the case of the Polymet wet inverted electrolytic.

It is advisable to use a filament transformer that has a center tap on the 2½-volt secondary, so the secondary may be properly grounded. It is not necessary that the filament transformer be shielded. In fact, neither would the choke have to be shielded, since there is no danger of audio frequency coupling, due to absence of any audio channel, and none will be close enough to the B supply in any installation to cause trouble. There is such a great difference in frequency between the 60 cycles of the AC line and any carrier you would tune in, that coupling between transformer or choke, and the carrier, is virtually out of question.

Excellent Results Assured

However, the case of the DC voltage supplied to the device with which the B eliminator is to be used is quite different, and as to that, the explanation has been given, that adequate filtration of the plate supply is required. It will be seen that the filtration is just as carefully provided as in many high-powered AC sets, where a 30-henry choke and 16 mfd. of filter capacity are not normally exceeded. Since the current is small and voltage low, the filtration is even better than in big sets using the same constant.

The diagrams are simple enough, the wiring easy, and if the picture diagram is followed, even a novice scarcely can make a mistake. Moreover, a most excellent B supply will be the result, a dependable and serviceable installation, fully meeting the requirements, although care should be taken not to exceed the maximum drain of 20 milliamperes, otherwise the 227 tube will not last long.

In some instances it will be found that the expected voltage of 110 volts or so will not be attained, not even nearly. The voltage may read between 25 and 50 volts. The reason, of course, is the 227 tube is defective, its emission being very poor. Therefore this B supply is also a tester for 227 tubes, as all you need do is to observe what the voltage reads, comparing it with what it should be with a good tube in the socket.

Key as to Discard of Tube

Tubes that afford readings of 10 per cent. or more under the normal should not be regarded as suitable for further service, even though they will "work" when placed in a radio set, that is, will detect somewhat, or will amplify somewhat. How far they are deficient from full detecting performance may be gleaned from the comparison of the no-drain voltage obtained when the tube is used in the B supply, with the no-drain voltage that should prevail.

(Continued on next page)

Electrical Measu

By James
Chief Instructor,

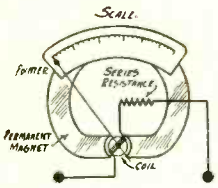


Fig. 1

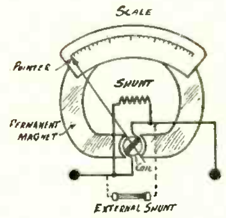


Fig. 2

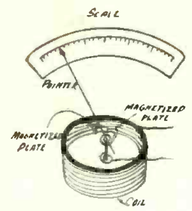


Fig. 3

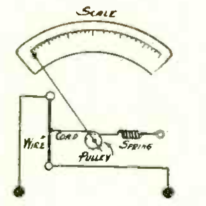


Fig. 4

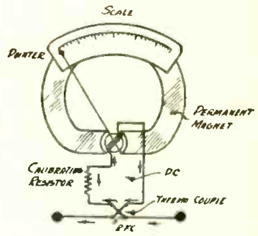


Fig. 5

MEASURING instruments are essential to every service man, therefore it is very important that one should have a good understanding of the underlying principles upon which these instruments operate, to be able to make accurate measurements which would be impossible without the proper instruments. To understand the usefulness of measuring instruments, it is necessary to understand just what they do when placed in an electrical or radio circuit.

In electricity there are units of measurements just as in everyday life we have the foot, the yard, the quart, the ounce, etc. The pressure (electromotive force, e.m.f.) is measured in volts. The current flow is measured in amperes. The amount of resistance (opposition to current flow) is measured in ohms. The volt is the pressure required to force one ampere of current through a circuit containing a resistance of one ohm. An ampere is the number of electrons passing through a circuit per second, the resistance of which is one ohm, when the pressure is one volt.

An ohm is the amount of resistance in a circuit through which one ampere of current is forced by a pressure of one volt.

In radio work we often deal with very minute voltages, sometimes as small as a millionth of a volt. Voltages this small are measured in micro-volts (millionths of a volt) rather than in volts. Resistances on the other hand are frequently very high—sometimes as high as millions of ohms. These are measured in megohms (meg means one million). Thus the prefix micro means one-millionth and the prefix meg means one million.

There is also in common use the prefix milli, meaning one-thousandth. So a milliampere would be one-thousandth of an ampere and a millivolt, a thousandth of a volt.

Instruments Used

In all practical electricity and radio it is easy to determine the voltage and the amperage of a current flowing in a circuit. For this purpose, voltmeters and ammeters are used. When the value of the e.m.f. in volts is known and the rate of current flow in amperes, practically all the necessary calculations can be made which will determine what course a radiotrician or service man will follow in servicing or improving a radio set.

The instruments commonly used in testing and servicing sets include ammeters and voltmeters for the measurement of direct and alternating currents, galvanometers, ohmmeters, milliammeters—in general the action of such measuring instruments depends on either the magnetic effect of a current or its heating effect.

Practically all of the DC voltmeters, ammeters and milliammeters operate on the D'Arsonval principle.

The D'Arsonval movement depends for its operation on the force causing a conductor carrying current to travel across a magnetic field in which it is placed, very similar in principle to a small motor. The essentials of a motor are a magnetic field produced either by a permanent magnet or an electromagnet, in which is situated a coil or a wire or a series of coils wound in a suitable formation. When a current is passed through the coils there is a torque or twisting action which causes the armature or moving portion to rotate.

The D'Arsonval or moving coil type instrument shown in Fig. 1 employs a simple coil only, carried by a pair of pivots so located that the coil is free to rotate in a strong magnetic field between the poles of a permanent magnet. The coil carries a pointer moving across the instrument scale. This coil cannot rotate indefinitely, because it is restrained by a hair spring, so that the torque or twisting force produced by the current passing through the coil has to overcome the resistance of the spring.

High Resistance in Series

The stronger the current the more will it succeed in moving the pointer, and therefore the greater will be the deflection or rotation of the coil, and the larger will be the scale reading shown by the pointer attached to the coil. The hair spring returns the pointer to zero when no current is flowing through the coil.

A voltmeter is connected directly across a line to measure the pressure of the circuit. It therefore would be a short circuit on the line so the resistance of the voltmeter must be high, so that very little current will flow through it.

The D'Arsonval voltmeters have a high resistance connected in series with the moving coil. Its value is adjusted so that at full scale voltage an amount of current flows that will just bring the pointer to the full scale position. At any intermediate voltage, the pointer will take up a corresponding position. When the full scale voltage is 150 or lower the series resistance is usually placed inside the instrument case. Where the voltage exceeds this value it is the usual practice to supply a separate resistance box which is connected in series with the instrument.

The action of an ammeter is the same as that of a voltmeter. However, its construction is somewhat different because an ammeter is connected in series with the line, so that the entire current will pass through the ammeter and the total current will be measured.

Shunts Determine Range

The D'Arsonval DC ammeter and milliameter is shown in Fig. 2. This instrument has a low resistance strip or shunt, through which the current passes. The only difference between the ammeter and milliammeter is the size of the shunt resistance employed. Since

How to Connect Midget B Supply to a Set

(*Continued from preceding page*)

Therefore low-voltage reading, at no drain, should be remedied by inserting a good tube in the B eliminator socket.

The filament transformer is good for 8.75 amperes without any sign of overheating, therefore, since only one tube is served in the B supply, there is enough power for three more 2½-volt heater tubes, 227, 224, 235 or G-51. The first pair are familiar to all. The 235 and the G-51 are new variable mu tubes, made by different manufacturers.

Anyway, three heater type tubes in the 2½-volt class may be served, in addition to the rectifier. Therefore two binding posts are provided to make this AC voltage accessible.

In building the B eliminator, follow the diagrams, both showing identical connections. Affix the AC toggle switch to one of the green leads of the transformer (one primary lead), so that the switch can be mounted on a hole in the cabinet side, with enough excess of this primary lead so that the assembly can be inserted in the cabinet after the switch has been affixed to the cabinet. It makes no difference which side of the line is interrupted by the switch.

The connections are: B minus to the grounded side of the set, converter or adapter to be served, B plus to the positive B lead from the set, converter or adapter. In battery installations B minus is usually connected to A minus, and that rule may be followed with safety in all cases. The grounded side of nearly all sets is denoted by the ground binding post, so connect B minus to that. If no B voltage reading obtains, that is, the set tubes get no B current, the remedy is to connect B minus to the metal chassis of the set, from which ground is insulated. The author knows of only one factory-made set that requires connection to the chassis.

If intermediate B voltages are required they may be obtained by voltage drops in resistors. For instance, connect a 50,000-ohm resistor from B plus to a screen for screen voltage, 20,000 ohms for two screens, 10,000 ohms for three screens.

ring Instruments

A. Dowie
National Radio Institute

the coil and shunt are in parallel the laws of parallel circuits apply.

No shunt other than the one provided with an instrument may be used without a recalibration of the scale readings.

A milliammeter can be used as a voltmeter by using it to measure the current caused to flow through a known resistance by the voltage to be measured.

The construction of an ohmmeter is practically the same as that of a DC voltmeter or ammeter, that is, it contains a permanent magnet, between which is pivoted a movable coil carrying a pointer. The winding of the movable coil, however, is divided into two parts by means of a tap at the center of the winding, and these two parts are included one in each of two branch circuits, the deflection of the movable coil depending upon the currents flowing through the parts of its winding, which currents are proportionate to the resistances connected to the branch circuits. The value of the resistance being measured is read directly from the scale which is graduated in ohms.

For practical measurements of alternating currents and voltages, instruments known as moving iron types are used almost exclusively. A sketch of the construction of the moving iron type is shown in Fig. 3. The principle of this type of meter (both for current and voltage) is that of repulsion of two similarly magnetized pieces of iron, one of which is fastened to a coil and the other to a pointer which rotates.

Heavy Wire for Ammeter Coils

Both iron vanes are surrounded by a coil of wire carrying the current to be measured and magnetizing both vanes, so that they are of the same polarity.

This instrument therefore acts on alternating current because the iron plates change in polarity when the current reverses, so that they still repel each other.

A voltmeter has a coil of fine wire with a series resistance which is adjusted so that when the full scale voltage is applied to the terminals the current flowing is just sufficient to cause the pointer to move to the full-scale position. Lower values of voltage move the pointer to points on the scale between zero and full scale.

The coil used in an ammeter is wound with heavy wire because it carries the current to be measured. This instrument being calibrated by changing the relative position of the coil and vane and in some cases by connecting an adjustable resistor across the terminals of the coil.

The average value of an alternating current or voltage chosen for comparison is the root-mean-square, which is the square root of the average of the current or voltage squared at any instant. If therefore the moving iron instrument is to be satisfactory, the reading it gives should be proportional to the square of the current flowing through it, and this is actually the case.

If the current is doubled it produces four times the effect. Such an instrument, therefore, would register the average value of the magnetic effect experienced from moment to moment, and since the magnetic effect in each case depends upon the square of the current, the total response of the meter is proportional to the mean of the current squared.

