JUNE 18
15 CENTS
RADIO WORLD
REG. U.S. PAT. OFF.

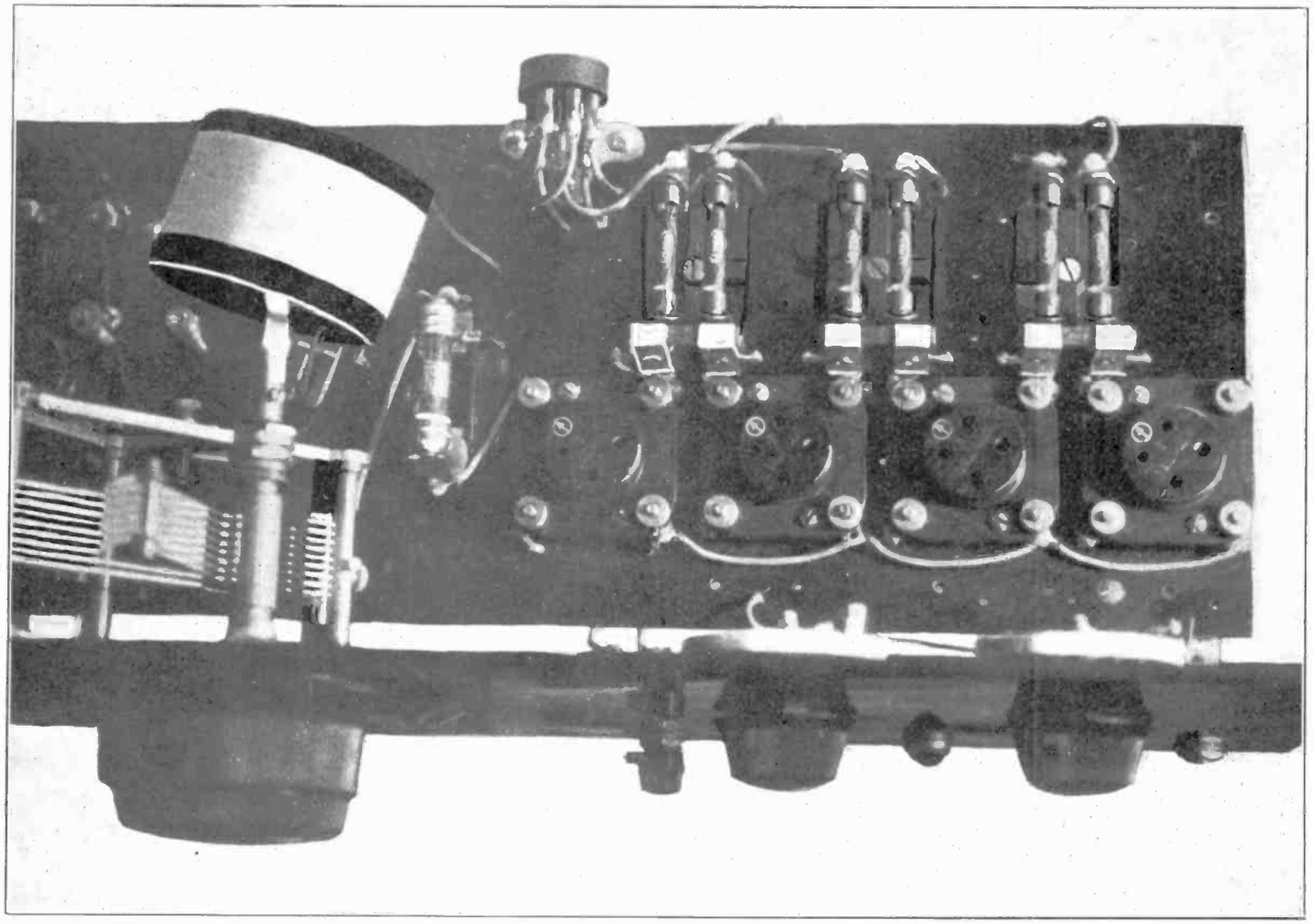
How to Select Correct Grid Bias

B — to A + or to A — ?

New Parts Announced

Low-Note Amplification

CONSTANTS FOR HIGH MU TUBES



(Hayden)

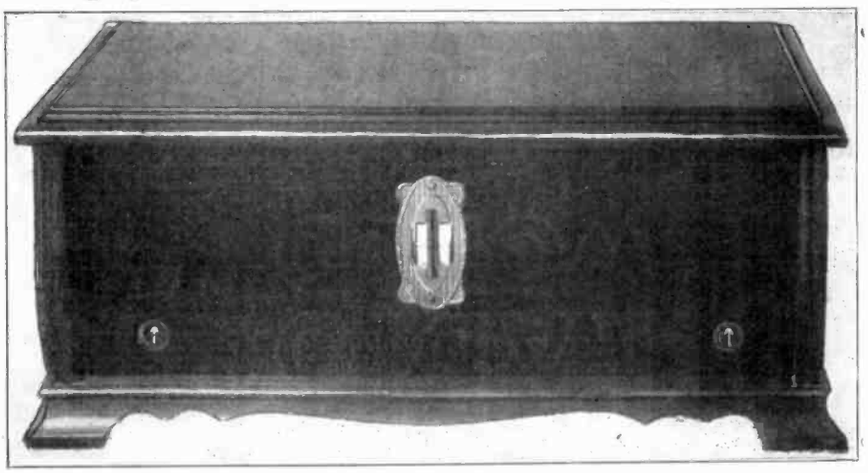
THE new 30-mu tubes require special constants. In the 6-Tube Equamatic with resistance AF, the plate resistors are .25 meg. and the audio leaks 2, 1 and .25 meg. respectively. The stopping condensers are .006 mfd. See page 3.

ANALYSIS OF SOCKET POWER OPERATION

B.S.T. DE LUXE

A NEW AND IMPROVED MODEL

Simply Beautiful—Beautifully Simple



The B. S. T. De Luxe, a 5-Tube Receiver, with Concentrated, Simplified Tuning, and Using Resistance Coupled Audio. Price of set, in genuine walnut cabinet, and including built-in eliminator of all "C" batteries

$60.00

GUARANTY RADIO GOODS CO.,
145 West 45th Street,
New York City.

Gentlemen:—Enclosed please find check (or money order) for $60.00, for which kindly ship by express at once one B. S. T. De Luxe 5-Tube Set, in genuine walnut cabinet, less accessories, but with built-in eliminator of all "C" batteries, on five-day money-back guarantee.

NAME .....

STREET ADDRESS .....

CITY .....STATE.....R.W.

The Set That All Admire

The B. S. T. De Luxe is one of the most beautiful sets made. Beautiful to eye and ear alike. Thrilling fidelity of tone and fine volume assured. Uses any type tubes. May be used with B eliminators without "motorboating." Awarded Certificate of Special Merit by Radio World after exhaustive tests.

A Switch, a Volume Control and a Tuning Unit—These are the Only Parts on the Bakelite Front Panel. Simplicity and Beauty in the Extreme.

GUARANTY RADIO GOODS CO.

145 WEST 45th STREET NEW YORK CITY

SIXTH YEAR

Vol. XI
No. 13
Whole No. 273
June 18, 1927
15c Per Copy. $6.00 Per Year

RADIO WORLD

A Weekly Paper Published by Hennessy Radio Publicattions Corporation from Publication Office, 145 W. 45th Street, New York, N. Y.

Phones: BRYant 0558 and 0559

[Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March, 1879]

The Six-Tube Equamatic

RF Neutralized, AF Resistance Coupled

By Herbert E. Hayden

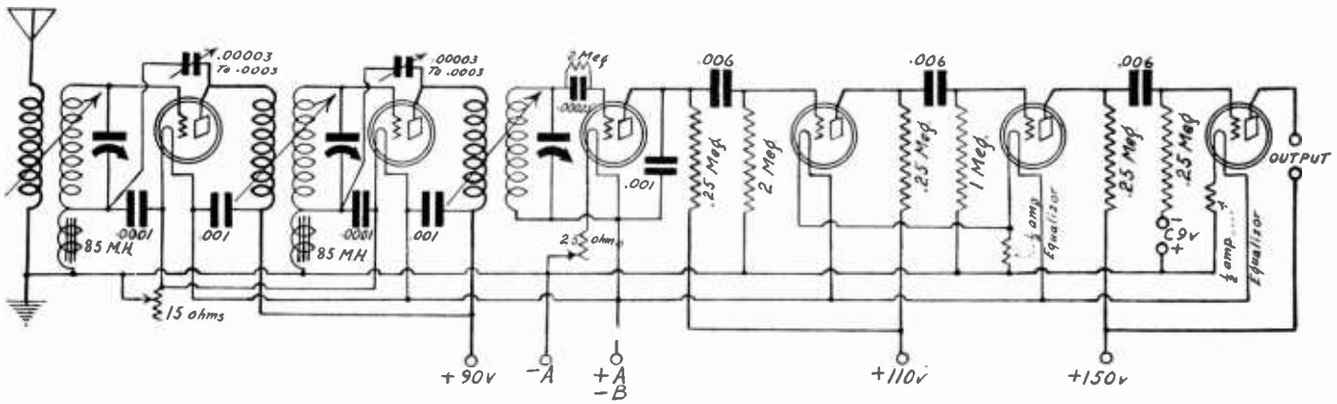


FIG. 1

The Equamatic System is used in this six-tube receiver. The audio channel is resistance coupled. Neutralizing condensers are employed. These two differences are the main ones distinguishing the circuit shown above from the five-tube Equamatic.

OF the many methods devised for equalizing radio frequency amplification over the entire broadcast band is one based on a continuously and automatically variable primary—the Karas Equamatic system. In this system the equalization is not accomplished by introducing losses into the tuners, which destroy selectivity at the high frequency where it is most needed, but is accomplished by varying the mutual inductance between the primaries and the secondaries of the tuned radio frequencv transformers. This has the effect of equalizing the amplification at all frequencies and at the same time increasing the selectivity for the high frequencies in the correct ratio for maintaining the same effective selectivity over the entire broadcast band.

The automatic feature of this system is introduced by placing the primary in each stage on the shaft of the corresponding tuning condenser and adjusting the angle between the primary and the secondary so that as the condenser is turned the effective coupling between the two coils is kept constant. That is, the mutual inductance between the two windings is varied in inverse proportion to the frequency. Thus the same energy transfer is effected at all frequencies and the absolute selectivity is the same over the entire tuning range. The degree of coupling at any one setting of the condenser can be adjusted at will by once adjusting the distance or angular displacement or both between the two coils.

The Inventor's Explanation

Louis G. King, of 10 Argyle Road, Brooklyn, N. Y., inventor of the Equamatic System, made the following explanation:

"Early in 1924 I came to realize that the commercial types of radio broadcasting receivers were constructed along very inefficient lines and that the biggest cause of this inefficiency was the use of fixed couplings in tuned radio circuits. Prior to the introduction of the Neutrodyne System, (the first commercially successful radio frequency receiver), all receivers without exception employed variable coupling in tuned circuits.

"When the Neutrodyne type of receiver was conceived, it was necessary to employ three tuned radio frequency circuits, and as it was impractical to incorporate six operating dials, really necessary for high efficiency, fixed coupling radio frequency transformers were used in order not to have an excessive number of operating dials. However, this was only done at great sacrifice of efficiency, as the fixed couplings employed were only efficient at one particular wavelength, inffiecient at the higher wavelengths, and difficult to control at lower wavelengths. In fact the present commercial types of tuned radio frequency receivers, due to these limitations, will in most cases not operate below 240 meters, and from 240 to 300 meters insure considerable distortion, and at the higher wavelengths, say over 400 meters, are incapable of bringing in distant stations in the manner they should.

The Problem Considered

"In my opinion this was one of the main reasons for the wave jumping epidemic of the lower wave stations, who realized that their programs are not properly audible in one receiver out of a hundred.

"Considering the reasons for these faults, it appeared that the problem was to provide a mechanical means to simultaneously operate a tuning element and a variable coupling in such a manner that the radio frequency transformer would be at peak efficiency at all frequencies, and that the movement should so synchronize the operation of the coupling and the tuning element, that this result would occur under all conditions.

"A great deal of experimental work was then undertaken, using a variety of mechanical arrangements, such as springs, cams, gears, eccentrics, sliding rods, and other devices. But, one by one such apparatus was discarded, on account of both mechanical and electrical troubles that would be sure to occur with any such complication.

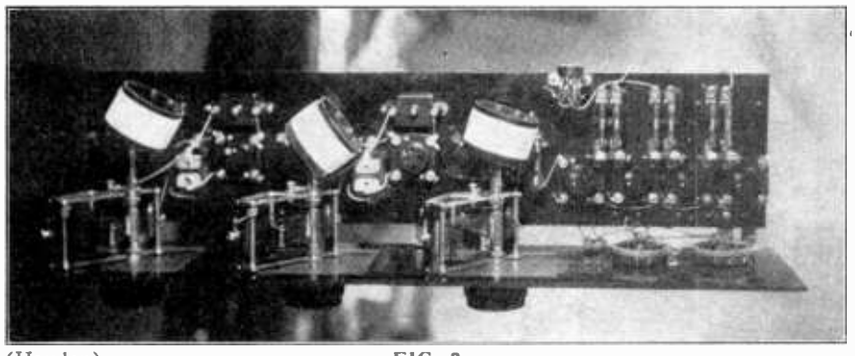
"It was realized that not only should the combination movable coupling be precise, exact, and free from blacklash, but on account of variations in associated apparatus, it was extremely necessary that both the range of coupling and the rate of acceleration of the coupling should be readily variable to take care of the different conditions encountered in an art where precision is absolutely essential.

Versatility of System

"After many months of experimental work, it was found that all the required conditions could be met in a very easy manner, by means of the extremely simple mechanical arrangement known as the Equamatic System.