Hot-Wire Ammeter

The hot wire type of current measuring device depends for its action on the expansion of a heated wire, instead of on the effect of a magnetic field on a coil. It may therefore be used to measure either direct or alternating current.

In its simplest form from the hot-wire ammeter consists of a fairly long thin wire of phosphor bronze, through which the current to be measured is passed. The passage of the current causes the wire to heat up, causing the wire to expand. Thus the wire, instead of being tightly stretched, sags in the middle when the current passes. By an ingenious arrangement such as shown in Fig. 4, this sag is made to produce a definite pull on a small cord or chain which passes around a pully wheel acting on a pivot. The rotation of this pully wheel operates a long pointer which travels over the scale and gives a reading of the current.

The disadvantage of the hot-wire measuring device is that it is slow in response and that the pointer must be adjusted frequently to zero position.

All instruments for measuring radio frequency currents depend for their operation on a thermoelectric effect and utilize the voltage which is developed when the junction of two dissimilar metals is heated such as steel and constantan, or manganin and constantan.

Junction Is Heated

These two wires are welded together at the center. The radio frequency current to be measured passes in through one wire and out through the other, heating the wires at the junction. The ends of the wires are connected to a calibrated resistor to the terminals of the moving coil of the instrument.

The heating effect of the radio frequency current passing through the dissimilar wires causes a direct current voltage to be generated, which in turn results in a flow of direct current through the instrument moving coil circuit as shown in Fig. 5.

The deflection of the pointer is proportional to the square of the current flowing in the conductor. For current of more than a few amperes these instruments are made with several thermocouples in series.

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GRADUATE Radio Training Association of America. Have diploma. Age 17 years. Desire position as assistant service man. Start for small salary. Free to go anywhere. Ralph J. Holbrook, 708 E. Airline Ave., Gastonia, N. C.

YOUNG MARRIED MAN, age 26 years, 5 years radio servicing experience. Student of National Radio Institute, now employed as service man by large Atwater-Kent dealer, desires permanent position. Best of references as to character and ability. Elmer Suthers. 5 East Grant, Marshalltown, Iowa.

GRADUATE of National Radio Institute of Washington, D. C., age 18 years, single. Two years' radio servicing and selling experience. Desire permanent position with radio jobber, dealer, or with public address systems or talking movies. Reasonable salary. Clarence Andrews, R. R. No. 1, Bath. Pa.

SERVICE, INSTALLATION AND SALES. Married, middle age, high school and college graduate. 12 years experience builder and service. Graduate National Radio Institute. Have Diagnometer, counter tube checker, Readrite tester, large library. Have serviced all makes of radios. Would take charge of service department for retail dealer. Highest references. Middle west preferred. Write Frank E. Goodwin, 235 E. Washington Ave., Kirkwood, Mo.

EXPERIENCED RADIO SERVICE MAN, 21 years old. Wants job servicing radio sets. Have had experience in broadcast sets as well as short-wave receivers and transmitters. Reference: International Correspondence Schools, Scranton, Pa. Student No. EHH 1175125. Will consider good job anywhere. Paul W. Curtis, 914 Ayers St., Coffeyville, Kans.

RADIO SERVICE MAN—Married, 12 years service, builder and sales. Graduate National Radio Institute 9B69. Complete testing laboratory, including 400-B Diagnometer. Have large library. Would prefer to take entire charge of service department of retail dealer. Best of references. Frank E. Goodwin, 235 East Washington Ave., Kirkwood, Mo.

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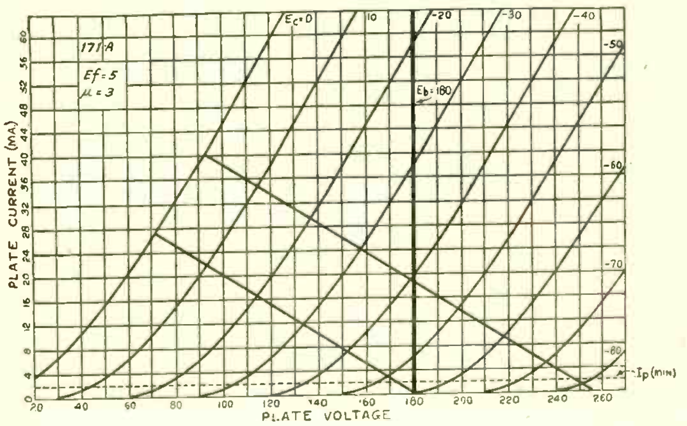


FIG. 916

A family of plate current, plate voltage curves for the 171A power tube with two load lines, both for a resistance of 4,500 ohms. The upper curves gives the practical operating conditions.

Curves for 171A Power Tube

WILL you kindly publish curves from which the output power of a power tube can be computed for different load resistances? A family of plate voltage current curves will do. —B. W. R.

You will find your curves in Fig. 916. The two load lines are drawn for the same resistance but for different voltages in the plate circuit.

* * *

Antenna Conflict

PLEASE explain the meaning of the term "antenna conflict" I have found in Government safety rules for installing radio sets.—G. W. S.

The definition, taken from the Department of Commerce handbook, "Safety Rules for Radio Installations," reads as follows: Antenna conflict means that an antenna or its guy wire is at a higher level than a supply or communication conductor and approximately parallel thereto, provided the breaking of the antenna or its support will be likely to result in contact between the antenna or guy wire and the supply or communication conductor." In other words, antenna conflict signifies a dangerous location of the aerial whereby it might possibly come in contact with other lines and cause a short-circuit.

* * *

List of Amateur Stations

PLEASE advise where information can be obtained on the locations and call letters of the Amateur and Government stations heard on the radio?—F. A. J.

The Government amateur station call book "Amateur Radio Stations of the United States" may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 25c. Another call book "Commercial and Government Radio Stations of the United States" may be purchased from the same office for 15c. The "Radio Service Bulletin," a monthly supplement to the latter book, costs 25c per year, but does not include amateur stations.

* * *

Regeneration Control

PLEASE advise which is the best method of controlling the regeneration in a short-wave set we contemplate building: (1), the condenser system, (2), the coil feedback system; (3), the resistance-shunt system.—W. A. A.

All of the systems you mention are usable and it is not possible to state which is preferable. Unless the resistor is very well made it may prove noisy. The coil system is effective, as well as the condenser control. The condenser system has great smoothness of action and minimum detuning effect. However, if you are following a definite set, you will make a mistake by changing the feedback method.

* * *

Operating Cost of Set

HOW much do you figure it costs to run an ordinary radio re-receiving set?—E. S.

If you mean only the amount of current consumed, and do not include the replacing of tubes, repairs, etc., it is possible to arrive at a fair estimate. In each case, however, it would be necessary to know the amount of current drawn, in order to compute the wattage. Sets vary greatly in power consumption. If you know how to read your electric meter, run your set steadily for a couple of hours, noting the readings before and after. You know what your rate is per kilowatt-hour. During the test, have all other lights and appliances turned off, so that the meter does not move until the radio set is turned on.

* * *

Automombile Interference

I LIVE on a busy traffic avenue, and in attempting to receive short-wave broadcasting I get a lot of interference from automobiles. Not all cars interfere, I notice. What can be done to eliminate this trouble?—S. G.

Some cars have metal conduits for most of the wiring and on this account there is little radiation from the wiring. The spark is the direct cause and because of the small physical dimensions of the wiring system, the wavelengths on which the interference is the strongest are short. You can help matters by locating the short-wave set in the end of the house farthest from the avenue. Also run the aerial away from the street and use a number of ground connections. In other words, just get your whole radio outfit farther from the cars, if possible. At least, run the aerial away from them.

* * *

Intermittent Interferences

OUR radio is interfered with by a crackling sound. It starts with a snap and stops the same way, the noise lasting only for a moment or two and then starting up a little later. The sound seems to have a low tone. We cannot find anyone nearby using a motor.—B. S.

Sometimes the interfering wave impulses are carried along electric wires for some distance. The sound probably comes from a motor somewhere and certainly from some electrical device. Have you requested cooperation of your power company? They will probably be willing to make tests and locate the source of this interference. Try disconnecting your aerial. If the noise stops, it is clear that it is being picked up by the aerial. You might try to run the aerial at right angles to the power lines and far from them. If the noise continues despite disconnecting the aerial, it is apparently coming via the power circuit, and a line noise eliminator would probably prove to be a solution to the problem.

* * *

Slide-Back Vacuum Voltmeter

I HAVE seen reference to a slide-back vacuum tube voltmeter but have never seen it described anywhere. Will you kindly explain what it is?—A. B. N.

In a slide-back vacuum tube voltmeter the bias on the tube is first adjusted with no signal voltage applied until a certain deflection is obtained in the plate circuit, usually very small. The bias is noted. Then the signal voltage is applied. The plate current increases. The grid bias is then increased until the plate current is exactly the same as before the signal was applied and the new bias noted. The signal voltage is then deduced from the difference between the two voltages. A potentiometer is used for adjusting the bias and the term "slide-back" is obtained from the fact that the position of the slider is moved toward the negative, or backward, to increase the bias. This was one of the earliest forms of vacuum tube voltmeter.

* * *

Tube Substitution in Direct Coupled Amplifier

IF a Loftin-White amplifier has been designed for a 245 tube can a 247 pentode be substituted without making any changes in the circuit? If not, what changes are necessary?—L. N. D.

The substitution can be made if the resistances in the voltage divider are changed so that the tubes will get the proper voltages. The success of the circuit depends entirely on the adjustment of the resistances and a tube taking a total of 39.5 milliampere plate current and a grid bias of 16.5 volts will require quite different resistances from a tube taking a current of 32 milliamperes and a bias of 50 volts.

* * *

Using 6.3 Volt Tubes on Farm Lighting Plant

IS THERE any way of using the 6.3 volt tubes in a circuit powered with 32-volt farm lighting plant without sacrificing most of the voltage for the heaters? That is, can most of the voltage be used for the plates and still use the battery for the heaters? —R. T. M.

You don't have to sacrifice any of the voltage because the heaters are not connected to the cathodes. That is, you can connect as many as 5 of the 6.3-volt tubes in series across the 32-volt battery, thus utilizing the whole voltage for the heaters, and still use the entire 32 volts for the plates and the screens. Of course, it would be necessary to connect batteries in series with the 32-volt battery to get enough voltage to operate the tubes satisfactorily. You should at least add 90 volts more. The power taken by the five tubes would be .3x6.3, or 1.89 watts.

* * *

Micro-Ray System

IN YOUR description of the Micro-Ray system of communication on 18 centimeters you stated that no power would be lost if hole in the back of the paraboloidal reflector were smaller than the diameter of the hemispherical mirror. How do you explain that statement? Is it not a fact that all the power that escapes through the hole is lost?—N. J. M.

If there were a reflecting surface in place of the hole the part of the energy striking this surface would be reflected back to the hemispherical mirror, which would send it back to the paraboloid, and this would send it back to the hemisphere. That is, that portion of energy would be tossed back and forth without a chance of escaping. This seems to be the argument but it does not take into account the principle of conservation of energy nor the fact that ultimately much of it would escape in the forward direction.

* * *

10 KC Selectivity

WILL a superheterodyne receiver having two RF stages and two IF stages, two sharp tuners in the RF level and three in the IF level have a selectivity of 10 kilocycles?—W. H. J.

Who knows? What do you mean by 10 kc selectivity? What is the selectivity of each tuner in the circuit and how accurately are all the tuned circuit adjusted to the desired frequencies? Selectivity is not measured in terms of frequency or kilocycles. Usually the selectivity is measured by the ratio of the inductive reactance to the resistance in the tuned circuit, a pure number. What is this number for each of the tuners in your receiver? Now if your circuits are tuned correctly and accurately, you can multiply all the selectivities together to get the selectivity of all of them. But the number you get will not tell whether your receiver has 10 kc selectivity or not, for 10 kc selectivity does not mean a thing.

* * *

Small Pentode Tube

HAS a pentode power tube been announced for the 2-volt tube series to take the place of the 231 power tube? If so, what are its characteristics?—T. B. C.

Such a tube has been announced and is designated as the 233. For characteristics of the tube see the May 2, 1931, issue. This tube is not interchangeable with any other existing tube, including the 231.

* * *

Interference from Electric Clocks

IT IS said that electric clocks do not cause any intererence with radio receivers. If that is true, why is it? Is there not an electric motor in the clock and do not all motors cause interference?—G. H. S.

There are two types of motors which do not cause interference. One is the induction motor and the other is the synchronous motor. Every electric clock, as such clocks are now known, contains a synchronous motor and therefore it does not cause interference. The reason induction and synchronous motors do not cause interference is that there are no brushes in them to cause any sparking.

* * *

Close Coupling, Low Selectivity

WHY is it that when two tuned coils are coupled very closely together the selectivity of the combination is less than when either winding is tuned? Should not the selectivity be twice as great when both circuits are tuned as when only one is tuned? —B. N. S.

That is not easy to answer without the use of mathematics. It is possible to set down the equations for a transformer that is tuned both in the primary and secondary to the same frequency when the coils are not coupled and the equations will show that the selectivity is very poor. Experiment shows that equations tell the true story.

* * *

Ultra-Short Wave Receiver

I AM contemplating building a receiver that will operate on waves below 10 meters but am undecided what type of receiver to build. Is a superheterodyne suitable for such short waves, and if so what is a good intermediate frequency? Would you recommend regeneration in the intermediate frequency amplifier? What about using radio frequency amplification? Would it be advantageous to step the frequency down in three steps, using two oscillators and two intermediate frequencies?—S. W. J.

A superheterodyne receiver would undoubtedly be the best. The intermediate frequency might be any value from 250 to 3,000 kc. A frequency of 1,500 kc seems to be a good mean. However, it depends just how low in wavelength you intend to operate the circuit. The shorter the waves the higher the intermediate frequency should be. Regeneration in the intermediate frequency amplifier would be advantageous since you could boost the amplification manifold without extra tubes. A stage of RF amplification would be useless because it would not contribute anything to the sensitivity. If would not be necessary to step the frequency down in three steps. Just an ordinary superheterodyne would be sufficient now that screen grid tubes and shielding are available.

* * *

Electrical and Geometric Degrees

WHAT is the difference between electrical and geometric degrees? Is a degree not a degree no matter where it occurs? —A. N. D.

Sure a degree is a degree. But there are only 360 mathematical degrees around a circle. In an electric armature having many pairs of poles there are as many complete circles, electrically, as there are pairs of poles. The armature, for example, may only move sixty degrees and yet go through a whole cycle, that is 360 electrical degrees. On such an armature there would be six pairs, or 12 poles. If there are only two poles there are as many electrical as geometric degrees. A vacuum tube oscillator generates an alternating current which is a circular function. It is not easy to refer this directly to geometry, is it? The current varies as time progresses, and varies in a definite way. The phenomenon may be presented geometrically and the time taken by one complete circle may be represented as 360 degrees. They are electrical degrees.

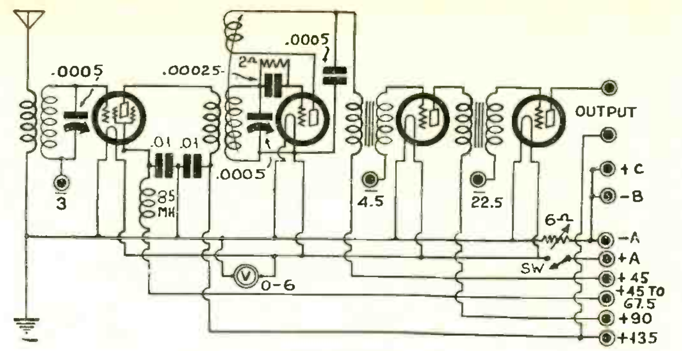


FIG. 917

A simple four-tube receiver in which there is a screen grid RF amplifier, and regenerative detector, and two stages of transformer coupled audio. The circuit is suitable for a portable set.

* * *

Portable Set

I AM looking for a four tube portable set with transformer coupled audio. It should contain one screen grid radio frequency amplifier and a regenerative detector. Will you kindly publish such a circuit?—W. B. N.

In Fig. 917 is such a receiver which may be used with the new two volt tubes, first a 232 screen grid tube, then two 230 tubes and finally a 231 power tube. If the filament battery voltage is 3 volts, the six ohm rheostat is sufficient to reduce the current until the voltmeter reads 2 volts, which is the proper operating voltage. The proper plate, screen and grid voltages are indicated.

* * *

Degree of Coupling

IN a band pass filter in which the two tuned circuits are coupled by a .05 mfd. condenser and the tuning condensers are .0005 what is the degree of coupling and what is the width of the band passed?—B. F.

If the two tuned circuits are exactly alike and the impedance of the tuning condenser and the tuning coil in each is Z and the impedance in common with the two is Zm, one frequency is determined by Z=O and the other by Z+2Zm=O. The difference between these two frequencies is the width of the band. Now if the inductance of each coil is L and the capacity of each tuning condenser is C, the value of Z is Lw—1/Cw, in which w is two times pi times the frequency. Thus one frequency is .159 divided by the square root of the product of L and C. The common impedance is —1/Cmw and therefore 2Zm is —2/Cmw. If we put this and the previous value of Z in the second equation and solve for the frequency we get .159 times the square root of the quantity (1/LC+2/LCm).

If we divide one of the expressions for frequency by the other and cancel we get f2/f1 equals the square root of (1+2C/Cm.) But C/Cm is very small compared with unity so that the square root of the quantity is very nearly equal to (1+C/Cm). Therefore f2—f1=f1C/Cm. That is, the band width, or the difference between the two frequencies, is equal to f1C/Cm. In this f1 is the frequency obtained from the simple relation Z=O.

It is clear that the band width does not remain constant but varies with the frequency and the capacity of the tuning condenser, or since the inductance remains constant we may deduce the fact that the width of the band varies as the square root of the capacity of the tuning condenser. At one million cycles the band width is 3,025 cycles in this particular case. The degree of coupling between the two circuits might be defined as the ratio C/Cm, which at one million cycles would be .003025.

* * *

Close-Coupled Oscillator

WHAT is the effect of close coupling between the tickler and the tuned coil in an oscillator on the generated current? On the stability of frequency? On the output power?—S.E.W.

The closer the coupling the more violently the tube oscillates and that means that the poorer the wave form. It also means greater output power. The frequency stability is less the closer the coupling. Some improvement may be effected by tuning the tickler coil instead of the grid coil both as to purity of wave form and frequency stability. But the best way to get a pure wave and a high frequency stability is to limit the feed back to the lowest value that will sustain oscillation. It makes little difference how the feed back is limited. One way is to use loose inductive coupling between the two coils.

MOVE IS MADE TO EJECT ALL RCA STATIONS

Washington.

The Supreme Court of the United States refused to disturb the finding of a lower Federal Court that the Radio Corporation of America had violated the the Clayton Anti-Trust Law in its inclusion of "clause 9" in contracts with licensed set manufacturers whereby these manufacturers had to equip their receivers initially with RCA tubes.

The clause has not been in effect since July, 1928, when it was abandoned on the ground it was not good policy to impose this restriction, but competing tube manufacturers have pending damage suits against RCA, on the ground their business was injured by an unlawful contract provision imposed by RCA on the set manufacturers it licensed.

Sections 13 and 15 of the Radio Act provide in effect that any holder of a license to broadcast, found guilty of violating the anti-monopoly laws, in addition to other penalties imposed, may be compelled by the court to forfeit all transmitting licenses.

WTMJ Seizes Decision

Since the National Broadcast Company is wholly owned by RCA, WTMJ, Milwaukee, has seized upon the decision in the "clause 9" case to petition the Federal Radio Commission for a clear channel on 870 kc, now shared by WENR, Chicago, which station was recently acquired by the National Broadcasting Company. The sharing station is WLS, Chicago.

The Commission has decided to pass upon the application, and thereby, render a decision affecting the status of the RCA, the National Broadcasting Company and other RCA-owned enterprises, in relation to the "clause 9" case. The Commission has directed its legal department to render a report on the legal aspects of the WTMJ case, which would bring the whole matter to the fore.

Meanwhile petitions for permission to use the maximum power of 50,000 watts are before the Commission for decision, and some of the applications are from stations owned and operated by the National Broadcasting Company. Therefore, since the very existence of the stations so owned is under consideration, action on all 50,000-watt applications is being deferred, hence the solution of the entire high-power problem is delayed.

25% of All Licenses Affected

With RCA and its subsidiary and associated companies holding nearly one-fourth of all radio licenses issued by this country for commercial and experimental purposes, exclusive of amateurs, it was explained that the Commission wishes to determine the applicability of provisions of the Radio Act to the case. For that reason the Commission has referred the question to its Legal Division for opinion, preparatory to any action.

Japan Every Morning

"I constructed one of the converters described in your magazine and it sure has worked well. Japan every morning after daylight, and the east coast any evening before sunset. I am in a poor location, too."—*Verlin L. Cochran,* 1264 *Second St., Chehalis, Wash.*

1,409 Licenses of RCA at Stake

The Radio Corporation of America has a total of 1,409 licenses for various radio purposes, principally transmission.

There are 25,000 licenses issued, but of these some 19,000 are issued to amateurs for purely experimental non-commercial operations.

RCA Communications, Inc., an RCA-owned enterprise, with trans-oceanic circuits in more than 30 foreign nations, has 121 point-to-point station licenses, 16 experimental, 2 special experimental and 1 marine relay.

National Broadcasting Company holds 7 broadcasting station licenses, which serve as the nucleus for its broadcasting networks, 2 visual broadcasting or television; 9 general experimental, and 3 special experimental.

Radiomarine Corporation of America has 1,175 shop station licenses, 22 coastal stations, 16 marine relay, 11 point and 11 coastal in Alaska, 2 aircraft and 4 experimental. RCA Victor has 2 experimental, 1 special experimental, and 1 visual broadcasting.