"Not only will this simple device allow any desired electrical range of coupling and acceleration with respect to the movement of a 180-degree straight line frequency condenser, but the movement may be instantly reversed to give any desired coupling effect in the opposite direction with respect to the movement of the condenser.

"It will be noted also that it is compact, employs no springs, cams, gears, eccentrics, sliding rods, etc., and performs all



(Hayden) FIG. 2

Top view of the six-tube Equamatic receiver, showing the mechanical layout.

its functions without any friction or wearing parts.

"It should be borne in mind that many types of actuating mechanisms were tried and discarded because I believe that any mechanical complication in this matter is likely to cause sufficient trouble to offset the undoubted advantages of the variable coupling.

"The Equamatic System can instantly be adjusted by hand without tools to meet the variable range of coupling and variable acceleration of coupling essential to the correct operation of any tuned radio frequency circuit, and may be used with remarkable advantage in any of the well known hookups."

Discussion of the Circuit

As will be observed from the diagram of the circuit in Fig. 1, radio frequency choke coils are used in the grid return leads of the radio frequency amplifiers. These are of 85 millihenry inductance and their purpose is to confine radio frequency to the tuned circuits. Also, with them it is possible to set the coupling between the primaries and the secondaries much closer than without them, without getting oscillations. Of course, the increased sensitivity is accompanied by a decrease in the selectivity at any one setting of the condenser. But this is no serious disadvantage, because in cases of three steps of tandem tuning with high grade tuned circuits it is easy to get enough selectivity.

The radio frequency choke coils are by-passed by .0001 mfd. fixed condensers, that is, these condensers are connected between the negative end of the filament and the high potential side of the choke coils. The 85 millihenry coil and the .0001 mfd. condenser then constitute a high pass filter which keeps the radio frequency currents out of the batteries. Thus the combination eliminates one of the sources of oscillation. This action is aided and abetted by the little variable condenser connected in each stage between the plate of the tube and the high potential side of the choke coil. These two variable condensers have a range of .00003 to .0003 mfd. One suitable adjustment of the condensers can always be found which gives the greatest volume without oscillation at any one setting of the tuning condensers. The adjustment of the small balancing condensers must be made for a given coupling between the primaries and the secondaries and is most conveniently made at the highest frequency (lowest wavelength station receivable).

By-Pass Condensers

As a further aid in eliminating sources of feedback .001 mfd. by-pass condensers are used across the B battery. Although these two condensers are connected in parallel and a single condenser of twice the capacity might ostensibly be more effective in keeping stray currents out of the B battery, two separate condensers keep the bypass current course as short as possible. While the two condensers are connected between the positive side of the A battery and the positive side of the B battery, an optional connection is to connect the condensers to the negative end of the filaments, that is, to the points where the .0001 mfd. condensers tie on to the filaments. This would be more effective in by-passing when the filament supply device has considerable resistance. When a storage battery is used it makes no difference. A desirable but not necessary addition is a by-pass condenser of .001 mfd. across the common rheostat controlling the first two tubes.

The detector operates with a grid leak of 2 megohms and grid condenser of .00025 mfd. connected in parallel. Since the grid return is to the positive end of the filament the intention is to use an —01A or similar tube for detector. A by-pass condenser of .001 mfd. is connected between the plate and the positive end of the filament. This condenser serves two purposes; first, to facilitate detection by making the load impedance at high frequencies very small, and, second, to prevent radio frequency currents from passing into the audio frequency amplifier.

Use Resistance Audio

The audio frequency amplifier follows standard resistance coupling design. Each of the three coupling resistors is a quarter megohm, values which especially suitable for the new mu 30 tubes. Each of the three stopping condensers is of .006 mfd. capacity. The resistance values of the grid leaks vary according to the position and signal intensity level. The first is two megohms, the second one megohm and the third is a quarter megohm. These combinations of stopping condensers, grid leaks and coupling resistors have been chosen with a view of preventing motorboating. The last combination is especially efficacious in this respect.

The volume is controlled in this receiver by means of the two rheostats, one of which controls the filament current in the radio frequency amplifiers and the other of which controls the current in the detector. The first has a maximum resistance of 15 ohms and the second 25 ohms. These two rheostats furnish an adequate control of volume and since they are in the radio frequency section of the circuit the volume can be controlled with them without noticeable effect on quality.

Bias Features

Grid bias of about one volt is obtained for the radio frequency amplifiers from the voltage drop in the 15 ohm rheostat. This bias varies somewhat as the filament current in these tubes is varied by turning the rheostat, but the variation is small and the operation of the tubes is not critical. Grid bias for the first two audio tubes is obtained similarly from the voltage drop in the first ½ amp. equalizor. The total bias required is 10 volts, and since one volt is obtained from the drop in the equalizer, the 9 other volts may be supplied by a battery of dry cells.

The plate voltage on the radio frequency amplifiers is 90 volts. This can be reduced if desired without greatly affecting the amplification. The applied plate voltage on the detector is 110 volts. This high voltage is used instead of the customary 45 volts to compensate for the drop in the .25 megohm coupling resistor. The same voltage is applied to the plate of the first audio amplifier. The applied voltage on the last two tubes is 150 volts. A higher plate voltage is required on the second high mu tube because the signal amplitude is greater on this tube than on the first. The last tube requires the higher voltage because it is a semi-power tube (112). No higher plate voltages should be used on any of the audio tubes without increasing the grid bias.

Placement of Parts

The radio frequency tubes and the detector may be of the —01A types, the first two audio frequency tubes —40 high mu types, and the last tube should be a 112. All of these tubes require a filament voltage of 5 volts, and this may be supplied by a six-volt storage battery.

The mechanical layout of the receiver can clearly be seen from Fig. 2, which is the view that greets the observer peering into the set. About two-thirds of the space is devoted to the radio frequency amplifier and the detector, the rest being devoted to the audio amplifier. There are three identical tuning units and couplers. These are placed at considerable distances apart to minimize stray coupling between the units. For the same reason the three secondary coils are placed in a straight line with the axes of the coils inclined at an angle of about 54 degrees from this line. These secondaries, of course, are the three large white coils drawn up at the back of the set. The three primaries are placed on the axes of the condensers between the axes and the secondaries. As can be clearly seen from the photograph, when the condensers are fully meshed, that is, set at maximum capacity, the turns of the primaries are parallel to the turns of the secondaries, giving maximum mutual inductance between the coils. When the condensers are wide open, that is, set for minimum capacity, the small primary coils are nearly at right angles to the secondaries, giving a minimum inductance between the windings. The Karas condenser plates are cut accurately to give straight line relationship between dial setting and frequency. The coupling between the secondary and the primary in any transformer is proportional to the product of the frequency and the mutual inductance. Since the mutual inductance decreases automatically as the frequency to which the circuit is tuned increases, the product, or the coupling, remains practically constant for all settings of the condenser.

Leads Are Short

The sockets for the two radio frequency amplifier tubes can be seen between any two of the tuning units in the middle of the baseboard. The 85 millihenry choke coils can be seen between the sockets and

(*Concluded on page 20*)

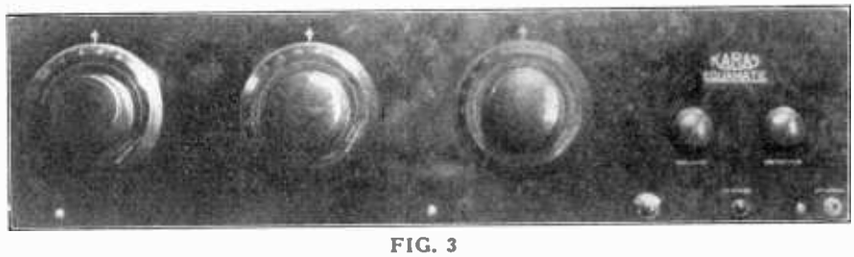


FIG. 3

Grid Bias Selection

How to Figure Out What Voltage to Use

By J. E. Anderson

Contributing Editor; Consulting Engineer

THE use of grid bias in a receiver is a detail and many are likely to regard it as unimportant. The fact is that the use of proper grid bias is a detail of utmost importance. In resistance and impedance coupled amplifiers it is a necessity. It either makes or breaks an amplifier of either of these types. To leave out the grid bias in resistance coupled amplifiers is to invite failure and distortion. And that is the main reason why resistance coupled amplifiers sometimes fail to give satisfaction. The fault is very easily corrected.

The proper grid bias for any amplifier depends on the applied plate voltage and on the amplification constant of the tube. To some extent it also depends on the type of circuit in which a tube of any given characteristics is used. It is well to remember that for any given applied plate voltage the required grid bias is less, the higher the amplification constant of the tube. A rough rule for determining the proper grid bias is to take the effective plate voltage and divide it by twice the amplification constant of the tube. The quotient gives the proper bias to be used. Suppose the amplification constant of the tube is 8 and the applied plate voltage is 160 volts. Twice 8 is 16 and this put into 160 gives 10 volts as the proper negative bias for that tube.

Effect of Filament Resistor

Again, suppose that the same tube be operated with 90 volts on the plate. In this case we have 90/16, or 5.6 volts. It must be remembered that this gives the effective grid bias, and that is not always the same as the voltage of the grid battery used. If there is a ballast resistor or rheostat in the negative leg of the filament of the tube and if the grid return goes to the minus end of the battery, the voltage drop in the resistor is part of the bias. This usually amounts to one volt. Hence in the two examples cited the voltage of the grid battery should be 9 and 4.5 volts, approximately what is recommended by the makers of the tubes.

Remember, however, that the effective plate voltage is the factor, not the plate voltage source. The drop in a resistor or coil must be considered.

Let us take some other examples. Suppose that the amplifier tube used is a 99, having an amplification constant of 6.5. If this is used on a six-volt filament battery and a plate voltage of 90, the voltage of the grid battery should be about 4.3 volts. Twice the amplification constant of the tube gives 13, and this put into 90 gives 7. The filiment terminal voltage of the tube is 3.3 volts and since the voltage of the filament battery is 6, the drop in the ballast resistor is 2.7 volts. The difference between 7 and 2.7 is 4.3 volts, which should be the grid battery voltage.

The Effective Plate Voltage

When the circuit is transformer or impedance coupled there is little difference between the plate battery voltage and the effective plate voltage. The voltage of the plate battery may be taken when determining the grid voltage to be used, but, on account of the drop in the primaries of high inductance transformers and in chokes it is well to deduct a little from the grid voltage thus obtained. For example, in the two cases treated above for the mu 8 tube, the grid voltages may be 9½ and 4, and for the mu 6.5 tube 4 volts. That is, it is well to deduct a few tenths of a volt. The grid voltage is not critical and a volt more or less will make little difference.

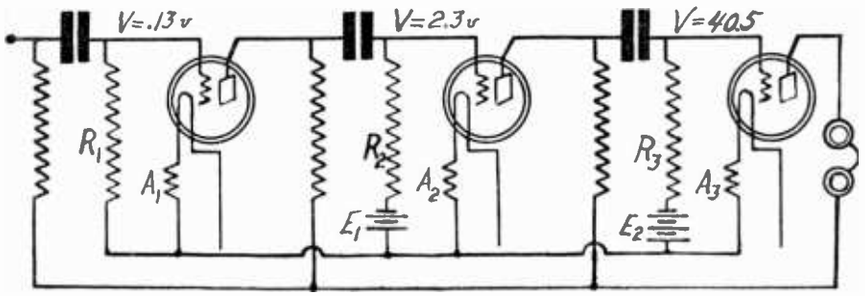


FIG 1

Circuit diagram of a resistance coupled amplifier illustrating the use of a grid bias as related to input voltage amplitude. In each of the three ballast resistors A1, A2, and A3 there is a voltage drop of one volt, which adds to the applied grid bias. The Vs at the grids indicate the maximum potential of the grid due to the signal. In the first the input voltage amplitude is .13 volt. This is so small that the bias obtained from the ballast resistor is sufficient. If the step-up is 18 per stage of resistance coupled amplifier, the amplitude of the signal voltage at the second grid is 2.3 volts. The grid should therefore be kept at 2.8 volts with respect to the negative end of the filament, or at 1.8 with respect to the negative of the filament battery. Therefore the grid battery E1 should have this potential, but a single dry cell of 1½ volts will work well. At the third grid the amplitude of the signal will be 40.5, assuming 18 as the step-up ratio. The potential of the battery E2 should therefore be 40 volts, 41 volt bias in all being required.

When it comes to resistance coupled amplifiers it is not so easy to determine the correct bias to use because there is a greater voltage drop in the coupling resistor than in the inductive couplers. Furthermore, the tubes used in the circuits usually have much higher amplification constants. This makes the needed bias less and small deviations from the correct values will be more serious. But the main requirement is that the bias must be high enough to prevent the tube from going positive at any time during a cycle.

Keep ½ a Volt Away

Not only must it not go positive during any part of a cycle but it must not come within about ½ volt of the zero bias point. For very weak signals a bias of about ¼ volt will be sufficient no matter what the applied plate voltage may be. But for the sake of economy of plate current it is well to make the bias greater than that for higher plate voltages. Both the plate battery and the tube will last longer if the bias is made higher.

When the signal is very great the adjustment of the grid bias to correct value is of greater importance. As before, the grid must not come closer to zero bias than ½ volt at any time during a cycle of the input voltage. Suppose then that the amplitude of the signal voltage is 1½ volts. The grid bias then should be at least 2 volts. The applied plate voltage will have to be increased to make this possible.