Cited Law Irrelevant, Davis Says, for RCA

A statement was issued by John W. Davis, chief counsel of the Radio Corporation of America, in the "clause 9" case, in which the De Forest Radio Company was the principal plaintiff. He said:

"The denial by the United States Supreme Court of the writ of certiorari sought by the Radio Corporation of America concerning the so-called 'clause 9' provisions of the Radio Corporation's licensing agreements in no way affects the agreements as now in force between the Radio Corporation of America and its licensees. The provisions contained in 'clause 9,' as a matter of fact, have not been in force since July 1928. The relations between the Radio Corporation and its licensees therefore remain unchanged.

"The specific issues involved in the adjudication of 'clause 9' were initiated by the De Forest Radio Company, which is not licensed under the patents of the Radio Corporation of America. The parties plaintiff in the so-called 'clause 9' damage cases have yet to establish their rights to do the kind of business referred to in their claims, or that they suffered any damage whatever by reason of the 'clause 9' provisions which have not been in operation in any event since July 1928.

"The so-called 'clause 9' case involved no issue and resulted in no adjudication of the kind contemplated by Section 13 of the Radio Act, which relates to the matter of licenses granted by the Federal Radio Commission for the operation of radio transmitting stations."

LAW INVOKED AGAINST RCA

Two provisions of the Radio Act relate to the effect of a finding of monopolistic activity, and prescribe a license forfeiture in the discretion of the court. These provisions follow:

"Section 13.—The licensing authority is hereby directed to refuse a station license and (or) the permit hereinafter required for the construction of a station to any person, firm, company or corporation, or any subsidiary thereof, which has been finally adjudged guilty by a Federal court of unlawfully monopolizing or attempting unlawfully to monopolize, after this act takes effect, radio communication, directly or indirectly, through the control of the manufacture or sale of radio apparatus, through exclusive traffic arrangements, or by any other means or to have been using unfair methods of competition. The granting of a license shall not estop the United States or any person aggrieved from proceeding against such person, firm, company, or corporation for violating the law against unfair methods of competition or for a violation of the law against unlawful restraint and monopolies and (or) combinations, contracts, or agreements in restraint of trade, or from instituting proceedings for the dissolution of such firm, company, or corporation.

"Section 15.—All laws of the United States relating to unlawful restraint and monopolies and to combinations, contracts or agreements in restraint of trade are hereby declared to be applicable to the manufacture and sale of and to trade in radio apparatus and devices entering into or affecting interstate or foreign commerce and to interstate or foreign radio communications. Whenever in any suit, action, or proceeding, civil or criminal, brought under the provisions of any of said laws or in any proceedings brought to enforce or to review findings and orders of the Federal Trade Commission or other Governmental agency in respect of any matters as to which said Commission or other Governmental agency is by law authorized to act, any licensee shall be found guilty of the violation of the provisions of such laws or any of them, the court, in addition to the penalties imposed by said laws, may adjudge, order, and (or) decree that the license of such licensee shall, as of the date of the decree or judgment, become finally effective or as of such other date as the said decree shall fix, be revoked, and that all rights under such license shall thereupon cease: Provided, however, that such licensee shall have the same right of appeal or review as is provided by law in respect of other decrees and judgments of said court."

Hotel Loser in Copyright Suit

Washington.

By a ruling of the Supreme Court, hotels must not reproduce copyright broadcast music without the permission of the owners of the compositions.

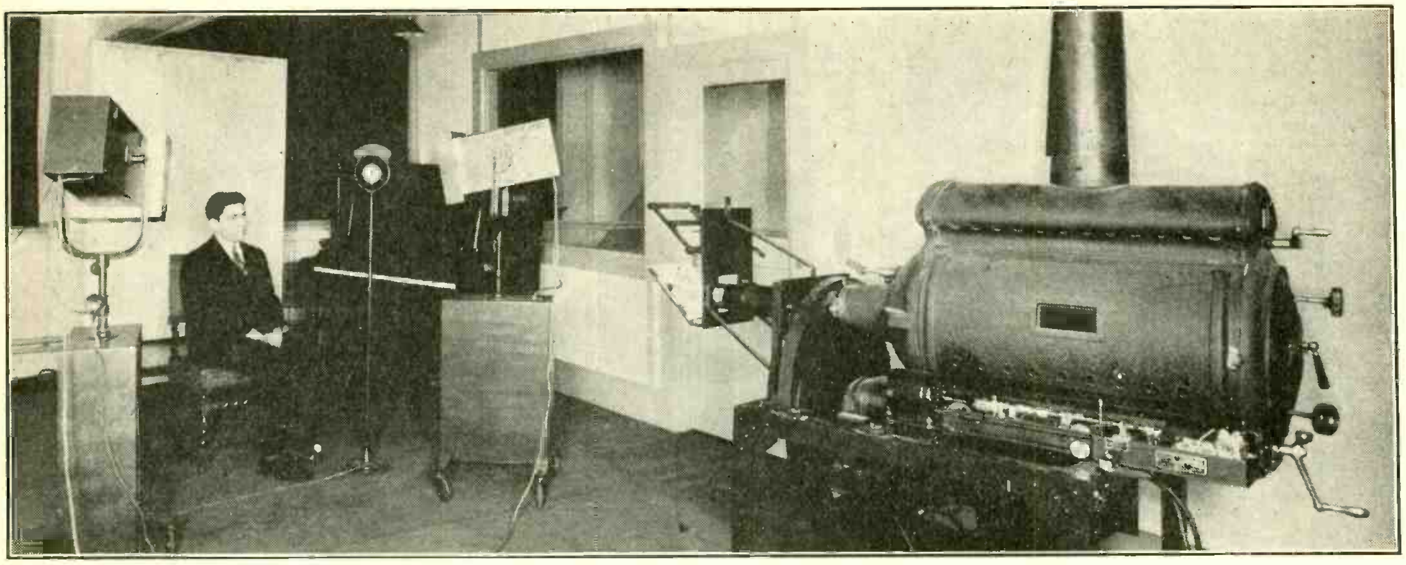
The case arose when the American Society of Composers, Authors and Publishers, of which Gene Buck is president, brought suit against the Jewell-La Salle Realty Company, which operates the La Salle Hotel in Kansas City, Mo., in a District Federal court. The hotel has a master receiving set, with loudspeakers throughout the building, and had been receiving programs from a station operated by Wilson Duncan, in Kansas City.

The lower court ruled that the acts of the hotel did not constitute a performance under the copyright law. The case then went to the Supreme Court on a writ of certiorari, in which the chief question was whether the action of the hotel constituted a performance under the copyright law.

Associate Judge Brandeis handed down the court's opinion.

"There is no difference," wrote Justice Brandeis, "in substance between the case where a hotel engages an orchestra to furnish music and that where by means of the radio set and loudspeakers here employed it furnishes the same music for the same purpose. In each the music is produced by instrumentalities it controls."

POINT OF ORIGIN OF RADIO TALKIE TRANSMISSION



Direct pick-up studio of W2XCD of the DeForest Radio Company at Passaic, N. J., showing scanner, projector and the two photo-electric cell units, as well as microphone, for synchronized sight and sound broadcasting.

RADIO TALKIES ON A SCHEDULE FOR FIRST TIME

Radio talkies, or combined television and sound broadcasting, were inaugurated recently in New York when WGBS and W2XCR transmitted a specially arranged program.

The sound portion of the transmission was sent out by WGBS and the visual portion by W2XCR. The program began at 6 p.m. and lasted most of the evening. It was the first time that a regular program with combined sight and sound had been broadcast with actual performers.

Thousands Interested

Special television and sound receivers had been set up in Aeolian Hall, where several thousand interested spectators and listeners gathered to catch glimpses of the image reception of the performers and to hear their reproduced voices. The images appeared to be a foot square when they were viewed through special lenses and the actors were easily recognizable by those who knew them.

A thunderstorm which passed over the region during the program marred not only the pictures received but also the sound, since it caused many static crashes.

Carnera Performs

One of the performers before the photo electric cells and the microphone was Primo Carnera, the boxer, who did a sketch in the sight-sound studio. Lionel Atwill gave a short scene from "The Silent Witness" and was assisted by Kay Strozzi.

Sylvia Field, Gladys Hanson and Louis Calhern presented a portion of "Give Me Yesterday."

Other performers in the special inaugural program were Gertrude Lawrence, Frances Williams, Peggy Hopkins Joyce, Dorothy Sands, Thais Lawton, Ina Hayward, Ruth Altman, Dorothy Appleby, Fay Saunders, Winnie Shaw, Lyda Roberti, Belle Bart, Dagmar Perkins, Constance Collier, Frances Upton, J. C. Flippen, William Faversham, Roark Bradford, Marc Connelly, Rowland Stebbins, William Harrison, Ludwig Satz, N. T. Granlund, Harry Hershfield, Jacob Ben-Ami, Billie Leonard, Dick Gilbert, Ruth Wimp, the Forman Sisters, and Charles Purcell, and the dancers Maria Gambarelli, Patricia Bowman and Fay Marbe. Sir Guy Standing and Edith Barrett went through a portion of "Mrs. Moonlight" and Felix the Clown of the Ringling's circus strutted before the instruments. Paul Althouse, tenor, sang.

Technical Details

The sound portion went out on the 254-meter wave of WGBS and the visual portion over the 147-meter wave of W2XCR. Two receivers were required at each receiving station, one for each wave, the two signals being combined by placing the loudspeaker near the viewing screen. The receiving equipment at Aeolian Hall was supplied by the Jenkins Television Corporation of Passaic, N. J.

Power Increase

The power of the television transmitter was 500 watts but shortly this will be increased to 5,000 watts, which has been allowed by the Federal Radio Commission. The scanning system uses 60 lines to the frame and 20 frames to the second, which is now becoming standard.

The schedule of transmission from these stations will be from 3 to 5 p.m. and from 6 to 8 p.m. every day except Sunday. On Sundays the transmission period is from 6 to 8 p.m. The first hour each afternoon talking films will be the basis of transmission and the remaining time actual actors will perform.

KMOX Seeks Vision

St. Louis, Mo.

KMOX, of this city, known as the "Voice of St. Louis," has applied to the Federal Radio Commission for a television transmitter license. It is reported that several other broadcast stations will also apply in a short time for such licenses. Interest in television is reported from all over the country.

Short Wave & Television Corporation of Boston has announced the acquisition of five more television patents in addition to ten acquired a few weeks ago, which shows clearly the awakening interest in the subject.

N. Y. STATE SUES TO BAR A FIRM FROM THE AIR

The question whether a State has the right to prohibit the broadcasting of subject-matter not in keeping with the laws of the State, although control of broadcasting is a Federal function principally, is raised by the Attorney General's office of the State of New York, in an action involving WOV.

The test case is being waged by the State on behalf of its State Insurance Department, against the International Broadcasting Company, operator of WOV, with transmitter at Secaucus, N. J., and a studio at 16 East Forty-second street, New York City.

Injunction Sought

The action is one to prevent the broadcasting of programs sponsored by the Mutual Life Insurance Company, of Des Moines, Ia., over WOV, because the insurance company has not conformed to the New York State Insurance Law, and therefore is unauthorized to do business in New York State.

The Attorney General's office asserts that since a section of the State's penal law makes it a misdemeanor to aid in the solicitation of procurement of insurance on behalf of a "foreign" insurance company not licensed to do business in the State, an action to enjoin the performance of any such illegal act is tenable.

Defense Claims No Jurisdiction

On several occasions, it is maintained, remarks were broadcast from WOV which constituted such solicitation with a view toward procurement of insurance by listeners.

The defense maintains that the State has no authority to intervene, as broadcasting is interstate commerce, hence under exclusive Federal control and supervision.

Another point made is that the broadcast itself was free from any infringement of the State law, as use of the mails for the same message would have been.

LIST OF STATIONS BY STATES

[The call letters, location of main studio and the frequency are given. If the transmitter is located at some other place than is the main studio, the transmitter location is given additionally, preceded by the letter "T."]

Call City kc

ALABAMA
WAPI—Birmingham 1140
WBRC—Birmingham 930
WKBC—Birmingham 1310
WJBY—Gadsden 1210
WODX—Mobile 1410
T—Springhill
WSFA—Montgomery 1410
WFDW—Tallodega 1420

ALASKA
KFIU—Juneau 1310
KFQD—Anchorage 1230
KGBU—Ketchikan 900

ARIZONA
KFXY—Flagstaff 1420
KCRJ—Jerome 1310
KTAR—Phoenix 620
KOY—Phoenix 1390
KPJM—Prescott 1500
KVOA—Tucson 1260
KGAR—Tucson 1370

ARKANSAS
KLCN—Blytheville 1290
KUOA—Fayetteville 1390
KFPW—Fort Smith 1340
KTHS—Hot Springs National Park 1040
KLRA—Little Rock 1390
KGHI—Little Rock 1200
KGJF—Little Rock 890
KBTM—Paragould 1200

CALIFORNIA
KRE—Berkeley 1370
KMPC—Beverly Hills 710
KELW—Burbank 780
KFVD—Culver City 1000
KXO—El Centro 1500
KMJ—Fresno 1210
KZM—Hayward 1370
KFWB—Hollywood 950
KNX—Hollywood 1050
T—Los Angeles
KFQU—Holy City 1420
KMCS—Inglewood 1120
KGER—Long Beach 1360
KFOX—Long Beach 1250
KECA—Los Angeles 1430
KFI—Los Angeles 640
KFSG—Los Angeles 1120
KGEF—Los Angeles 1300
KGFJ—Los Angeles 1200
KHJ—Los Angeles 900
KMTC—Los Angeles 710
KTBI—Los Angeles 1300
KECA—Los Angeles 1430
KTM—Los Angeles 780
T—Santa Monica
KMTR—Los Angeles 570
KLX—Oakland 880
KLS—Oakland 1440
KROW—Oakland 930
T—Richmond
KPPC—Pasadena 1210
KPSN—Pasadena 1360
KFBK—Sacramento 1310
KFXM—San Bernardino 1210
KFSD—San Diego 600
KGB—San Diego 1330
KGO—San Francisco 790
T—Oakland
KFRC—San Francisco 610
KGGC—San Francisco 1420
KFWI—San Francisco 930
KJBC—San Francisco 1070
KJBS—San Francisco 1070
KPO—San Francisco 680
KTAB—San Francisco 560
T—Oakland
KYA—San Francisco 1230
KQW—San Jose 1010
KREG—Santa Ana 1500
KDB—Santa Barbara 1500
KSMR—Santa Maria 1200
KGDM—Stockton 1100
KWG—Stockton 1200

COLORADO
KFUM—Colorado Springs 1270
KPOF—Denver 880
KFUP—Denver 1310
KFEL—Denver 920
KFXF—Denver 920
KOA—Denver 830
KLZ—Denver 560
KFXJ—Grand Junction 1310
KGEW—Fort Morgan 1200
KFKA—Greeley 880
KGHF—Pueblo 1320
KGIW—Trinidad 1420
KGEK—Yuma 1200

CONNECTICUT
WICC—Bridgeport 600
T—Easton
WTIC—Hartford 600, 1060
T—Avon
WDRC—Hartford 1330
T—Bloomfield
WCAC—Storrs 600

DELAWARE
WDEL—Wilmington 1120
WILM—Wilmington 1420
T—Edge Moor

DIST. OF COLUMBIA
WOL—Washington 1310
WMAL—Washington 630
WRC—Washington 950

FLORIDA
WFLA—Clearwater 620
WRUF—Gainesville 830
WJAX—Jacksonville 900
WQAM—Miami 560
WIOD-WMBF—Miami 1300
T—Miami Beach
WDBO—Orlando 1120
WCOA—Pensacola 1340
WSUN—St. Petersburg 620
WDAE—Tampa 1220
WMBR—Tampa 1370

GEORGIA
WGST—Atlanta 890
WSB—Atlanta 740
WRDW—Augusta 1500
WRBL—Columbus 1200
WMAZ—Macon 890
WFDV—Rome 1370
WTOC—Savannah 1260
WQDX—Thomasville 1210
WRBI—Tifton 1310
WTFI—Toccoa 1450

HAWAII
KGU—Honolulu 940
KGMB—Honolulu 1320

IDAHO
KIDO—Boise 1250
KID—Idaho Falls 1320
KFXD—Nampa 1420
KSEI—Pocatello 900
KGKX—Sandpoint 1420
KTFI—Twin Falls 1320

ILLINOIS
WCAZ—Carthage 1070
KYW-KFKX—Chicago 1020
T—Bloomingdale Township
WAAF—Chicago 920
WBBM-WJBT—Chicago 770
T—Glenview
WCFL—Chicago 970
WCRW—Chicago 1210
WEDC—Chicago 1210
WENR-WBCN—Chicago 870
T—Downers Grove
WGES—Chicago 1360
WGN-WLIB—Chicago 720
T—Elgin
WIBO—Chicago 560
WJBT—Chicago 770
T—Desplaines
WKBI—Chicago 1420
WLS—Chicago 870
T—Crete
WMAQ—Chicago 670
T—Addison
WMBI—Chicago 1080
WCHI—Chicago 1490
T—Batavia
WPCC—Chicago 560
WSBC—Chicago 1210
WHFC—Cicero 1420
WJBL—Decatur 1200
WEHS—Cicero 1420
WKBS—Galesburg 1310
WEBQ—Harrisburg 1210
WCLS—Joliet 1310
WKBB—Joliet 1310
WJBC—La Salle 1200
WJJD—Mooseheart 1130
WJAZ—Mount Prospect 1490
WMBD—Peoria Heights 1440
WTAD—Quincy 1440
WHBF—Rock Island 1210
KFLV—Rockford 1410
WCBS—Springfield 1210
WTAX—Springfield 1210
WDZ—Tuscola 1070
WILL—Urbana 890
WCBD—Zion 1080

INDIANA
WHBU—Anderson 1210
WKBV—Connersville 1500
WCMA—Culver 1400
WGBF—Evansville 630
WGL—Fort Wayne 1370
WOWO—Fort Wayne 1160
WJKS—Gary 1360
WWAE—Hammond 1200
WKBF—Indianapolis 1400
T—Clermont
WRAF—La Porte 1200
WJAK—Marion 1310
WLBC—Muncie 1310
WSBT—South Bend 1230
WBOW—Terre Haute 1310

IOWA
WOI—Ames 640
KFGQ—Boone 1310
KWCR—Cedar Rapids 1310
KSO—Clarinda 1380
KOIL—Council Bluffs 1260
WOC—Davenport 1000
KGCA—Decorah 1270
KWLC—Decorah 1270
WHO—Des Moines 1000
WSUI—Iowa City 880
KFJY—Fort Dodge 1310
KFJB—Marshalltown 1200
KTNT—Muscatine 1170
WIAS—Ottumwa 1420
KICK—Red Oak 1420
KFNF—Shenandoah 890
KMA—Shenandoah 930
KSCJ—Sioux City 1330
WMT—Waterloo 600

KANSAS
KGNO—Dodge City 1210
WLBF—Kansas City 1420
KFKU—Lawrence 1220
WREN—Lawrence 1220
KSAC—Manhattan 580
KFKB—Milford 1050
WIBW—Topeka 580
KFH—Wichita 1300

KENTUCKY
WCKY—Covington 1490
WFIW—Hopkinsville 940
WHAS—Louisville 820
T—Jeffersontown
WLAP—Louisville 1200
WPAD—Paducah 1420

LOUISIANA
KMLB—Monroe 1200
WABZ—New Orleans 1200
WDSU—New Orleans 1250
T—Gretna
WJBO—New Orleans 1420
WJBW—New Orleans 1200
WSMB—New Orleans 1320
WWL—New Orleans 850
KRMD—Shreveport 1310
KTBS—Shreveport 1450
KTSL—Shreveport 1310
KWEA—Shreveport 1210
KWKH—Shreveport 850
T—Kennonwood

MAINE
WRDO—Augusta 1370
WABI—Bangor 1200
WLBZ—Bangor 620
WCSH—Portland 940
T—Scarboro

MARYLAND
WBAL—Baltimore 760, 1060
T—Glen Morris
KCAO—Baltimore 600
WCBM—Baltimore 1370
WFBR—Baltimore 1270
WTBO—Cumberland 1420

MASSACHUSETTS
WBIS—Boston 1230
WEEI—Boston 590
T—Weymouth
WHDH—Boston 830
T—Gloucester
WLOE—Boston 1500
T—Chelsea
WNAC-WBIS—Boston 1230
T—Quincy
WSSH—Boston 1410
WSAR—Fall River 1450
WLEX—Lexington 1410
WLEY—Lexington 1370
WBSO—Needham 920
WNBH—New Bedford 1310
T—Fairhaven
WMAF—South Dartmouth 1410
WBZ—Springfield 990
T—East Springfield
WORC-WEPS—Worcester 1200
T—Auburn
WTAG—Worcester 580

MICHIGAN
WELL—Battle Creek 1420
WBCM—Bay City 1410
T—Hampton Township
WKZO—Berrien Springs 590
WHDF—Calumet 1370
WXYZ—Detroit 1240
WJR—Detroit 750
T—Sylvan Lake Village
WMBC—Detroit 1420
WWJ—Detroit 920
WKAR—East Lansing 1040
WFDF—Flint 1310
WASH—Grand Rapids 1270
WOOD—Grand Rapids 1270
T—Furnwood
WJBK—Highland Park 1370
WIBM—Jackson 1370
WMPC—Lapeer 1500
WKBZ—Ludington 1500
WBEO—Marquette 1310
WEXL—Royal Oak 1310

MINNESOTA
KGDE—Fergus Falls 1200
WCCO—Minneapolis 810
WDGY—Minneapolis 1180
T—Anoka
WHDI—Minneapolis 1180
WLB-WGMS—Minneapolis 1250
T—St. Paul
WRHM—Minneapolis 1250
T—Fridley
KGFK—Moorhead 1500
KFMX—Northfield 1250
WCAL—Northfield 1250
WSTP—St. Paul 1460
T—Westcott