How does the rule of grid bias apply to the case of resistance coupled amplifications? The effective plate voltage, even for high applied voltage, is very small. Yet the rule seems to hold fairly well if the applied plate voltage rather than the effective plate voltage is used. For example, suppose that the mu of the tube is 30 and the applied voltage is 180 volts. The rule gives 180/60, or 3 volts as the bias to be used. This means two volts in addition to the one volt drop in the ballast resistor. This is not far from correct, though as before, it is slightly too large. One and a half volts, given by a single dry cell, would be about right. The effective bias would then be 2½ volts, giving an allowable input amplitude of 2 volts.

How to Determine Amplitude

If this tube is so coupled to the succeeding tube that the voltage step-up is 18 times, the amplitude of the input voltage to this tube would be 36 volts, which is not far from the maximum allowable input to a 71 power tube. The maximum input to this tube is 40½ volts, and this would be obtained if the input to the preceding high mu tube is 2.3 volts. This would make the grid of the high mu tube swing within 0.2 volt of the zero bias point. Since this would only occur at the louder moments in the signal, the tube could safely be operated thus without causing trouble.

The voltage input to the first high mu tube, that is, the one preceding the high mu tube discussed above, is so small that it is not necessary to consider any possibility of overloading. If the set-up in the voltage is 18 as before and the voltage input to the second tube is 2.3 volts, the input to the first is only 2.3 divided by .18 volt, or .13 volt. It is not necessary to use a grid battery for that tube because the drop in the ballast resistor is all that is necessary to give adequate bias. However, if it is convenient to use the same battery as is used for the second high mu amplifier no harm will be done to the amplification, and the life of the tube will be lengthened somewhat.

B Minus to A Plus or Minus?

A Consideration of Short Circuit Effects

By Capt. Peter V. O'Rourke

Contributing Editor

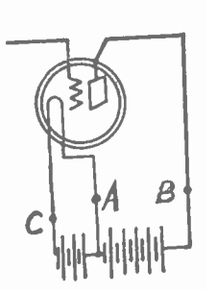


FIG. 1

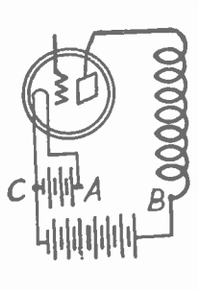


FIG. 2

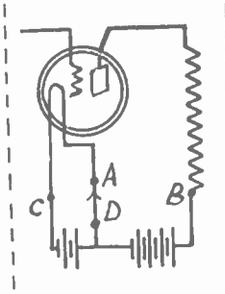


FIG. 3

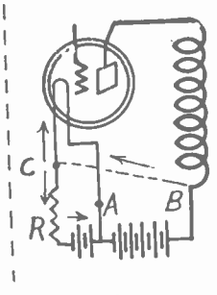


FIG. 4

The negative terminal of the B battery is connected to the positive terminal of the A battery (Fig. 1). Very litt e danger of burning out the tube if short circuits should occur between A and B, A and C, or B and C. All the damage would be done to the batteries and the leads.

The negatives of the A and B batteries are connected together (Fig. 2). In case of short circuit between A and B, B and C, or C and A there is little danger of damage to the filament but batteries and the leads would be damaged.

Negative of B is connected to positive of A with the filament switch placed in the positive lead to the filament (Fig. 3). When the switch is closed the case is the same as in Fig. 1. When the switch is open the tube will be burned out if a short circuit should occur between A and B.

A resistance is connected in series with the A battery lead (Fig. 4). Should a short circuit occur between B and C under these conditions the filament would very likely be burned out because R would divert the current through the filament.

SHORT-CIRCUITS will happen now and then, sometimes with disaster to the tubes, other times devastating the batteries. Short-circuits will happen even in these days of orderly, well-insulated wiring. They will happen as long as screwdrivers are poked into the set while the batteries are turned on, or as long as solder and nuts and screws are dropped into the wiring. Whether disaster results depends to a certain extent on how the circuit has been wired up.

In Fig. 1 the positive of A is connected to the negative of B. (The long battery line is positive, the short line negative.) Suppose that a short-circuit should occur between the points marked A and B. The B battery alone will be short-circuited, but the tube will not be endangered. No good is done to the B battery. Suppose the short occurs between C and A. The A battery is shorted but the tube is not hurt. But something will begin to smoke the short will last for a second or two.

Now, suppose that the short occurs between B and C. Both the A and the B battery will be shorted. The current through the filament of the tube will be increased slightly but not dangerously, unless there is a large resistance in series with the A battery. In that case the B battery will drive a dangerous current through the filament.

The Two Negatives

In Fig. 2 the two negatives of the batteries are connected. Now suppose that a short occurs between the points A and B. The two batteries will be shorted but they will buck each other. The extent of the short circuit will depend on how much higher the plate voltage is than the filament voltage.

If the A battery is of the storage type, the A battery will simply be charged by the B battery, and the filament current will be only slightly increased. Again if there is a large resistance in series with the A battery, a dangerous current will be driven through the filament. If this resistance is in series with the filament there will be no danger of a burnout of the filament, but the batteries will be damaged. If the filament battery is open when the short occurs, that is, if the filament switch is open and is located in one of the leads not a part of the B battery circuit, the filament will of course burn out instantly.

If a short circuit occurs between the points A and B in Fig. 3 when the switch is open the tube will burn out, but the tube will not be particularly endangered when the switch is closed. If the short occurs between D and B the tube is in no danger, but of course the B battery will suffer. If the short occurs between B and C when the switch is closed the filament will receive little more than normal current.

The Resistance Danger

Fig. 4 illustrates why there is more danger of burning out the filament when there is a resistance in series with the A battery than when there is none. Suppose that the points C and B are shorted. When the current reaches the point C it can go two ways, through the filament and through the A battery. It divides in inverse ratio to the resistance in the branches. If R is zero the resistance of the filament is many times greater than the resistance in the A battery. Hence very little current goes through the filament and nearly all of it goes through the A battery. The battery acts as a short circuit to the filament.

When the resistance R is large as compared to the resistance of the filament, most of the current from the B battery flows through the filament and there is danger of burning it out. The larger the R is the greater the danger. Hence when the circuit is open, that is, when the filament switch is open the danger is greatest, because no current is diverted from the filament to the battery. Of course, the larger the resistance R, the less current flows in the B battery.

C Battery Shorting

Sometimes the C battery becomes shorted in such a way that the filaments of the tubes are damaged. Referring to Fig. 5, suppose that the points C and A become shorted. Now if the resistance of the C battery is negligible in comparison with the ballast resistor R, the voltages of the A and C batteries add up to drive a larger current through the filament r. Damage results. Suppose that the grid bias battery voltage is equal to that of the filament battery. The current through the filament is just doubled and a burnout is likely to result. Often the voltage of the C battery is several times greater than that of the A battery. In such cases a short circuit of very short duration will cause a burnout.

Now suppose that the resistance in series with the C battery is large in comparison with the ballast resistor R. In that case a short circuit between the points A and C will cause no damage to the filament but will damage the battery. Since the resistance in the C battery is always very small, only a small value of R will suffice to burn out the filament if the voltage of the grid battery is larger than the voltage of the A battery.

Should a short circuit occur between the points C and B, both the batteries will be short-circuited but no damage will occur to the filament unless there is a considerable resistance in series with the A battery. The greatest resistance that could be in series with the A battery is infinite, which is the case when the A battery switche is open. In that event the C battery alone is effective across the filament of the tube. The current that will flow through the filament then depends on the total resistance in series with the C battery and on its voltage.

Suppose that the tube is an —01A and that the circuit is designed to operate on a six-volt storage battery. The value of r is then 20 ohms and that of R 4 ohms. The total resistance in series with the C battery is then 24 ohms. If the voltage of the grid battery is 9 volts, as is often the case, the current through the filament on short circuit will be 3/8 ampere, or 50% more than normal. While this will not burn out the filament it will certainly shorten its life.

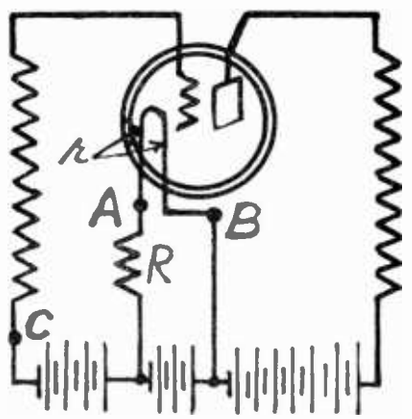


FIG. 5

This illustrates how the filaments of tubes can be damaged by short-circuiting the C battery. When points C and A are shorted and when the resistance of the C battery is negligible in comparison with the resistance R the filament is in danger. Also when the points C and B are shorted and when the filament battery switch is open, the filament is in danger.

Getting the Low Notes

With Transformer or Impedance AF

By Dennis J. O'Flaherty

ONE of the necessary conditions for getting the low notes out of a receiver in which the coupling is by transformer or impedance is to have a high inductance in the load of the amplifier tubes. A tube will not amplify properly unless the impedance of the load device is much larger than the plate resistance of the tube itself. Since the impedance of an inductance is directly proportional to the frequency, the amplification of the high notes will be greater than that of the low when the coupling devices are transformers or impedances. If the inductance of these is not very high, the impedance at low frequencies will be very small and consequently the amplification at these frequencis will also be small. The low notes will not be heard at all in such receivers, at least not directly.

As the inductance of the primary of a coupling transformer or the inductance of a coupling choke coil is increased the amplification of the low notes increases, but that of the higher notes does not increase appreciably. In fact, the amplification of the highest audible notes may decrease as a result of the introduction of distributed capacity in windings.

Test Gives the Proof

While it has been known a long time that the inductance in the plate circuit of a tube must be high in the case of transformer and choke coil coupling if the low frequencies are to be brought out, there are still many who overlook its importance, chiefly because they have not given the matter a test. But a simple experiment will convince anybody of the necessity of having a high inductance in the primary or in the coupling choke coil. For the test it is desirable to have a good audio frequency transformer provided with taps on the primary so that all the turns or only part of them can be used. The circuit should be set up so that the change from one to the other can be made quickly.

When only a small number of the primary turns is used in the transformer, the step-up ratio is high, because the secondary turns remain constant. When all the primary turns are used the step-up ratio is low. It may be as low as one-to-one.

The change in quality on switching from all the turns to the smallest number is most astounding. With all the turns in, and consequently with a low ratio transformer, the low notes come booming through with full strength. When the circuit is switched to the small

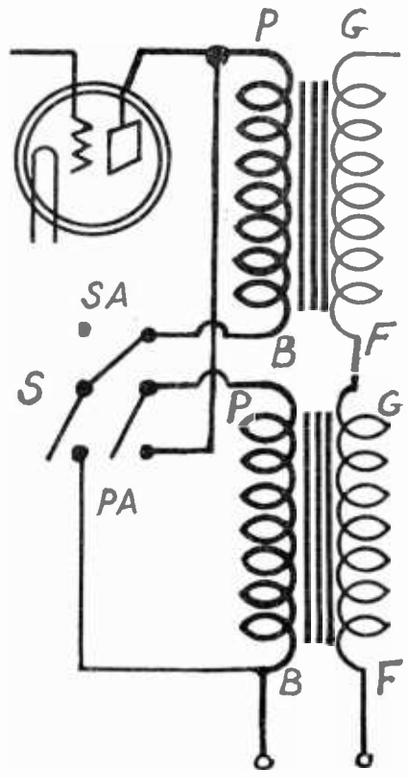


FIG. 1

Diagram of connections showing series aiding and parallel aiding connections of two transformer primaries. A double pole-double throw switch S is used to change from one connection to the other. When switch is up the connection is series aiding, when it is down the connection is parallel aiding. The secondary windings remain connected in series aiding. This assumes that the two transformers used are the same or their terminals correspond.

primary and the high ratio, the low notes disappear almost completely, while the high and middle seem to jump up in intensity.

Volume Changes Little

With the full primary in use the quality is pleasing, with only a portion in use the quality is very bad. It is just like the stuff we had to endure in the early days of broadcasting. This change is not due to the change in ratio of the transformer but to the change in the impedance of the primary winding.

Another noteworthy thing is that the change in the number of turns in the primary does not appreciably change the volume of sound emitted by the receiver. One would suppose that the reduction in the step-up ratio would greatly reduce the volume, but this is not so. The reason is that as the primary turns are increased the primary voltage is increased, and this offsets the reduction in the step-up ratio. No doubt there are certain frequencies which are more intense when the high ratio is used, but in the response taken as a whole there is no appreciable change.

It is realized that very few enthusiasts will be able to obtain a good transformer with a tapped primary. But they may still perform the experiment if they have available a couple of ordinary transformers.

The Two Ways

Both of these transformers are connected between two of the amplifier tubes in the receiver. The secondaries are connected in series aiding. Now the primaries can be connected in two ways. First they can be connected in series aiding. The inductances of the two then add up and the load impedance on the first tube is high. The lower notes will come through well, better than if only one of the transformers were used although the step-up ratio is the same.

The other way of connecting the two primaries is in parallel aiding. The impedance of the combination is then only one-half of either. This connection has a high effective step-up ratio and a low primary impedance. The low notes will not come through well. The change from the series to the parallel connections changes the load impedance on the tube in the ratio 4-to-1.

Frost Fixed Resistor A Brand-New Item

The latest addition to the complete line of radio apparatus manufactured by Herbert H. Frost, Inc., Elkhart, Ind., is a wire-wound fixed resistor, to which is attached a bracket terminal, providing a perfect electrical connection and one which permits no possibility of loose connections, regardless of stress, strain, expansion or contraction. They are made in all sizes of from 1-2 to 400 ohms.

Station Owners Peril Trade, Says Bellows

Hot Springs, Va.

Henry A. Bellows, Radio Commissioner, addressing the National Electrical Manufacturers' Association, said the radio industry was on shaky ground because 78 per cent of the stations are owned by parties having no interest in the sale of parts, sets or accessories. This puts the set buyer at mercy of the stations, in his opinion. He added:

"The entire range of American industry does not present a more curious economic spectacle than the strange anomaly of radio. The manufacturers of radio receiving equipment are actively engaged in producing something which, of and by itself, has no intrinsic value whatsoever. You cannot cut the grass with a radio set or sew buttons with it; you can use it only for securing a particular type of service furnished by the broadcasters.

"Under the new broadcasting licenses, effective June 15, there are 694 radio broadcasting stations now operating under the jurisdiction of the Federal Radio Commission. Of this total number, 25, or 4 per cent, are owned by manufacturers of electrical equipment.

"Because numbers are misleading, let me give the proportions on the basis of weighted averages, full allowances being made for power output. On this basis the manufacturers of electrical equipment are providing 8 per cent of the nation's broadcasting service, the dealers in electric supplies or power 13 per cent, the education and religious institutions 23 per cent, the newspapers 9 per cent and other types of activity 47 per cent.

"This means that more than three-quarters of the broadcasting service, on which the whole structure of radio receiving-set manufacture is based, is being provided by interests entirely outside of the electrical field.

"There are probably not 10 stations in the country which can show as much as an even break between revenue from sale of time on the air, and expenses."

The audience listened attentively to the Commissioner's remarks.

Socket-Power for Your Set

Problems and Solutions of AB Sources

By Walter E. Holland

Research Engineer, Philadelphia Storage Battery Co.

WHEN the first B socket power units appeared on the market about three years ago it was freely predicted that similar A units would be developed and bring about batteryless radio operation from the light socket. It was soon found, however, that for A power to operate standard receiving sets with the tube filaments in parallel circuit, the principles and means used successfully for B socket power were inapplicable. A socket power development followed a different course and the A battery is still with us, as a part of the successful A socket power unit.

There was an unfavorable reaction on the part of dealers and the public when it was found that the first B socket power units had numerous limitations and in many cases developed serious trouble. The rectifier tubes were found to be unreliable and short-lived. The high resistance of the filter choke coils and rectifier, the inadequate output and the lack of proper voltage-regulating means limited the application of the units to a certain few radio sets. There was also much trouble with condensers. These difficulties have been overcome. Socket-powered radio last season was accepted by the trade and the public alike as "recommended practice." This season it is destined to become "standard."

B Eliminator Considered

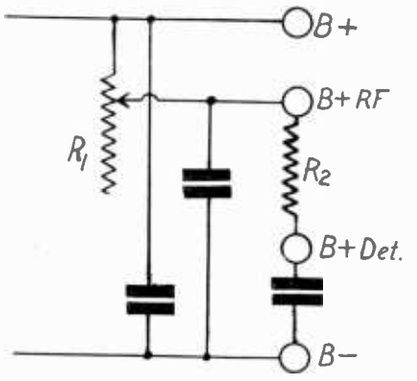
Present B socket power units all operate on the same principle, namely, that of using current from the socket by first rectifying it to the direct form and then smoothing out the ripples. The essential elements of this device are a transformer, a rectifier, one or more choke coils, condensers and voltage-regulating means. B socket power units made by different manufacturers vary chiefly as to the kind of rectifier used and the method of regulating the output voltage to compensate line voltage variations and to suit the plate requirements of the different tubes in the set.

Means for regulating the output voltage are required so that the desired overall or power-tube voltage may be obtained at different AC line voltages over the commercial range of 105 to 125 volts and at different values of load current depending upon the number and kind of tubes in the set. Means are also needed to reduce the overall voltage to the lower voltages required by the other amplifier and tubes and the detector tube.

For voltage regulation, different manufacturers use different combinations of variable and fixed resistors and in some cases a voltage regulator tube. With two or more variable resistors to adjust, the chances are that the installer, unless he have uncommon knowledge and good high-resistance meters, will have great difficulty in adjusting the voltages at the several output terminals to the best values.

One Hard Problem

To adjust the voltages properly without a meter is almost impossible because a change in the setting of one resistor necessitates a resetting of the other resistors and if the resistors are changed in the wrong order the results will be bad. On the other hand, if the intermediate plate voltages are set by means of a fixed shunt resistor with taps, the system is too inflexible to take care of ordinary variations in tubes and sets to give best results.



"TO ADJUST the voltages in a B eliminator the most satisfactory arrangement appears to be a single variable resistor (R1) designed to give 70 to 90 volts for the intermediate amplifier tubes, with a suitable fixed resistor (R2) in series to reduce the voltage for the detector."

The most satisfactory arrangement appears to be a single variable resistor designed to give 70 to 90 volts over a wide range of current for the intermediate amplifier tubes, with a suitable fixed resistor in series to reduce the voltage further as needed for the detector. Calibrated transformer or resistor taps provide a fixed setting to take care of different line voltages and numbers of tubes. With this system it has been found perfectly practicable to adjust the voltages by ear to the best values for any given set. No meter readings need be taken and when the voltages are once set they need never be changed.

The filter condensers have been a source of much trouble in B socket power units. Condenser breakdown has been the result, chiefly, of manufacturers using condensers that were not designed to withstand the maximum voltages to which they were subjected in use.

Condensers Now Measure Up

In other cases the trouble has been due to improper control of the details of manufacture of the condensers or the use of poor materials as a result of the rapid expansion of condenser production which was required to meet the demand. The standardization of ratings and methods of testing condensers, together with the generous exchange of information by the members of the Condenser Committee of the National Electrical Manufacturers' Association, should be very helpful in preventing misapplication and trouble in the future.

Most of the breakdown trouble has occurred where condensers were used with tube-type rectifiers requiring a relatively high transformer voltage for a given output voltage under load. With electrolytic rectifiers, lower transformer voltages may be and are used and condenser breakdown is very rare. Out of approximately 2,500,000 condenser sections used in the B filter circuit of socket power units by one manufacturer during the past two years, only 250 sections or one one-hundredth of one per cent. are known to have broken down in use.

Experience with filter condensers used with different types of rectifier forces the conclusion that the use of a full-wave electrolytic rectifier protects the condensers from strain, not only by lowering the transformer voltage for a given output voltage but by absorbing voltage peaks. A group of electrolytic rectifier cells connected in bridge circuit across the transformer seems to act as an electrical shock absorber in respect to the filter condensers.

Harmless Electrolyte

The old sentimental objection to wet rectifiers has been overcome by a type of aluminum electrolytic rectifier having a harmless electrolyte solution and requiring no additions of water. This type of rectifier is inexpensive and has a guaranteed life of 1,650 operating hours.

This guarantee is conservative, numerous tests having shown the average life to be well over 2,000 hours or two years of average service. A large number of these rectifiers have been in regular service more than two years without even dropping off appreciably in output voltage. These rectifiers are so reliable, so simple in construction and the manufacture is so easy to control that there are practically no defectives or early failures. Approximately 2,000,000 aluminum electrolytic rectifier cells of one make are now in service in the B circuit of socket power units, yet only about 6 per cent. as many have been shipped separately for jobber and dealer stocks and for replacement. The difficulty is to get the dealers to stock them, so small has been the demand for replacement cells to date.

Aluminum electrolytic rectifiers are free of noises such as often develop in certain types of tube rectifier. Connected in bridge circuit for full-wave rectification, they by-pass some of the alternating current which would otherwise get into the output circuit and deliver a form of direct current that is easy to filter. They are efficient and economical of current, owing to their low internal resistance, and for the same reason will give a flatter voltage curve than tube rectifiers over the range of plate current required for different receiving sets.

Plate Current Variation

This better voltage characteristic is important not only in building a B socket power unit to operate different radio sets but also in a given set where the volume control is obtained by regulating the filament temperature of one or more radio-frequency tubes. This more or less standard method of controlling volume will often vary the total plate current by a large percentage, and if the B socket power unit has a steep voltage—current characteristic, the plate voltages are likely to vary so much that distortion or inferior reception will result.

It is possible to build B socket power units with full-wave electrolytic rectifiers for high output voltages by connecting the direct-current outputs of two or more bridge groups in series. There are now in commercial production B and AB combination socket power units which will give 180 volts at currents up to 60 milliamperes. The same units will give 220 volts at about 40 milliamperes, thus providing sufficient margin for a 40-volt grid bias in addition to 180 volts for a power tube where it is desired to use the re-

sistance method of grid biasing. These units have safety switch protection and comply with Underwriters' Standards in all respects.

A great deal of experimental work has been done in an attempt to develop an A socket power system along the lines of the B system, that is, one providing filtered rectified current direct from the socket. For the large currents required for receiving sets using the standard large tubes with the filaments connected in parallel, the cost of choke coils and condensers needed to smooth out the ripples is so great as to be prohibitive. Electrolytic condensers, storage batteries or other forms of electrolytic cell may be substituted for paper condensers in the filter circuit but even then the cost remains much too high. Furthermore, the advantages of a direct-from-the-socket unit with an electrolytic-cell filter circuit are not apparent and the performance questionable.

There is also a difficult rectifier problem in such a unit. The rectifier must be of a type that will deliver the total required filament current plus an excess to feed the shunt paths in the filter circuit and it must deliver this current at a voltage considerably in excess of that required by the tube filaments to allow for the voltage drop in the choke coils. Gas-filled rectifier tubes of the Tungar or Rectigon type fulfill the requirements as to current and voltage but unfortunately have the disagreeable habit of developing oscillations which tune in on the radio set and come out of the speaker as noise. Buffer condensers connected across the rectifier will reduce but will not always eliminate the noise.

Sensitive Filament Circuit

It has been found that the filament circuit is much more sensitive than the plate circuit to line disturbance or noises and voltage fluctuations. In disturbances which have little or no effect on the set operation with a B socket power unit may cause bad noise when operating with a direct-from-the-socket A unit. Likewise the usual small voltage fluctuations in the house current supply which occur at frequent intervals even in the best regulated cities may cause a large increase or decrease in volume with a direct-from-the-socket A unit, where there would be no perceptible change in volume with a B socket power unit under the same circumstances. This great change in volume, with a small variation in line voltage, is particularly noticeable when using a set with the radio-frequency tube filaments turned down to reduce the volume of a local broadcasting station. Under such conditions, using a direct-from-the-socket A unit, the volume change produced by a rise or fall of only one volt in the 115-volt AC supply may be so great as to be very annoying while a change of two volts may cause almost complete fading or blasting loudness.

In a direct-from-the-socket A unit for paralleled filaments, the transformer, rectifier and other units must of necessity be so large that serious problems are introduced in connected with ventilation to carry off the heat as well as in regard to the prevention of hum from magnetic coupling between the power transformer and the audio transformers or other units of the radio set.

High Capacity Rectifiers

For special receiving sets having the tube filaments connected in series, the problem of providing satisfactory A power direct from the socket is somewhat simpler and several such sets with built-in power equipment are on the market. Of these the only ones that have been sold in any quantity are limited to the use of the small low-power tubes.

Recently there have appeared similar sets with standard quarter-ampere tubes using certain new types of tube rectifiers as the means of obtaining direct current for both the A and the B circuits. These rectifiers have yet to prove themselves. The large high-voltage-test condensers and the large choke coils required in the filter circuit are very costly if properly designed and built to stand up under the rather severe operating conditions. It seems to be generally accepted that to use series filaments some compromises in design resulting in less satisfactory performance of the radio set are necessary. This fact, together with the many difficulties inherent in a direct-from-the-socket A power system, makes it an open question how successful this kind of socket-powered radio will prove.

Radio advance needs to be stabilized. The trade and the public are for complete elimination of batteries only if and when equal performance is realized, and new sources of trouble are not introduced. It will pay to make haste less rapidly. Manufacturers who try to reach the ultimate at one leap without going through the usual necessary period of development and testing are courting failure. The successful automobile manufacturers have their proving grounds where new features and models are subjected to every conceivable test before adoption. Even then, as we all know, some mistakes in cars get through. Thorough testing is even more necessary in an industry as intricate and delicate as radio. It is not profitable to rush the development and skimp the testing just to bring out something new ahead of a competitor. It is better to be right than first.

"The Proven Unit"

The only proven A socket power unit for the operation of standard parallel-filament receiving sets is generally known as the trickle charger type. For convenience this may be called the indirect as distinguished from the direct-from-the-socket type of unit. In the indirect unit a small special type of storage battery stores the energy of light-socket current delivered to it when the radio is out of use by a low-rate rectifier or trickle charger.

The battery gives up the stored energy to the filaments and the trickle charger is disconnected when a master switch on the socket power unit is thrown. The master switch is usually connected to control both the A and the B power as well as the filament circuit of the set and may be either a manual or magnetic switch. This system of A power, of course, is applicable to standard radio sets of all kinds. There can be no hum from ripple or rectifier oscillation in the A power and induction troubles are avoided since the alternating current is entirely disconnected from the battery and charger when the radio is in use. The charging transformer and rectifier are kept to a minimum size and cost because the charging current is kept very low by spreading the charging over the entire time between periods of use of the radio.

The success of this type of A socket power unit depends largely upon having a battery of proper design. The battery should have perfect sealing and a vent construction that will absolutely prevent any acid spray passing out. The vents should also be designed so that when the solution level becomes low water may be added to the cells without removing the vent caps. The battery container should be transparent for convenience in adding water to the correct level. Space for a relatively large volume of solution above and between the battery plates should be provided to make a "camel battery," that is, one that will go a long time without a drink. Most important of all the battery should have built into it a visible charge indicator that will tell at a glance whether the trickle charger is delivering enough current to it to make up for the current drawn by the tubes and keep it charged.

A convenient means of adjusting the trickle charge rate should be provided so that the charging current may be reduced to the lowest point that will keep the battery charged as shown by the charge indicator. This will not only save current and prolong the life of the rectifier but will greatly extend the time that the battery will operate without needing water.