MISSISSIPPI
WRBQ—Greenville 1210
WGCM—Gulfport 1210
T—Mississippi City
WJDX—Jackson 1270
WRBJ—Hattiesburg 1370
WCOC—Meridan 880
WDIX—Tupelo 1500
WQBC—Vicksburg 1360
WFVS—Cape Girardeau 1210
KFUO—Clayton 550
KFRU—Columbia 630
KGIZ—Grant City 1500
WOS—Jefferson City 630
WMBH—Joplin 1420
KMBC—Kansas City 950
T—Independence
KWKC—Kansas City 1370
WDAF—Kansas City 610
WHB—Kansas City 860
T—North Kansas City
WOQ—Kansas City 1300
KFEQ—St. Joseph 680
KGBX—St. Joseph 1310
KFWF—St. Louis 1200
KMOX—St. Louis 1090
KSD—St. Louis 550
KWK—St. Louis 1300
T—Kirkwood
WEW—St. Louis 760
WIL—St. Louis 2100

MONTANA
KGHL—Billings 950
KGIR—Butte 1360
KFBB—Great Falls 1280
KGEZ—Kalispell 1310
KGVO—Missoula 1420
KGCX—Wolf Point 1310

NEBRASKA
KMMJ—Clay Center 740
KFOR—Lincoln 1210
KFAB—Lincoln 770
WCAJ—Lincoln 590
WJAG—Norfolk 1060
KGNF—North Platte 1430
WAAW—Omaha 660
WOW—Omaha 590
KGFW—Ravenna 1310
KGKY—Scottsbluff 1500
KGBZ—York 930

NEVADA
KGIX—Las Vegas 1420
KOH—Reno 1380

NEW HAMPSHIRE
WKAV—Laconia 1310

NEW JERSEY
WCAP—Asbury Park 1280
WPG—Atlantic City 1100
WCAM—Camden 1280
WBMS—Hackensack 1450
WHOM—Jersey City 1450
WKBO—Jersey City 1450
WAAM—Newark 1250
KGCP—Newark 1250
WNJ—Newark 1450
WOR—Newark 710
T—Kearny
WODA—Paterson 1250
YJBI—Red Bank 1210
WOAX—Trenton 1250
WAWZ—Zarephath 1350

NEW MEXICO
KGGM—Albuquerque 1230
KGFL—Raton 1370
KOB—State College 1180

NEW YORK
WMBO—Auburn 1310
WNBF—Binghamton 1500
WBBC—Brooklyn 1400
WBBR—Brooklyn 1300
T—Rossville
WCGU—Brooklyn 1400
WCLB—Brooklyn 1500
WFOX—Brooklyn 1400
WLTH—Brooklyn 1400
WMBQ—Brooklyn 1500
WBEN—Buffalo 900
T—Martinsville
WEBR—Buffalo 1310
WGR—Buffalo 1310
WGR—Buffalo 550
T—Amherst
WKBW—Buffalo 1480
T—Amherst
WMAK—Buffalo 1040
T—Grand Island
WSVS—Buffalo 1370
WCAD—Canton 1220
WGBB—Freeport 1210
WBGF—Glens Falls 1370
WEI—Ithaca 1270
WLCI—Ithaca 1210
WMRJ—Jamaica 1210
WOCL—Jamestown 1210
WLBX—Long Island City 1500
WABC-WBOQ—New York 860
T—West of Cross Bay Boulevard, Queens County, N. Y. 1350
WCDA—New York 1350
T—Cliffside, N. J.
WEAF—New York 660
T—Belmore
WEVD—New York 1300
T—Forest Hills
KGBS—New York 600
T—Astoria, Long Island
WHAP—New York 1300
T—Carlstadt, N. J. 1300
WHN—New York 1010
WJZ—New York 760
T—Bound Brook, N. J.
WLWL—New York 1100
T—Kearney, N. J.
WMCA—New York 570
T—Hoboken, N. J.
WNYC—New York 570
WOV—New York 1130
T—Secaucus, N. J.
WPCH—New York 810
T—Hoboken, N. J.
WQAO-WPAP—New York 1010
T—Cliffside, N. J.
WRNY—New York 1010
T—Coytesville, N. J.
WPOE—Patchogue 1370
KOKO—Poughkeepsie 1440
T—Mount Beacon
WHAM—Rochester 1150
T—Victor Township
WHEC-WABO—Rochester 1440
WNBZ—Saranac Lake 1290
WGY—Schenectady 790
WFBL—Syracuse 1360
WSYR-WMAC—Syracuse 570
WHAZ—Troy 1300
WHDL—Tupper Lake 1420
WIBX—Utica 1200
WWRL—Woodside 1500
WCOH—Yonkers 1210
T—Greenville

NORTH CAROLINA
WWNC—Asheville 570
WBT—Charlotte 1080
WSOC—Gastonia 1210
WBIG—Greensboro 1440
WPTF—Raleigh 680
WRBT—Wilmington 1370
WSJS—Winston-Salem 1310

NORTH DAKOTA
KFYR—Bismarck 550
KDLR—Devils Lake 1210
WDAY—Fargo 940
T—West Fargo
KFJM—Grand Forks 1370
KGCU—Mandan 1200
KLPM—Minot 1420

OHIO
WHBC—Canton 1200
WFBE—Cincinnati 1200
WKRC—Cincinnati 550
WLW—Cincinnati 700
T—Mason
WSAI—Cincinnati 1330
T—Mason
WGAR—Cleveland 1450
WJAY—Cleveland 610
WHK—Cleveland 1390
T—Seven Hills
WTAM—Cleveland 1070
T—Brecksville Village
WAIU—Columbus 640
WCAH—Columbus 1430
WEAO—Columbus 570
WSEN—Columbus 1210
WSMK—Dayton 1380
WJW—Mansfield 1210
WHBD—Mount Orab 1370
WIBR—Steubenville 1420
WADC—Tallmadge 1320
WSPD—Toledo 1340
WKBN—Youngstown 570
WALR—Zanesville 1210

OKLAHOMA
KGFF—Alva 1420
KOCW—Chickasha 1400
KGPM—Elk City 1210
KCRC—Enid 1370
WNAD—Norman 1010
KFJF—Oklahoma City 1480
KFXR—Oklahoma City 1310
KGFG—Oklahoma City 1370
City 900
WBBZ—Ponca City 1200
KGGF—South Coffeyville 1010
KVOO—Tulsa 1114

OREGON
KFJI—Astoria 1370
KOAC—Corvallis 550
KORE—Eugene 1420
KOOS—Marshfield 1370
KMED—Medford 1310
KBPS—Portland 1420
KEX—Portland 1180
KFJR—Portland 1300
KGW—Portland 620
KOIN—Portland 940
T—Sylvan
KTBR—Portland 1300
KWJJ—Portland 1060
KXL—Portland 1420

PENNSYLVANIA
WCBA—Allentown 1440
WSAN—Allentown 1440
WFBG—Altoona 1310
WNBW—Carbondale 1200
WIBG—Elkins Park 930
WEDH—Erie 1420
WSAJ—Grove City 1310
WBAK—Harrisburg 1430
WCOD—Harrisburg 1200
WHP—Harrisburg 1430
T—Lemoyne
WJAC—Johnstown 1310
WGAL—Lancaster 1310
WKJC—Lancaster 1200
WJBU—Lewisburg 1210
WLBW—Oil City 1260
WCAU—Philadelphia 1170
T—Byberry
WELK—Philadelphia 610
WFI—Philadelphia 560
WHAT—Philadelphia 1310
WIP—Philadelphia 610
WLIT—Philadelphia 560
WPEN—Philadelphia 1500
WRAX—Philadelphia 1020
WTEL—Philadelphia 1310
KDKA—Pittsburgh 980
T—Saxonburg
KQV—Pittsburgh 1380
WCAE—Pittsburgh 1220
WJAS—Pittsburgh 1290
T—North Fayette Township
WWSW—Pittsburgh 1500
WRAW—Reading 1310
WGBI—Scranton 880
WQAN—Scranton 880
WNBO—Silver Haven 1200
WPSC—State College 1230
WBAX—Wilkes-Barre 1210
T—Plains Town ship
WBRE—Wilkes-Barre 1310
WRAK—Williamsport 1370

PORTO RICO
WKAQ—San Juan 890

RHODE ISLAND
WMBA—Newport 1500
WPAW—Pawtucket 1210
WDWF-WLSI—Providence 1210
T—Cranston
WEAN—Providence 780
WJAR—Providence 890
WCSC—Charleston 1360
WIS—Columbia 1010
WSPA—Spartanburg 1420

SOUTH DAKOTA
KFDY—Brookings 550
KGDY—Huron 1200
KGDA—Mitchell 1370
KGFX—Pierre 580
WCAT—Rapid City 1200
KSOO—Sioux Falls 1110
KUSD—Vermillion 890
KGCR—Watertown 1210
WNAX—Yankton 570

TENNESSEE
WOPI—Bristol 1500
T—Trainerd
WDOD—Chattanooga 1280
WFBC—Knoxville 1200
WNOX—Knoxville 560
WROL—Knoxville 1310
WGBC—Memphis 1430
WHBQ—Memphis 1370
WMC—Memphis 780
T—Bartlett

Call City kc
WNBR—Memphis .. 1430
WREC-WOAN—Memphis 600
T—Whitehaven
WLAC—Nashville . 1470
WSM—Nashville ... 650
WSIX—Springfield.. 1210
WOBT—Union City. 1310

TEXAS

KFYO—Abilene 1420
KGRS—Amarillo ... 1410
WDAG—Amarillo .. 1410
KUT—Austin 1500
KFDM—Beaumont . 560
KWWG—Brownsville 1260
KGKB—Brownwood. 1500
WTAW—College Station 1120
KGFI—Corpus Christi 1500
KRLD—Dallas 1040

Call City kc
WFAA—Dallas 800
T—Grapevine
WRR—Dallas 1280
KFPL—Dublin 1310
KTSM—El Paso 1310
WDAH—El Paso ... 1310
KFJZ—Fort Worth . 1370
KTAT—Fort Worth. 1240
T—Birdsville
WBAP—Fort Worth 800
KFLX—Galveston .. 1370
KFUL—Galveston .. 1290
KFUM—Greenville . 1310
KRGV—Harlingen . 1260
KPRC—Houston 920
T—Sugarland
KTLC—Houston 1310
KTRH—Houston ... 1120
KXYZ—Houston ... 1420
KGKL—San Angelo. 1370
KMAC—San Antonio 1370
KONO—San Antonio 1370

Call City kc
KTAP—San Antonio 1420
KTSA—San Antonio 1290
WOAI—San Antonio 1190
T—Selma
WACO—Waco 1240
KGKO—Wichita Falls 570

UTAH

KLO—Ogden 1400
KDYL—Salt Lake City 1290
KSL—Salt Lake City 1130

VERMONT

WCAX—Burlington . 1200
WSYB—Rutland ... 1500
WNBX—Springfield. 1200
WQDM—St. Albans. 1370