Where the correct adjustment of the trickle charge rate is possible, a properly designed battery will operate for several months without needing water. It is important to provide for the adjustment of the trickle charge rate over a wide range on account of the great variation in the filament current requirements of different radio sets and in the hours' use of the set by different individuals. The highest charge rate setting should be one that may be used to quickly bring up the battery after two or three successive days of exceptionally long use. Experience has shown that while a trickle charge rate of .3 ampere will take care of average requirements, it is necessary to provide a rate of 1 ampere to take care of maximum requirements of users of big sets.

Practically the only difficulties that have arisen in connection with the indirect or trickle charger type of A socket power unit have been due to the failure of the user to add water to the battery. This was also a problem when batteries were first used on automobiles. In radio as well as in the case of the automobile the difficulty had now been quite generally overcome through education of dealers and the public. The household duties of many women include the frequent watering of plants. It would be no great hardship to extend their household duties to include the as-easily-done watering of a battery once every one to three months.

Successful Combination

The indirect type of A socket power has been combined very successfully with the B socket power system to make a compact single unit. A single transformer large enough to take care of the A power requirements is wound with separate A and B secondaries. When the A secondary is loaded, the B secondary is not, and vice versa. Thus the relatively small cost of the B secondary is substituted for the cost of the complete transformer required in a separate B unit. The combination results in other economies in the housing and wiring. These AB combination units are now being built with relay switches which control both the A and the B power through the operation of the regular switch on the radio set. Such socket power units are especially suitable for use in console models. A receiving set equipped with an AB socket power unit of the type described can be sold at a very attractive price.

There are many advantages to the radio set manufacturer in socket power employing the indirect A principle. No compromise in set design is required and no special models need be built for operation from the light socket. Parallel-filament sets must be made in any case for battery operation in unelectrified homes and the same identical sets may be sold for light-socket operation. The resulting standardization of production and stock is, of course, of great advantage to any manufacturer but especially to those whose principle it is to give the most for the money. Even where the manufacturer desires to list a completely equipped socket-powered model, there are great advantages in production and cost in using a standard set chassis in combination with a standard socket unit of the type described. The same model may then be used in an unelectrified home by replacing the socket power unit with batteries.

The Scientific Miracle of Tube Manufacture

By R. C. Robinson

Engineer in Charge, Vacuum Tube Department, General Electric Company

The value of research is unquestionably proven by the worth of the various types of evacuated tubes or bulbs which have been sold during the past few years. Experiments, in which some material attached to lead wires was sealed into glass vessels and the vessels exhausted became of great commercial importance when Edison made his first incandescent lamps in 1879.

The improvements in these lamps up to the present time is a most fascinating story, and represents the work of thousands of skilled researchers and the expenditure of millions of dollars.

The changes from the bamboo and silk filaments to squirted cellulose, from the plain carbon to treated carbon, later followed by the Gem filament, the osmium filament ,the tantalum filament, and finally drawn tungsten have brought the incandescent lamp to the excellence which it has today, as a household necessity.

Progress in Manufacturing

At the same time that these changes were being made equally important advances were going on in the art of assembling and exhausting these lamps. Edison's lamps took hours to exhaust while the present day marvel takes seconds. Originally slow acting mercury pumps were used for this work. These were replaced by Packard oil pumps, then by Gerycke oil pumps, later by rotary oil pumps, and finally by mercury condensation pumps of the Langmuir type. In order to improve the vacuum obtained with the pumps, they are assisted by different chemicals; in the earlier days by phosphorous in the presence of a glow discharge in the bulb, and later by numerous chemical compounds, known as "getters," such as various chlorides and fluorides, which when introduced into the bulb materially improve the performance of the lamp.

Equally as wonderful are the improvements in the methods of assembling the lamps. At first all of the work was done by hand, but it is now almost entirely accomplished by machinery, operators being necessary only for loading the machines and final inspection and packing of the lamps. These machines are almost human and are wonderful pieces of mechanism. They blow the bulbs, make the stems from glass tubing, seal them into the bulbs, exhaust them, and even seal off the lamps.

Output 300,000,000 Yearly

Some idea of the advance of the art along these lines is best gained by the statement that more than 300,000,000 vacuum lamps per year are made in approximately one-half the floor space that was necessary for one-half this number six years ago, and that the production per operator, due to the big improvement in machinery, has increased three-fold in the past eight years.

The results of these extended researches and improvemenas have given us a lamp seven times as efficient as Edison's, and one of the few household necessities which have steadily decreased in price. Since 1921 their price has been decreased ten times, so that now they cost us only 49% of what they did in 1914.

Many scientific men, such as Fleming, J. J. Thomson, Richardson, Langmuir, etc., have studied the different phenomena observed in incandescent lamps. When the lamp is well exhausted they found an electric current would pass from the hot filament, if charged negatively, to a plate which was charged postively and sealed into the bulb opposite the filament.

Phenomena More Important

The results of these purely scientific investigations have been more far-reaching even than those on the incandescent lamp itself. From them have arisen our X-ray tubes, high voltage rectifiers, the entire radio vacuum tube line, photo-electric cells, cathode ray tubes, etc.

Langmuir's studies of the current flowing through the space in lamps proved that a hot body in a good vacuum gives off electric particles—electrons—the quantity depending on the temperature of the hot body and the material from which it is made.

In the present-day vacuum tubes three types of substances are used as the source of electrons: the oxides of certain metals as calcium, barium, stronium, etc.; the pure metals themselves, as tungsten or molybdenum; and these pure metals mixed with a small amount of thoria.

Oxide Coated on Wire

The oxides are coated on a wire like platinum or nickel and give off their electrons at temperatures below the melting points of these metals. The pure tungsten filaments are operated at about 2,400 degrees to 2,500 degrees K (Kelvin), and those containing thoria around 2,000 degrees K. Operating at the same temperature, the emission from thorium is about 5,000 times greater than from tungsten. A pure thorium filament, however, vaporizes and melts at too low a temperature to get sufficient emission from it to make a successful tube. It, however, evaporates much slower when in the form of a thin film on tungsten and so it is used in this condition.

The popular UX201-A has such a filamen, a tungsten base containing one or two per cent of thoria. This thoria, at the operating temperature, slowly diffuses to the surface of the filament as thorium metal. The large emission of the thorium is thus secured at the high operating temperature of the tungsten filaments.

Emission 63 Billion Billion

Some idea of the quantity of electrons given off from the hot filament is gained from the fact that 6.28×10^{19} escape per second from one square centimeter surface when the emission current is one ampere.

Under the influence of a high voltage between the anode (plate) and the cathode (filament) the electrons escaping from the hot cathode travel at great speed to the positive anode placed opposite it. If gas is present it either "poisons" the surface of the emitting cathode or modifies the electron flow so that it destroys the proper characteristics of the tube.

It is, therefore, very important that all the gas possible be removed from the tube. This removal of gas necessitates a great amount of painstaking work, which in the case of some of the larger wireless tubes must be carried on for fifteen or twenty hours, during which time they are connected to vacuum pumps. The elements of the tube have to be carefully prepared before they are sealed into the glass bulbs. It is very essential that these parts be freed from all dirt and grease ad be kept as clean as possible, before mounting them into tubes. They are fired at a high temperature in a reducing atmosphere such as hydrogen, or in a vacuum, to remove all contaminating oxides, and as much of the occluded gas as possible.

Elaborate Pumps

The pumping systems by which these tubes are exhausted are very elaborate, and in the case of those used for the larger tubes, sometimes cost as much as $5,000 per unit. The tubes are placed in baking-out ovens and are attached to the pumping system. In order to obtain a sufficiently good vacuum three or more pumps are operated in series: the first one or rough pump is capable of giving a vacuum of 1 m.m. mercury; the next about .001 m.m.; and the final approximately .000001 m.m. This last pump is also assisted by chemical means, such as phosphorous pentoxide, to help remove water vapor from the tube, or by a refrigerant, such as liquid air or chilled brine, to freeze out this moisture.

The exhaust operation is carried out as follows: The bulb is exhausted thoroughly while it is heated as hot as possible without actually softening the glass (400 degrees to 500 degrees C, depending on the glass used) for periods varying from a few minutes to two hours according to the size of the tube.

Gases Driven Out

This bake-out drives the gases (principally water vapor and carbon dioxide) from the glass walls. Next the filaments are burned at temperatures higher than they will be when in service. This removes the gases from the filament, leads and supporting anchors.. Finally the anodes, grid structure or other parts must be brought to incandescence to expel their occluded gases. This may be done by heating them in a high frequency electric field, or by bombarding them with electrons from their own cathode.

By using high enough voltage between the cathode and anode (100,000 or more volts in the case of X-ray tubes and high-voltage kenotrons) the electrons strike the anodes with such force that the anode will be brought to a bright incandescence.

It is easily possible to melt holes through tungsten sheets in this manner, temperatures over 3,000 degrees K being reached in such instances.

This heating of the elements must be continued until as much gas as possible is removed from them.

Symptoms of Gas Presence

Presence of gas in the tube is shown by fluorescent spots on the surface of the glass bulb or by a glow in the bulb itself. When all the gas that can be removed mechanically by pumps has been drawn out, in order still further to improve the vacuum, metallic vapors such as those of phosphorous, magnesium or calcium, etc., are distilled into the bulbs and, condensing on the inside of the glass walls, unite chemically and physically with the residual gases. The tubes are then sealed off from the pumps by melting, with a gas flame, the glass tube which attaches them to the pump.

Before the tubes can be sold they must be aged and operated at voltages and power outputs greater than will be called for in actual service. These operations still further improve the vacuum as the electrons strike some of the gas molecules so hard that they actually drive the gas into the glass walls of the containing bulb.

This effect is greater the higher the voltages used.

After all these operations the vacuum in

(*Concluded on next page*)

The Kilocycle's Case Argued by Dellinger

Washington.

Recommending the use of "kilocycle" instead of "meter" in the measurement of radio transmission frequencies, Dr. J. H. Dellinger, radio chief of the Bureau of Standards, in a statement, declared that the decision of the Federal Radio Commission to designate frequencies in kilocycles, instead of wavelengths in meters, generally meets with the approval of radio scientists. The full text of his statement follows:

"The new word (kilocycles) introduced into radio station announcements by order of the Federal Radio Commission is one evidence that the Commission is being guided in its decisions by the public interest. The decision to replace meters by kilocyles is in line with scientific accuracy as well as greater convenience to the public.

Meters a Bad Habit

"The Bureau of Standards, in a statement just issued, points out that the original use of wavelengths and meters was really a mistake, has caused no end of confusion, and has been an obstacle in the path of the serious-minded who sough to learn the principles of radio

The public has continued to use meters simply because the habit got started, and for no other reason.

"It is much easier for the radio listener to log the stations on his dials in kilocycles because all station frequencies are in even numbers, 620, 630, etc., spaced 10 kilocycles apart. The wavelength ratings, on the other hand, like 483.6, 475.9, are troublesome and are separated different amounts all over the scale.

"In selecting the even kilocycle ratings the Commission is utilizing the results of several years' experience in the development of broadcasting. Spacings other than the uniform 10 kilocycles between stations have been tried and have always added to interference. The inherent reason for this is that the radio wave carrying speech or music does not occupy a single sharp frequency, but actually occupies a little band of frequencies 10 kilocycles wide.

The Word Analyzed

"The word **kilocycle** need cause no dismay. **Kilo** means **thousand** and is familiar to everyone in **kilowatt,** which means a thousand watts. The other part of the word, **cycle,** means one complete alternation. The number of kilocycles is the number of thousands of times that the rapidly alternating current in the antenna or the set repeats its flow in either direction in one second.

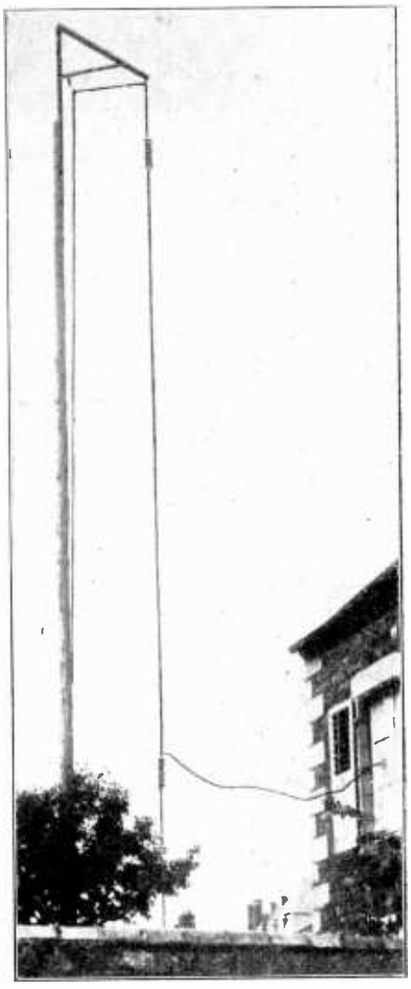
"When it is necessary to find out the kilocycle rating corresponding to a certain number of meters, or vice versa, it is done by dividing 300,000 by the number. For example, 300 meters corresponds to 1,000 kilocycles, and also 300 kilocycles corresponds to 1,000 meters. In view of the action of the Commission, however, there will probably be very little occasion for anyone to make any use of meters, and the need for making the conversion from one to the other will disappear.

The Best Trend

"While **kilocycle** is a new word to many radio listeners it is an established term in radio engineering. On account of its greater convenience, and because the wavelength designation is secondary, confusing, and superfluous, engineers have gone increasingly to the kilocycle basis in the past four years, and manufacturers have more and more inclined to marking their dials in kilocycles rather than meters.

"The use of kilocycles was given standing as authoritative American practice when, on the recommendation of the Bureau of Standards representatives, the 1923 National Radio Conference adopted a resolution that stations be rated in kilocycles. The definite adoption of this practice by the Federal Radio Commission is in harmony with the trend of the best radio engineering and manufacturing."

A PRIZE ANTENNA



(F. M. Delano)

THIS NOVEL antenna, constructed by M. Auger, member of the Reseau des Emmetteurs Francais, aided him in receiving second prize in the long distance reception and transmission contest held by this organization in France. His transmitting station's call letters are 8EB.

Tube Materials Important

(Concluded from preceding page)

many instances is better than .000001 m.m., or in other words, there is less than one molecule of gas left of every 700,000,000 originally present in the tube.

To get full emission from the hot cathode, it is absolutely essential to have this high vacuum in the tubes. A very good indication of the perfection of the vacuum is afforded by the use of the so-called 3/2 power law. This law states that the maximum thermionic current between electrodes of any shape varies with the 3/2 power of the voltage between them. It holds true for practically all measurements up to the saturation point, except a few at low voltages. If gas is present in the space, the law does not hold.

The materials used for parts of the tube and spacing and shape of the parts, play a very important role in the design and performance of vacuum tubes. Copper, nickel, platinum, molybdenum and tungsten are most commonly used for the electrodes, the work which the tube has to do determining the choice of material. For low power tubes, in which the anodes (plates) do not get red hot, nickel is generally used. The larger tubes either have to be water cooled, or have their elements made from the high melting metals, molybdenum and tungsten. The electrodes are shaped and spaced according to the output and electrical characteristics desired.

[From M. I. T. Technology Engineering News]

Choose Your Portable Receiver

You surely want a portable set for your vacation. What kind will you build? Get a good view of the field of portable sets for home constructors by obtaining three issues of RADIO WORLD.

June 11—The Suit Case Six, a Sensitive Portable, Easy to Operate, by James H. Carroll, Contributing Editor. This set works from a loop or antenna and has a stage of tuned RF, two stages of untuned RF, tuned regenerative detector input and two stages of audio. This set can be built into a fibroid suitcase that can be bought for $2.

May 14—Three Tube Portable That Works From a Loop and Runs a Speaker, by Herbert E. Hayden.

April 30—A One-Tube Portable, Using a Loop, by Jasper Jellicoe.

Send 45 cents for the June 11, May 14 and April 30 issues. RADIO WORLD, 145 W. 45th St., New York City.

DX Will Be Easier, Is Irwin's Opinion

Chicago.

Every broadcast station will gain in the number of listeners by virtue of the new wavelengths, effective June 15, believes G. Clayton Irwin, Jr., general manager of the Radio World's Fair, who is in Chicago for the First Annual Trade Show, which opens here on June 13 under his direction.

Listeners will be able to hear more stations than ever before during the Summer and with the Fall will come a revival of DX interest, in his judgment.

Elimination of heterodyning by the national reallocation of wavelengths, together with the splitting of time by many stations provides the opportunity for many broadcasters to gain new friends in near and distant points, he said.

Voice Sent Better

Spokane, Wash.

The third Western Electric amplifier with a range from 16 to 7,000 cycles, the latest improved type, has recently been installed at KHQ. This amplifier, with all equipment, cost about $1,000. It has given a much improved tone to the broadcast, particularly where the voice is concerned.

HIS BIG SET HEAP MUCH FUN

(Underwood & Underwood)

BESIDES "washing an elephant" there are other "big things" to do, for instance building the biggest set any of your friends have seen. This is what Theodore Hardeen did. Hardeen (at right) plays the set while he does some feats of magic with the aid of his daughter, Gladys (at left). He is a brother of the late Harry Houdini.

NEW HOME, NEW MIC

WBZA recently moved into a spacious r Hotel Statler, Boston. The photograph s constituting the studio. The first of a n is installed at

Studios In Chicago To Be Opened by N. B. C.

Merlin H. Aylesworth, president of the National Broadcasting Company, announced that in the early Fall the National Broadcasting Company will open studios in Chicago which will supply radio programs to stations of the concern's Red, Blue and Pacific Coast networks.

Chicago has been definitely identified with the National Broadcasting Company since last November, through six stations which have been transmitting network radio programs emanating from New York. These are KYW, WGN, WEBH, WJJD, WMAQ and WQJ. The fact that Julius Rosenwald is a member of the company's advisory council has also given Chicago an established position in the organization, which operates the only national broadcasting service in the United States.

"The opening of Chicago offices and studios is not a departure from the policy of the National Broadcasting Company," Mr. Aylesworth declares.

"We had planned to make Chicago our central source of material for the University of the Air, but difficulties arose which made establishing Chicago studios impossible until this time.

"The opening of headquarters in Chicago makes possible a more complete broadcasting service in the Middle West. We are now able to include in our networks Des Moines, Omaha, Bristow, Okla, and Dallas, Tex. These cities will be added by direct wires in the Fall when the Chicago studios are complete."

George F. McClelland, vice-president and general manager of the National Broadcasting Company, states, "Members of the engineering staff of our organization have been ordered to Chicago to start at once with the work of developing the intricate and comprehensive wire facilities necessary to our operations. From now on the time of the National Broadcasting Company's officials is to be divided between Chicago and New York."

Executive offices have already been opened in Chicago. The mechanical steps necessary to the development of adequate studios, facilities and wire connections will require the next ninety days, which will elapse before the formal opening, according to Mr. Aylesworth, who said that Chicago would then be in the enviable position of serving the nation by radio.

The National Broadcasting Company, with its three networks, covers the entire United States. There are at present on the Red Network twenty-two cities, while eight are associated with the Blue. The Pacific Coast Network, which reaches from Los Angeles to Spokane, includes seven stations.

Officials of the National Broadcasting Company estimate that an audience of 20,000,000 listens to the three chains.

TEACHES PIANO OVER AIR

LOS ANGELES.

Allene Chaudet, piano player and instructor, has inaugurated a piano teaching class, over KNX, which is proving successful. All that is necessary to join the class, which is held every Wednesday from 4:30 to 5 P. M., is a radio a piano and a chart which is issued free on request.

SHORT-WAVE SCHEDULE

The evening programs of WGY are now also being broadcast by short-wave stations 2XAF, 32.77 meters, and 2XAD, 22.02 meters. On Tuesday, Thursday and Saturday, 2XAF will do the broadcasting, while on Monday, Wednesday, Friday and Sunday, 2XAD will broadcast.

The short waves travel very far on small power.

Lindbergh Day A Radio Event

June 11 was "Lindbergh Radio Day" for the National Broadcasting Company and associated stations throughout the entire United States. Lindbergh programs, in addition to the official ceremonies in which the flier participated in Washington, were arranged for WEAF, WJZ, WRC and the Pacific Division.

Arrangements were made with the Washington reception committee, headed by John Hays Hammond, who accepted the National Broadcasting Company's offer to link up the entire nation from coast to coast for the broadcasting of the Lindbergh ceremonies at Washington.

It is estimated 30,000,000 could have tuned in for the event.

Lindbergh's Landing Quickly Announced

Nine minutes after Captain Charles Lindbergh touched French soil on the completion of his New York-to-Paris flight, WGY announced its feat by raido. The speedy service to the waiting fans was made possible through the co-operation of the United Press.

STATIONS SEND BELLANCA NEWS

News was again the spotlight attraction on the air when Chamberlin and Levine winged their way from New York to a point near Berlin, in their Bellanca plane, Columbia, for a record non-stop flight. Stations which broadcast periodic bulletins were swamped with telephone calls, urging them to give the reports more rapidly. WOR, WEAF and WJZ in the metropolitan district won the highest honors for distribution of the news.

ROPHONE, AT WBZA

iew studio on the tenth floor of the
iows the principal room of the series
:w studio type condenser microphone
WBZA.

White Depicts Niagara Aglow

An opportunity to view the brilliant illumination of Niagara Falls through the observing eye of Major J. Andrew White, was afforded listeners of WGY and the radio stations of its western network the other night.

The occasion was the festival of light, an annual affair at Niagara Falls since the installation of the spectacular lighting effects by the General Electric Company two years ago.

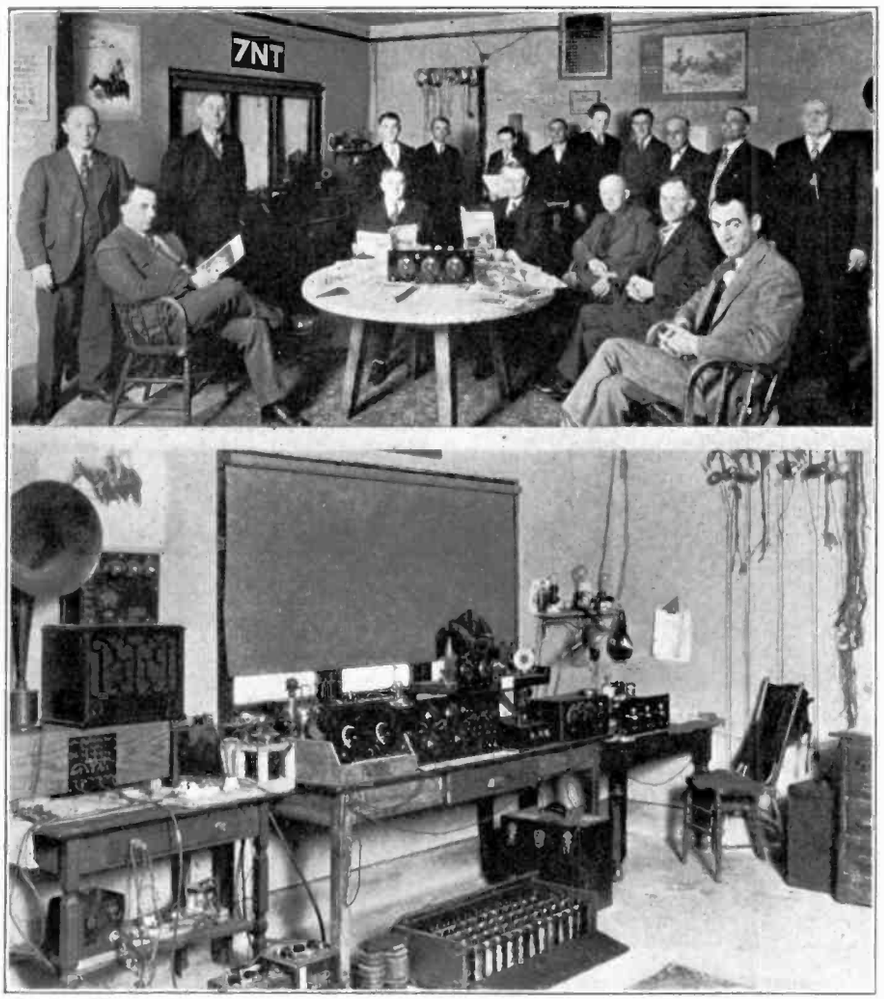
Major White, widely known as sports announcer and air reporter of international events, had his descriptive talent severely tested for, in place of a blow-by-blow description, he was called upon to convey a flash description with complete color effects. He was stationed on the roof of the Hotel Niagara and told the story of the vivid flashes of the pyrotechnic display, the distant roar of the falls and the explosion of bombs giving realism and atmosphere to the running account. During the fireworks display the Falls were bathed in 1,440,000,000 candlepower of colored lights from the twenty-four huge arc searchlights installed on the Canadian side of the Falls by the General Electric Company.

WMAK, of Buffalo, WHAM, Rochester, WFBL, Syracuse, and WPDQ, Buffalo, also carried the description of the Festival of Light.

OBSERVED WAR GAME

Lieut. Col. E. P. Edwards, manager of the radio department of the General Electric Co., and E. M. Kinney, assistant engineer of the same department, were civilian radio observers on the Black Fleet, during the recent Army-Navy maneouvres off Narragansett.

BIG STRIDES BY BUTTE CLUB



(Dwyer-Ward)

THE BUTTE RADIO CLUB has impressed not only all of Montana with its progressive work in radio but has attracted national attention. Its membership and importance are increasing with rapid strides. Some of the officers and members are shown in the meeting room. In the lower photo the members have dispersed in favor of the regular equipment and installation of the club.

Search for New Queen Is Started by Fair

The search for the Queen of American Radio, 1927-8, has begun.

She will be the official representative of the women radio fans of the United States for the term of one year, and will be a guest of honor at the Radio World's Fair in New Madison Square Garden, New York City, Sept. 19-24.

Her predecessors as Queens are Miss Rena Jane Frew, of Beaver, Pa., for 1925-6, and Mrs. Lotta Harrauff, Princeton, Ill., 1926-7.

They were chosen because of their knowledge of radio and their ability to interpret its usefulness, in spoken and written word, and they have drawn ever-increasing attention to the fact that radio is now a necessity in every home. They emphasized the value of radio as an educator and moulder of public opinion.

Another woman holds high position in radio, Mrs. Flossie Erickson of Bloomington, Ill., whose achievements in reception set new records. Mrs. Erickson, with various receivers and many different aerials, has brought in foreign countries as well as nearly 400 American stations. She has received four cups from the Radio World's Fair and the Chicago Radio Show, by vote of the judges designated at these official exhibits of the radio manufacturers.

This year the title of Radio Queen will go to the woman who writes the best essay on the topic: "What Radio is Doing for the Women of the World."

Intensive study has been given by sociologists to this question and everyone concedes that radio influence for good is staggering to the imagination. That being so, the judges in the contest anticipate answers of tremendous interest.

All essays must be submitted to the Directors of the Radio Queen Contest, care of the Radio Manufacturers' Show Association, 1800 Times Building. No entries will be received after midnight, August 31.

SERIES FILAMENTS NOT FOR DC

It is not advisable to connect the filaments in series, when using a DC A and B battery eliminator, since the voltage required to light the filaments causes the voltage for B supply to drop so low that the tubes don't amplify properly.