VIRGINIA

WJSV—Alexandria
T—Mount Vernon Hills
WBTM—Emory 1200
WLVA—Lynchburg. 1370
WGH—Newport News 1310
WTAR-WPOR—Norfolk 780
WLBG—Petersburg. 1200
T—Ettrick
WBBL—Richmond . 1210
Call City kc
WMBG—Richmond . 1210
WRVA—Richmond . 1110
T—Mechanicsville
WDBJ—Roanoke ... 930
WRBX—Roanoke ... 1410

WASHINGTON

KXRO—Aberdeen .. 1310
KVOS—Bellingham. 1200
KFBL—Everett 1370
KGY—Lacey 1200
KWSC—Pullman ... 1220
KFQW—Seattle 1420
KJR—Seattle 970
KOL—Seattle 1270
KOMO—Seattle 920

Call City kc
KPKC—Seattle 650
KRSC—Seattle 1120
KTW—Seattle 1270
KVL—Seattle 1370
KXA—Seattle 570
KFIO—Seattle 1120
KFPY—Seattle 1340
KGA—Seattle 1470
KHQ—Seattle 590
KMO—Tocoma 860
KVI—Tacoma 860
T—Des Moines
KUJ—Walla Walla. 1370
KPQ—Wenatchee .. 1500
KIT—Yakima 1310

WEST VIRGINIA

WHIS—Bluefield ... 1420
WOBU—Charleston . 580
WMMN—Fairmont . 890
WSAZ—Huntington. 580
WWVA—Wheeling . 1160

WISCONSIN

WTAQ—Eau Claire. 1330

Call City kc
T—Township of Washington
KFIZ—Fond du Lac 1420
WHBY—Green Bay. 1200
T—West De Pere
WCLO—Janesville .. 1200
WKBH—La Crosse . 1380
WHA—Madison 940
WIBA—Madison 1280
WOMT—Manitowoc. 1210
WHAD—Milwaukee. 1120
WISN—Milwaukee . 1120
WTMJ—Milwaukee. 620
T—Brookfield
WIBU—Poynette ... 1210
WRJN—Racine 1370
WHBL—Sheboygan. 1410
WISJ—South Madison 780
WLBL—Stevens Point 900
WEBC—Superior ... 1290

WYOMING

KDFN—Casper 1210

*[The list of broadcasting stations by frequencies (nine full pages) was published completely in the April 11th issue. Frequency, call letters, location, power and time sharers were given. Data on power time sharers and owner, not included in this week's list, may be obtained from the other list, which was of a completeness second to none.—*EDITOR.]

List of Police Transmitters

Call Owner Location	kc.
WRDR—Township of Grosse Point, Grosse Point Village, Mich.	2410
KGPB—City of Minneapolis, Police Department, Minneapolis, Minn.	2416
KGOZ—City of Cedar Rapids, Cedar Rapids, Iowa	2470
KVP—City of Dallas, Police & Fire Signal Dept., Dallas, Tex.	1712
WPDF—City of Flint, Flint, Mich.	2440
WPDC—City of Chicago, Police Department, Chicago. Ill.	1712
WKDU—City of Cincinnati, Cincinnati, Ohio	1712
WRBH—City of Cleveland, Cleveland, Ohio	2452
WMDZ—City of Indianapolis, Police Department, Indianapolis, Ind.	1712
WPY—City of New York, Police Department, New York, N. Y.	438 and 500
WPDS—City of St. Paul, Department of Public Safety, St. Paul, Minn.	2416
WMP—Commonwealth of Mass., Dept. of Public Safety, Division of State Police, Framingham, Mass.	1662
WCK—Detroit Police Dept.. Belle Isle, Mich.	2410
WMO—City of Highland Park, Highland Park, Mich.	2410
WBA—Pennsylvania State Police, Harrisburg, Pa.	257
WBR—Pennsylvania State Police, Butler, Pa.	257
WDX—Pennsylvania State Police, Wyoming, Pa.	257
WJL—Pennsylvania State Police, Greensburg, Pa.	257
WMB—Pennsylvania State Police, West Reading, Pa.	257
WPDA—Police Department, City of Tulare, Tulare, Cal.	2416
KGPA—Seattle Police Dept.	1596
& Seattle Fire Dept., Seattle. Wash.	2416
WPDJ—City of Passaic, New Jersey. Passaic, N. J.	2416
WPDE—City of Louisville, Louisville, Ky.	2440
KGPC—City of St. Louis, Police Dept., St. Louis, Mo.	1712
WPDI—Franklin Co. Board of County Commissioners, Columbus, O.	2416
KGJX—Pasadena Police Dept., Pasadena, Cal.	1712
WRDS—State of Michigan, Ingham Township	1662
WPDH—City of Richmond, Richmond, Indiana	2416
WPDO—City of Akron, Akron, Ohio	2458
KSW—Berkeley Police Dept., Berkeley, Cal.	2410
WMJ—City of Buffalo, Buffalo, N. Y.	2422
WPDB—City of Chicago, Chicago, Ill.	1712
WPDK—City of Milwaukee, Milwaukee, Wis.	2452
WRDQ—City of Toledo, Toledo, Ohio	2470
WPDG—City of Youngstown, Youngstown, O.	2458
WRDU—City of New York, Fire Department, Brooklyn, N. Y.	1596
KGPG—City of Vallejo, Vallejo, Cal.	2410
WPDL—City of Lansing, Lansing, Mich.	2440
WPDW—Metropolitan Police, City of Washington, D. C.	2410
WPDP—Bureau of Police, Dept. of Public Safety, City of Philadelphia, Philadelphia, Pa.	2440
WPDD—City of Chicago, Police Department, Chicago, Ill.	1712
WPDN—City of Auburn, Auburn, N. Y.	1712
KGPE—Kansas City, Kansas City, Mo.	2422
KGPP—City of Portland, Portland, Ore.	2452
WPDR—City of Rochester, Rochester, N. Y.	1712
KGPD—R. N. Wiley, Chief, Dept. of Electricity,	1596
City and Co. of San Francisco, San Francisco, Cal.	2410
KGPH—City of Oklahoma City, Oklahoma City, Okla.	2452
KGPF—City of El Paso Police Department, El Paso, Texas	2416
KGPI—City of Omaha, Omaha, Neb.	2470
KGPJ—City of Beaumont, Beaumont, Tex.	1712
WPDM—City of St. Petersburg, St. Petersburg, Fla.	2440
WPTD—City of Kokomo, Kokomo, Ind.	2470
KGPK—City of Sioux City, Sioux City, Iowa	2470
* —Calif. Highway Patrol, Bakersfield, Cal.	1662
WPDV—City of Charlotte, N. C., Charlotte, N. C.	2458
WPDU—Pittsburgh, Pa., Pittsburgh, Pa.	1712
KGPM—City of San Jose, San Jose, Cal.	2410
KGPL—City of Los Angeles, Los Angeles, Cal.	1712
KGPN—City of Davenport, Davenport, Iowa	2470
WPDX—Detroit Police Dept.. Detroit, Mich.	2410
* —City of Atlanta, Police Dept., Atlanta, Ga.	2452

* Pending

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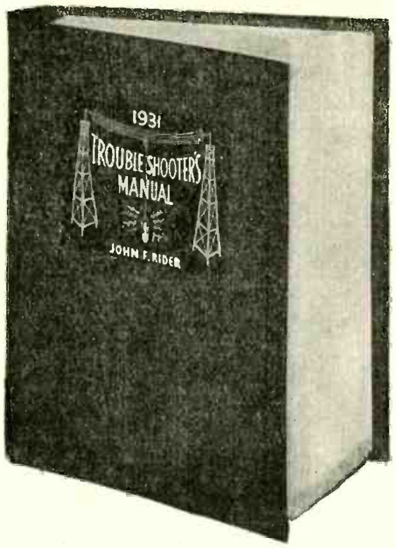

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TO remedy cross-modulation and cross-talk, without circuit changes, a new AC screen grid tube has been developed, the G-51. In AC circuits where the volume control varies the grid bias or the screen voltage, or in which there is an automatic volume control, the new tube works wonders. This is the sensational tube developed by Stuart Ballantine. Price, $3.80.

RELIABLE RADIO CO.
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METALLIZED RESISTORS

PLAIN ENDS

1.0 meg. and 2.0 meg.

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.02 meg. (20,000 ohms) .5 meg. (500,000 ohms)
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Price, 25c each, all sizes as above.

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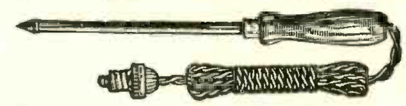

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PILOT A. C. SUPER WASP, TUBES, VOLUME CONTROL, 245 POWER STAGE. Perfect condition, $20. R. E. L. Ultra-Vernier dials, 65c. 2½ volt, 16 amp. transformers, $2. Include postage, money order or cash with order. Sidney Magid, 275 Corbin Place, Brooklyn, N. Y.

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TRANSFORMERS—ABC 224, 227, 245, 280 tubes, $2.35. 1½, 2½, 5 volt; 2½ volt, 5½ amp.; 7½ volt, 3 amp. 99c each. Shielded 2½ volt, 11 amp. $1.65. All center-tapped. Shielded .00035 coils, screen grid or three element, 65c; 4 coils, $2.25. Shielded INF transformers. L. Waterman, 2140 Kirby West, Detroit, Michigan.

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U. S. BROADCASTING STATIONS BY FREQUENCY.—The April 11th issue contained a complete and carefully corrected list of all the broadcasting stations in the United States. This list was complete as to all details, including frequency, call, owner, location, power and time sharers. No such list was ever published more completely. It occupied nine full pages. Two extra pages in the April 11th issue were devoted to a conversion table, frequency to meters, or meters to frequency, 10 to 30,000, entirely reversible. 15c a copy. RADIO WORLD, 145 West 45th Street, New York, N. Y.

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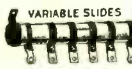
Dry Electrolytic Condensers

Mount in any position! Guaranteed never to blow out! Remarkably compact and very inexpensive, permitting generous use of filtering systems. The greater the mfd. capacity employed, the less A.C. hum remains. 500 volt peak rating. Ideal for all 171A - 245 power packs—use two of each capacity desired for 250 power packs (1,000 volt peak thereby assured).

No.	Mfd.	Diameter	Length	YOUR PRICE
1801	1	¾ in.	2⅛ in.	$0.27
1802	2	1 in.	2⅛ in.	.44
1804	4	1½ in.	2⅛ in.	.83
1808	8	1⅜ in.	4½ in.	1.20
1816	16	3 in.	4¼ in.	2.10
1824	24	3 in.	4¼ in.	2.70
1832	32	3 in.	4¼ in.	3.30
1854	54	3 in.	4⅛ in.	4.73

Adjustable Voltage Divider

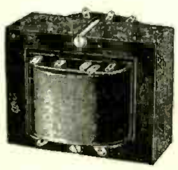


Designed for extra heavy duty. It can be used in any radio power operated set, "B" eliminators, power packs, amplifiers, etc. Especially useful in all radio set replacement work, used in converting battery sets into power sets. The correct voltage is obtained by loosening screws of sliders and by moving the latter into the correct position. Voltage cannot vary due to the peculiar construction of the resistor and contact sliders. Shipping weight ½ lb. List $1.50.

No. 2275—Divider, 10,000 Ohms, 3 slides........................ **75c**

No. 2276—Divider, 25,000 Ohms, 4 slides........................ **75c**

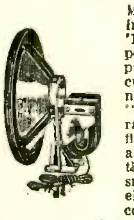
Peerless ABC Power Transformer—80 Watts



As used in "Courier Model 65" chassis. Plate, control-grid, screen-grid, filament voltages for three '24's, two '27's two '45's, and '80 rectifier (electrostatic reproducer biasing potential rectifier). Has approximately the following output ratings: 2.5 V., 10 A.; 700 V., center-tapped, 350 V. and 120 Ma. on each side; 5 V., 2 A.; 3 V., 60 Ma. Primary tapped for low or high line voltage. The correct replacement for big sets. For 110-120 volts, 50 or 60 cycles. Dimensions 4x4x3½ in. Weight 6 lbs. List $12.00.

No. 1403—YOUR PRICE......... **$2.65**

Kolster Speaker Chassis

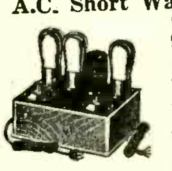


May be connected directly in the plate circuit of type '12A tubes; or to higher-power tubes through an output device. In push-pull circuits, speaker may be connected from plate to plate. "9-inch cone" type. Paper-rattle is prevented by a flannel damper; bass notes are well reproduced due to the "free-edge" effect. Its small dimensions make it eligible for use in home-constructed midget sets. Comes with 6 ft. cord. Dimensions: 10 x 5½ x 9½ inches. Shipping weight 6½ lbs.

List Price, $18.00.

No. 1500—YOUR PRICE........ **$2.80**

A.C. Short Wave Converter

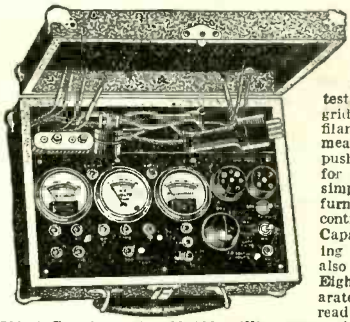


The thrill of tuning in short waves is yours, because you can connect this short-wave converter to your broadcast receiver, no matter what type receiver you have. Tunes from 10 to 200 meters, using only two plug-in coils. Coils, already wound, are supplied with outfit. Converter has built-in filament transformer to heat three 227's. All you need obtain from your receiver is a positive "B" voltage, anything from 45 to 180 volts. Voltage not critical. No molestation of the receiver. No tricky regeneration control, only a single, smooth-operating dial to manipulate. No squeals, no grunting, no body capacity. All parts for 3-tube short-wave converter, including cabinet, with filament transformer, complete instructions and pictorial diagram. Shipping weight 8 lbs.

List Price $20.00.

No. 1617—YOUR PRICE, less tubes **$9.45**

NEW READRITE Analyzer



This three-meter analyzer has selector switch for checking all parts of tube circuits by connecting to the set sockets. Selection for testing voltages of plate, grid, cathode and screen-grid done quickly and accurately. Plate current, filament volts, line and power supply volts are measured. Grid swing test for tubes used. Just push one button for screen-grid and other button for other tubes. Makes testing of all type tubes simple and thorough. 4½-volt grid battery is furnished. Battery is used for grid test and continuity testing of transformers, chokes, etc. Capacity and resistance charts furnished showing use of instruments for testing condensers, also measuring resistances up to 100,000 ohms. Eight scale readings of meters may be used separately with the jack terminals provided. Scale readings are 0-60-300-600 D.C. volts, 0-10-140-700 A.C. volts and 0-20-120 milliamperes. A.C. and D.C. filament voltages are accurately measured on the one meter. Strong case with leatherette covering. Attractive. Compact. Complete. Fills every need for the expert serviceman or the beginner for radio set analyzing. Size 10¾x3½x8 inches. Shipping weight 15 lbs. List Price $25.00.

No. 700—READRITE ANALYZER. YOUR PRICE........................ **$14.70**

R.C.A. Double Filter Chokes

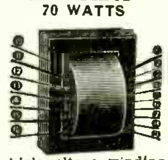
This heavy-duty, extremely strong, double filter choke can be used for all types of filter circuits, experimental work, power amplifiers, receivers, eliminators, power packs, converted sets, etc. Known as R. C. A. replacement part for all Radiola models, particularly Nos. 33, 17 and 18. Each choke D.C. resistance, 500 ohms. Connected in parallel, these double filter chokes have a rating of 15 Henries at 160 Mills; connected in series, 60 Henries at 80 Mills. Fully shielded in heavy metal case with special insulating compound. Size 5¼ x 3¾ x 2⅞. Shipping weight 6 lbs.

List Price, $10.05.

No. 8336—YOUR SPECIAL PRICE.. **90c**

Earl Power Transformer

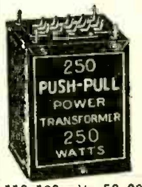
70 WATTS



Make money revamping the old battery set. This power transformer used in Earl Model 22 receiver supplies "A," "B" and "C" potentials for: two '27's (or screen - grid '24's), three '26's, two '71A's and one '80 rectifier; total current output of high-voltage winding at maximum output (about 200 volts) is 80 ma. High-voltage secondary, filament winding for '27's, and for '71A's are center-tapped. May be used in any number of combinations. Suitable resistors, a couple of 4-mf. filter condensers, two 30-henry chokes and by-pass condensers complete fine power pack. Size 3¾ x 3 x 2¾ inches. 16 long leads and full wiring directions. Shipping weight 5 lbs. List Price $7.50.

No. 1410—YOUR SPECIAL PRICE **$1.73**

"250" A.C. Power Transformer



This power transformer supplies currents for five 15 - volt Arcturus tubes drawing 5 Ma. and ½ amp. on filaments; one 2.5 V. tube; two '50's, and two '81's. Two 227 or 224 (if suitable resistance is used) and 750 volts. Full wave "B" and "C." Entirely shielded in metal. 4¾x4¾x6½ inches high. Weight 15 lbs. For 110-120 volts, 50-60 cycles. List $20.

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Professional Telegraph Key

Used for telegraphy, radio, home practice, house-to-house communication, as a keying means in test circuits, etc. Mounted on heavy micanite base 3¼x5x½ in. thick. Has 2 switches to telegraph on two circuits, independently or together. A wonderful chance to get a commercial telegraph key with sturdy ¼-in. silver contacts! Handles a lot of power. Shipping weight 2 lbs. List price $3.50.

No. 1625—YOUR PRICE.......... **70c**

FREE!

NEW SUMMER EDITION

The new Summer Edition of our greatly enlarged RADIO SERVICE TREATISE has just come off the press. If you liked the Winter Issue, you will like this one a hundredfold. It contains some 75 new hook-ups, circuit diagrams; and some 350 illustrations. **POSITIVELY THE GREATEST BOOK EVER PUT OUT BY ANYONE.** Among the new matters listed are:

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WRITE TODAY. Enclose 2 cents for postage. Treatise sent by return mail.

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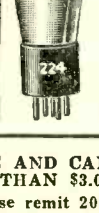
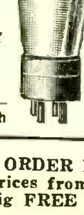


Sold on a 6 MONTHS FREE REPLACEMENT GUARANTEE BASIS, PROVIDING TUBE LIGHTS! All tubes are carefully meter-tested before shipment, and carefully packed. Do not confuse these HIGH QUALITY tubes with any other "low priced" tubes—our low prices are possible because we do a VOLUME business!

Choice of	Choice of	Choice of	Choice of	NEW Choice of
226	112A	245	222	230
227	200-A-199UX	280	210	231
171A	199UV-120	171	250	232
201A	224		281	
63c each	69c each	79c each	$1.58 each	$1.08 each



Utah Dynamic A.C. Power Speaker—Model 33A

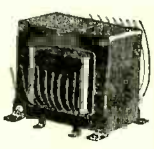
110-volt, 60-cycle A.C. light socket supply for field excitation with Westinghouse dry rectifier. 9 in. high, 9½ in. wide, 7½ in. deep. Speaker comes packed in wooden crate. Weight 19 lbs. It is one of the most powerful as well as best reproducers in the market. 9-inch cone.

List Price $50.00.

No. 1506—YOUR SPECIAL PRICE **$7.45**

Kolster Power Transformer

85 WATTS

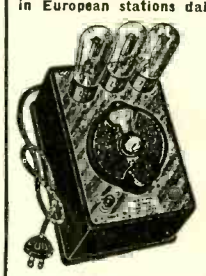


Will supply sufficient current and voltage for push-pull '10's, in conjunction with type '81 half-wave rectifiers. The 2.25-volt secondary output is just below the rated maximum for type '24 and '27 tubes; tubes will last much longer than when heated from a higher-voltage transformer. Four secondaries are rated as follows: Secondary S1, 7.5 V., 1.25 A.; S2, center-tapped, 7.5 V., 1.25 A.; S3, 1.5 V., 4.25 A.; S4, 2.25 V., 1.65 A.; S5, 725 V., 90 Ma. Primary is tapped for low line voltage. For 110-120 volts, 50-60 cycles. 4½ x 4½ x 4½ inches. Shipping weight, 12 lbs. List Price, $19.50

No. 4336—YOUR PRICE........ **$4.55**

NEW! NEW!! Superheterodyne S-W Converter

Positively greatest converter ever built. It brings in European stations daily, clear as a bell.



At last a short-wave converter that converts any broadcast set into a superheterodyne short-wave receiver. Employs three 227 tubes and covers from 20 to 115 meters. No plug-in coils! Coil switch is used to cover all wave-lengths. Single dial control, no body capacity, no squeals. This converter has built-in filament transformer to heat the three 227's. All you need to obtain from your receiver is a positive B voltage anywhere from 45 to 180 volts. Voltage is not critical; no molestation of the receiver. So simple a child can operate it. Size 7x10x5 inches. Shipping weight 8 lbs.

No. 1614—Super Converter. List Price $25. Your Price (less tubes) **$15.93**

Genuine Magnavox Microphone

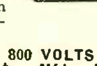
Do Your Own Home Phonograph Recording

Made by the world-famous Magnavox Co. While originally made to strap on the head, it is easy to screw a handle onto one of the side brackets. The side brackets are covered with soft rubber and place the microphone at the best speaking distance from the mouth. Comes with 6 feet of cord. **The biggest mike bargain in America!** Complete with straps and buckle to fit around head. Brand new, in original factory packing. Shipping weight 1 lb.

List Price, $10.75.

No. 1610—YOUR SPECIAL PRICE **$1.55**

High-Voltage Condenser Units



We guarantee these condensers unconditionally. They are ideal for general replacement purposes and can be installed in any new power-pack. All condensers are furnished with 8-inch lengths of tinned "push-back" wire.

600 VOLTS Cat. No.	Mfd. Capac.	Your Price	800 VOLTS Cat. No.	Mfd. Capac.	Your Price
1702	½	$0.25	1706	1	$0.40
1703	1	.30	1707	2	.70
1704	2	.40	1708	4	1.05
1705	4	.60			

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