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

Member, Radio Publishers Association

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

TELEPHONES: BRYANT 0558, 0559
PUBLISHED EVERY WEDNESDAY
(Dated Saturday of same week)
FROM PUBLICATION OFFICE
HENNESSY RADIO PUBLICATIONS CORPORATION
145 WEST 45th STREET, NEW YORK, N. Y.
(Just East of Broadway)
ROLAND BURKE HENNESSY, President
M. B. HENNESSY, Vice-President
HERMAN BERNARD, Secretary
European Representatives: The International News Co. Bream's Bldgs., Chancery Lane, London, Eng. Paris, France: Brentano's, 8 Avenue de l'Opera

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

SUBSCRIPTION RATES

Fifteen cents a copy. $6.00 a year. $3.00 for six months. $1.50 for three months. Add $1.00 a year extra for foreign postage. Canada, 50 cents.

Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5½"	231 lines	150.00
½ Page, 8¼" D. C.	231 lines	150.00
¼ Page, 4½" D. C.	115 lines	75.00
1 Column, 2¼"x11"	154 lines	100.00
1 Inch		10.00
Per Agate Line		.75

Time Discount

52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
4 consecutive issues	10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities ten cents per word, $1.00 minimum.

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

Stations Are Divided On Use of Call Names Instead of the Letters

Answers to the questionnaire mailed to all broadcasting stations by the National Association of Broadcasters, regarding the substitution of names for call letters, show that the old stations prefer call letters, while the new ones desire names. One station which has been on the air for quite a time preferred the use of the name until about 11 P. M., after which the call letters should be used for the interest of DX fans.

"To the 681 questionnaires mailed we have received more than 100 replies which point out, in the case of stations established from three to five years, that call letters are considered as a sort of stock-in-trade which has been expensively established," said L. S. Baker, secretary of the association. "Younger stations, however, show an inclination to vote 'yes' to the question being considered (names instead of call letters). Several have signified that in their estimation, station names once established will prove to be of greater value than call letters."

Wired Radio Lacks Lure of Space Wave

By Hugo Gernsback

Editor of "Radio News"

When broadcasting was established in this country, the universal opinion was that the service would always be free. No one in America has ever seriously considered broadcasting paid for directly by the listeners. This is in distinct contrast to the European system, whereby every radio set is taxed by the government anyywhere from 25 cents a month upwards to pay the broadcasters. This is the custom that prevails in most countries of the world with some few exceptions. Of course, even in the United States, some one foots the bill—that some one being usually the public. But this is indirect taxation, whereas the European system is one of direct taxation on each set.

In America the broadcasters expect to get back, through the returns from goodwill programs or indirect advertising, their outlay for broadcasting—in which effort, it may be said, they have been fairly successful. Not every station, however, operates at a profit, nor will probably do so for some time to come. In general, the principle has been recognized in this country that radio should be free for all, so that any one buying a set can listen in to his heart's content, year in and year out. This is the prevailing system of "space radio."

Difficulties Solved

There is, however, another system which may shortly go into operation in the Eastern part of the United States, and which is known under the name of "wired radio." There is nothing new about this, for it is not a new invention by any means.

General G. O. Squier took out patents on wired radio many years ago, but so far the system has not met with much success or encouragement in application to broadcasting; although this can be accomplished by wired radio over existing lines, be they telephone or telegraph, electric-light or power. It is understood that, for the time being at least, the telephone interests will have none of wired radio. On the other hand, one of the largest electric light and power corporations in the country, with networks extending throughout the East, definitely intends to go "on the wire" with wired broadcasting in the near future, probably within six or eight months.

Many technical difficulties had to be overcome to make this possible, but officials of the company sponsoring wired radio now believe that the difficulties have been smoothed out, and that a real service can actually start very soon. Somewhere in the East there will be studios where three different wavelengths over existing wire systems.

Choice of Three Programs

By means of a simple switch on a special receiving set, it is promised, the listener renting the instrument from the wired-radio company will be able to select any one of the three programs being fed to the electric light wires, and this program will issue from a loudspeaker. Two models of receivers are planned. One will use a crystal detector, and is intended primarily for headphone reception. The other will include a regular audio amplifier and a loudspeaker, all A, B, and C power being derived from the power line. No aerial and ground will be used, as the receiver picks the programs directly off the power wires.

If one already owns a radio receiver, he can rent the crystal receiver and connect it to his set in such a manner that the audio amplifier in the set will amplify the signals; the radio loudspeaker will then reproduce them as it does space-radio impulses. This is just an outline of the proposal, from the advance information at hand.

Interesting as are the possibilities of wired radio, however, I personally do not believe that it will prove a formidable competitor of space radio.

It may be said, as a matter of fact, that the so-called wired radio really should not be called radio at all, although it uses radio instrumentalities throughout. In any event, wired radio certainly takes the romance and thrill out of radio broadcast reception, unless you are satisfied with one or two local stations. With space radio even a mediocre set has no trouble tuning in any evening at least forty or fifty stations; and if the set is a really good one, as many as a hundred stations can be logged.

This does not mean, of course, that you can enjoy a hundred different programs during that evening, because the time limitation is against this. But the argument remains in favor of space radio; for the simple reason that, if you wish to stay with any one of the programs, you can do so by tuning in the station you wish to listen to and, unless it is an exceptionally bad night, when much static prevails, there is not much difficulty in staying with the station selected. If I do not wish to know what is going on in Chicago, I can listen to Washington or to New York, or to Atlanta. That is, with space radio. With wired radio it would seem that there must be limitation to a very few programs. The fact is, you will have to take what you get. This seems to be a serious disadvantage, and only time will tell whether it can be successfullly overcome.

Assured of Programs

On the other hand, it may be said that, with wired radio, you do not have to contend with static and uncertainties, but you may be assured of a program at all times. How this choice will strike the average listener it is, of course, impossible to predict.

Then comes the most important point under consideration; and that is, wired radio will not be free. The apparatus will not be sold, but leased at a certain monthly rental per instrument.

Just how many persons will avail themselves of such a service, when general radio entertainment always has been free, remains as yet to be seen. While there can be no doubt that wired radio will in all probability never supplant space radio, it is possible that it will prove an interesting adjunct to space radio. The parallel to this may be found in space radio and the phonograph.

When radio first came into vogue it was freely predicted that the phonograph would be speedily relegated to the scrap heap. I predicted early in 1921, when broadcasting first started, that nothing of the kind was likely to happen, and rather that the phonograph would be helped by radio. This indeed proved to be the case, for there are more phonographs and more records being sold today than at any other time.

It is in the nature of every radio fan to investigate and the prediction is freely made that, if wired radio comes into universal use, the parts business will take a sudden leap. Every radio fan and every set builder will no doubt try, at one time or another to build a radio receiving set that will bring in the wired-radio program.

(Broadcast from WRNY)

SHE RUNS WJZ STUDIO

(Strand)

BERTHA BRAINARD, former newspaper woman, is the manager of WJZ, one of the world's leading broadcast stations.

WJZ MANAGED BY WOMAN WHO LOVES TO WORK

By Herbert B. Glover

Bertha Brainard, manager of WJZ, owned by the Radio Corporation of America, "key" station of the National Broadcasting Company's blue network and one of the country's most powerful radio stations, is not only one of the real pioneers in the radio broadcasting industry, but she is thoroughly versed in all its branches.

The State of New Jersey produced both Miss Brainard and the broadcasting station whose activities she now directs. She was born in South Orange and was graduated from the South Orange High School and the Montclair Normal School. During her school days she was interested in theatrical work and took part in many amateur performances.

At the outbreak of the World War she enlisted in the motor ambulance section of the American Red Cross. She served with her unit for many months during the hostilities. After the Armistice, she turned to literary pursuits, working for the Fairchild Press.

In New Job

When WJZ first came into being, Miss Brainard immediately realized the potentialities of broadcasting. At that time, WJZ was a small station in the experimental stage, owned and operated by the Westinghouse Electric and Manufacturing Company. It was one of two broadcasting stations in the United States. With her experience as a writer serving as her card of introduction, Miss Brainard interviewed the manager of the station and submitted to him a proposal to conduct a weekly review of current Broadway plays from the Newark studio for WJZ's listeners.

Old-timers among broadcast listeners will remember Miss Brainard's weekly theatrical chats, entitled "Broadcasting Broadway." Preparing and presenting them entailed a great deal of work and she received no recompense for it other than a thorough knowledge of the broadcasting methods then in use. She showed such efficiency in her work, however, and she became so popular with the radio audience and with the station's staff, that the management of WJZ soon asked her to serve the station in another capacity.

WJZ needed a representative in New York City. Miss Brainard accepted the position.

Starts Women's Hour

When WJZ's studios and offices were moved to the Aeolian Building in New York City, Miss Brainard was made assistant manager of the station. She was responsible for inaugurating a broadcast hour specially devoted to the interests of women. Under her guidance, the period became immediately and greatly popular.

In the fall of 1926, management of WJZ was taken over by the National Broadcasting Company and Miss Brainard was made manager of the station. Today, she is one of the outstanding women in the radio field and the only woman managing a station of the size, the power and the importance of WJZ.

"Radio broadcasting is the most interesting game in the world," Miss Brainard declares. "One never does the same thing twice. One night it is visiting celebrities, the next an operatic diva. There is no monotony, but instead a stream of interesting experiences and interesting people."

KAHN'S VERSATILITY

ROGER WOLFE KAHN, leader of the Hotel Pennsylvania Grill Orchestra, which broadcasts from WJZ in New York City, every Tuesday and Friday nights from 10:30 to 11:30 P. M., (E.D.S.T.). Roger is a son of Otto H. Kahn, of the banking firm of Kuhn, Loeb & Co. Otto is head of the Metropolitan Opera House. Roger is not only a player and leader but a composer.

Protests Prove Futile On Wave Allocation

The Radio Commission has denied the requests of those stations which wanted a frequency other than the one assigned to them, where decisions have been made. However, other protests are under consideration. The following petitions were denied:

WJAZ, Chicago, Ill., owned by the Zenith Radio Corporation; assigned 263 meters, protested and requested 389.4 meters.

WGL, N. Y. City, owned by the International Broadcasting Corporation; assigned 256.3 meters, protested and requested 422.3 meters.

WDWM, Newark, N. J., owned by Radio Industries Broadcast; assigned 236.1 meters, protested and requested 280.2 meters.

The request of WFIW, Hopkinsville, Ky., owned by the Acme Mills, Inc., for the 361.2 meter wave, has been withdrawn. The station accepts its assigned wave of 280.2 meters.

Changes Announced In List of Stations

Since the list of stations published in the June 11 issue of RADIO WORLD went to press the Federal Radio Commission announced a few changes, which are published herewith. Possessors of the list as published should therefore embody the amendments:

Station	Location	Kc	M	Watts
WABI	Bangor, Me. (will not divide time with WGBX)	770	389.4	100
WASN	Boston, Mass.	990	302.8	100
WFCI	Pawtucket, R. I.	1330	225.4	50
WGBX	Deleted.			
WNAC	Boston,, Mass. (will not divide with WEAN)	850	352.7	500
WNRC	Greensboro, N. C.	1340	223.7	500
WSMK	Dayton, Ohio	1010	296.9	200
WSSH	Boston, Mass. (will not divide time with WASN).			
WWNC	Asheville, N. C.	1010	296.9	1000
KFRC	San Francisco, Calif..	660	454.3	500

'Quake Stops Clocks; Station Supplies Time

Los Angeles

During a recent earthquake in Mexico, all of the clocks in the little village of Coronilla were stopped.

An American superintendent of a large mine who owned the only radio set in the town tuned in KFI the following evening and heard the correct time broadcast. Thus the residents of Coronilla were able to resume life on regular schedule.

Fork at Teeth Used By Camper as Phone

When E. C. Hampton of Los Angeles went into the Kings River Canyon in the Sierra Nevadas for the opening of the trout season, he took his portable radio receiving set with him.

When he pitched camp the first night and set up his receiver he discovered to his horror that he had lost his ear phones —and he had purposely left the loud speaker at home to make his load lighter and more compact. Despair and defeat stared him full in the face for a while and then he started to experiment with some of the implements at hand.

Hampton attached a fish hook to the leadout wire but nothing happened. He then wired a fork to the hook, and still nothing could he heard. Suddenly he remembered an experiment in bone conduction which he had performed years ago in a high school physics laboratory. His joy was complete, when after setting the dials, he touched the fork to his teeth and heard, clear as a bell, "This is KFI, Los Angeles, the next number will be....."

Greece Licenses Sets; Prison for Offenders

The Director of Greek Telegraphs, Telephones and Posts announced that all owners of radio receiving and broadcasting sets must apply within 15 days to the Ministry of Communications for obtaining the necessary license, according to advices to the Department of Commerce from Commercial Attache Gardner Richardson, Athens, Greece.

Failure to apply for such a license within the time limit specified, will be punishable with seizure of the apparatus, up to 12 months' imprisonment and a fine.

Radio University

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

When writing for information give your Radio University subscription number

FIG. 541
The panel layout requested by James P. Nuidle

ON PAGE 20 of the Feb. 26 issue of RADIO WORLD there appeared a circuit diagram of a trap unit, as sent in by James Wallach. I built this and added it on to my four-tube set and wish to say that it helps immensely in getting distance, as well as increasing the selectivity. However, I note that the volume on local stations is not any greater. Is this characteristic of the unit?

(2)—Isn't this unit really an extra stage of radio frequency amplification?

(3)—When I try to tune in the lower wavelengths with this unit in, the set oscillates too much. Would a variable primary or a 2,000-ohm variable resistance in the plate lead of the new tube help any?—LESTER MURROW, Jackson, Mich.

(1 and 2)—Yes.

(3)—This would help a great deal. Increase the number of turns on the primary to twenty-five.

* * *

I HAVE the circuit diagram of a five-tube receiver, in which two stages of tuned radio frequency amplification, a non-regenerative detector and two stages of transformer coupled audio frequency amplification are used. A triple condenser (the capacity of each section being .00035 mfd.) is used to tune the secondaries of the coils, which are of the figure eight type. I would like to build this set. The coils are the only products that I haven't got.

(1)—Could plain solenoids be used? I have plenty of two and three-quarter-inch diameter tubing and No. 22 double cotton covered wire. If so, give the data.

(2)—A variable grid leak is specified. Could a fixed leak be used?

(3)—If so, please specify the value, using an —01A tube as a detector.

(4)—A rheostat is used for both radio frequency tube filaments. Is this all right?

(5)—May the coils be tipped at an angle in similar fashion to those in a Neutrodyne?—CHARLES ARTHURS, Cambridge, Mass.

(1)—Each primary winding should consist of ten turns. Each secondary winding should consist of seventy turns. Between each primary and secondary winding, allow a one-quarter inch space.

(2)—Yes.

(3)—Use a four megohm leak. But a variable one will be better.

(4 and 5)—Yes.

* * *

THERE APPEARED on page 10 of the March 12 issue of RADIO WORLD a circuit diagram of a crystal detector receiver. About what is the range of such a set, both in the city and country?

(2)—Would a synthetic crystal work all right here?

(3)—Can the same type of antenna as specified for the average tube set be used, e.g., one hundred feet, inerted L shape?—FRANKLIN L. OSGOOD, Cincinnati, O.

(1)—About fifteen miles, in a fairly good location in the city and about twenty-five miles in the country.

(2 and 3)—Yes.

* * *

TWO YEARS ago I built a four-tube reflex, the first tube being reflexed, the next being a non-regenerative detector and the following two audio amplifiers, coupled by transformers. I would like to rebuild this set. I use —01A tubes throughout.

(1)—Could another tube be added in a stage of tuned radio frequency amplification, using a drum type control with, of course, three condensers?

(2)—If not, could the drum control with two condensers be used just for the detector and RF stages?

(3)—Would another stage of transformer coupled audio cause distortion?

(4)—The plates of both tubes are now connected to a common B lead, where ninety volts are applied. Also there is no provision for a C battery. Could a higher plate voltage be used on the plate of the last tube for greater volume? What C batteries should be used?—HAROLD WHITE, Newark, N. J.

(1)—No, this would cause erraticness.

(2)—Yes. Be sure that the rotor sections are not common. If they are, and the grid leak is shunted across the grid condenser, it will be necessary to run the leak from the G post to the plus A post of the socket.

(3)—Yes.

(4)—Yes. Use one hundred thirty-five on the last plate and ninety on the first. The C bias for the first tube should be four and one-half, while for the last tube, it should be nine.

* * *

THE ARRANGEMENT shown on page 15 of the Jan. 15 issue of RADIO WORLD, for switching in or out the B eliminator or trickle charger, has attracted my attention and I wish to use it in conjunction with my set. Could the switch be placed on the panel of a receiver, or must it be placed underneath the set?—HENRY KING, Pittsburgh, Pa.

It should be placed in such a position that the AC line is not parallel to the antenna and ground, or the grid and plate leads. If put on the panel, of course, this would happen. Therefore, beneath the set either in a console compartment or underneath the table, would be all right.

* * *

I HAVE a four-tube set, using one tuned stage of radio frequency amplification, a detector and two transformer audio stages. Rheostats are used in each filament circuit. Could all but the RF rheostat be replaced by ballast resistors. I wish to do away with all these knobs on the panel.

(2)—The tuning is quite broad. Could this be due to the closeness of the primary to the secondary, there being no space at all between them? They consist of twenty turns. Is this also too much?

(3)—Would the addition of a coil and variable condenser in series with the antenna help the selectiveness of the set? If so, could a .00035 mfd. variable condenser be used? How should the coil be made?—ROBERT KEITH, Ft. Wayne, Ind.

(1)—Yes.

(2)—Place the primary winding about one-quarter inch away from the secondary winding. Reduce the primary turns to ten.

(3)—The installation of the variable condenser and coil will help to increase the selectivity as well as the volume of the set. For the .00035 mfd. condenser you have, wind fifty-nine turns on a three-inch diameter tubing using No. 22 double cotton covered wire.

* * *

WHAT IS 9,000 kilocycles equal to in meters?

(2)—What is 150 meters equal to in kilocycles?

(3)—What is 10 meters equal to in kilocycles?

(4)—What is 10,000 kilocycles equal to in meters?—SAMUEL WENTWERTH, Springfield, Ill.

(1)—33.31 meters.
(2)—1,999 kilocycles.
(3)—29,982 kilocycles.
(4)—29.98 meters.

* * *

A FRIEND recently gave me the circuit diagram of a five-tube receiver using a single tuned radio frequency stage, a non-regenerative detector and three stages of resistance coupled audio frequency amplification. Will I get good quality reproduction?

(2)—Although the set calls for separate condensers, he told me that I could use a double condenser with satisfaction. He also said that the only changes necessary, would be to install small midget condensers across the condenser for balancing and return the grid to plus A, via the leak. Is this correct?

(3)—Will a seven by twenty-four inch panel and cabinet give me ample space for this set?

(4)—The data calls for a two ohm, one and one-half ampere rheostat to control the filaments of the detector and resistance coupled audio tubes. I have a two ohm, two ampere rheostat. Could this be used?

(5)—Could a set of this type be used with much success on a loop? If so, could I follow the directions given in the Nov. 6 issue of Radio World on page 11?—WILLARD ELGIN, Bridgeport, Conn.

(1, 2, 3, 4 and 5)—Yes.

* * *

THE PANEL layout for a five-tube set, using two stages of tuned RF amplification, a detector and two stages of transformer audio coupling, wherein controls resembling the Mar-Co Illuminated Controls, except that no light switch is provided with each, a filament switch, a single circuit jack and a single rheostat, which controls the RF tube filaments are used, would be appreciated.—JAMES P. NUIDLE, Hackensack, N. J.

Fig. 541 shows the panel layout. The switch is placed next to the control on the right. The rheostat is placed above the jack in the extreme right hand corner. The panel is of the seven by twenty-four inch type.

* * *

REGARDING THE three-tube regenerative receiver, described by Jasper Henry in the April 2 issue of RADIO WORLD on page 13.

(1)—Could the first double circuit jack be left out? How?

(2)—Can both audio tubes be placed on a single ½ ampere ballast resistor?

(3)—Could I substitute the filament control jack with a pair of binding posts, and use the filament switch to disconnect or connect the filament circuit? How?

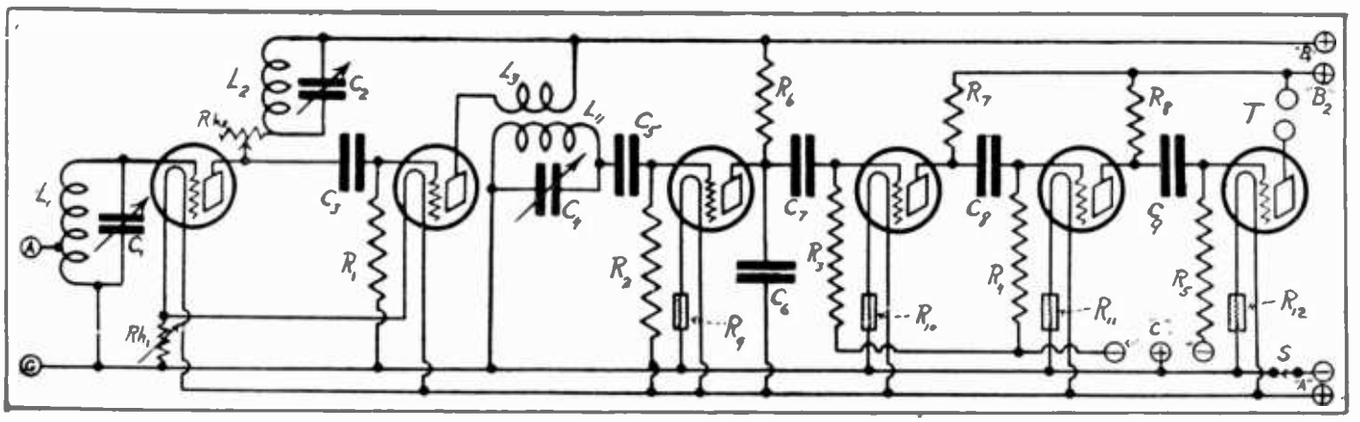


FIG. 542

The circuit diagram of the six-tube receiver requested by Carl O. Messmer.

(4)—Could the twenty-ohm rheostat be supplanted by a thirty-ohm rheostat?—LESLIE URGOTTEN, San Francisco, Calif.

(1)—Yes. Just run the end of the tickler winding of the tuner to the P post on the transformer. The B post on the transformer is, of course, brought to the B plus twenty-two-and-one-half volt post.

(2)—Yes, provided you are going to use —01A type tubes in both sockets.

(3)—Yes. In this case the negative return of the filaments is brought to the minus A, C plus lead, before it goes to through the switch.

(4)—Yes.

* * *

I HAVE a one-tube regenerative set, which works very satisfactorily. I would like to, however, increase the number of tubes, and rebuild the complete set into a larger cabinet, etc.

(1)—The Hartley system of regeneration is used. That is, the regeneration is obtained via a variable condenser. This means that there are two controls, one being the condenser which tunes the secondary winding of the coil, and the other, the regenerative control. Would I get good results if I ganged these condensers together?

(2)—I have a 200A knocking around, which I would like to use in place of the —01A, now used in the detector circuit. Will this necessitate the change of the grid return or from plus to minus A?

(3)—I have a three-stage resistance coupled audio amplifier. Could this be used with success in connection with this set?—JOHN LONGSTRUM, Philadelphia, Pa.

(1)—No.

(2 and 3)—Yes.

* * *

I WISH to build the three-tube portable described in the May 14 issue of RADIO WORLD as a regular set for home use, and therefore would like to have the following information.

(1)—Can —01A tubes be used?

(2)—If so, what changes are necessary?—L. PHILIP MORTON, Lexington, Ky.

(1)—Yes.

(2)—Use a ten-ohm, three-quarter ampere rheostat. Instead of bringing both plate leads of the amplifiers to a common post, bring them to separate posts. Do the same with the grid return leads. To the first AF plate, apply ninety volts, while to the second audio plate, apply one hundred thirty-five. Use a 4½ volt C battery for the first stage and a nine volt C battery for the second stage.

* * *

I BUILT the four-tube receiver described on page 14 of the Jan. 15 issue of RADIO WORLD. The results are fine. The tuning is however a bit broad. Would a reduction in the primaries to about six turns cure it?

(2)—The detector rheostat is not critical as to adjustment. Could I therefore replace it with a ¼ ampere ballast resistor?

(3)—The radio frequency tube is quite critical, even with the filament adjustments. Would a 2,000-ohm variable resistance inserted in series with the B plus RF lead aid this?—HARRY ULWIDER, East Pittsburgh, Pa.

(1)—Yes. Also place the primaries further away from the secondaries.

(2)—Yes.

(3)—Yes.

* * *

I THINK that about six months ago, a six-tube set, using a regenerative RF tube, which was made regenerative by the use of a special resistance-impedance combination, a non-regenerative radio frequency amplifier as well as a non-regenerative detector and three stages of resistance coupled audio frequency amplification was described. If this is so, the circuit diagram with the constants would be very much appreciated.—CARL O. MESSMER, Atlantic City, N. J.

The circuit diagram of this set is shown in Fig. 542. L1, L2 and L4 all consist of eighty turns, each wound on a one and one-half inch diameter tubing. No. 26 single silk covered wire is used. The antenna coil L1 is tapped at the fifteenth turn. On the L4 tubing, L3, consisting of fifteen turns is wound, with no spacing between the windings. Use the same wire. Rh2 is a 100,000 ohm variable resistance. Rh1 is ten ohm, one-half ampere rheostat. R9, R10, R11 and R12 are 1A Amperites, R1, R2 and R3 are one megohm leaks. R4 is a one-half megohm leak, while R5 is a one-quarter megohm leak. R6, R7 and R8 are all one-tenth megohm resistors. C7 and C8 are one-quarter mfd. fixed condensers. C9 is a two mfd. fixed condenser. C6 is a .0005 mfd. fixed condenser. B1 equals sixty-seven and one-half volts. B2 equals one-hundred and thirty-five volts. S is the filament switch. C3 is a .001 mfd. fixed condenser. The coils are mounted on the end plates of the variable condensers at angles. These are placed about five inches apart.

* * *

I WOULD like to build the five-tube set described by Irving Witz in the Aug. 7 issue of RADIO WORLD. However, instead of the spider-weave coils, I would like to use solenoids, since I have about five six-inch long, two-inch diameter tubings. Using .00035 mfd. variable condensers and No. 24 double cotton covered wire, how many turns should be wound to constitute the primary and secondary of these coils?—CARL K. HANDLER, Atlantic City, N. J.

The primaries should consist of ten turns. The secondaries should consist of one hundred and nine turns. Each primary and secondary winding is made on one form with a quarter-inch space between them. Place them at right angles to each other at the extreme ends of the cabinet.

* * *

ON PAGE 13 of the Sept. 25 issue of RADIO WORLD there appeared the circuit diagrams of two, one-tube regenerative receivers, one using the tickler in the plate and the other, using a variable condenser tuning the plate. Which of these circuits is the more stable?

(2)—I notice that the grid leaks are brought from the grid posts to the F plus posts of the sockets, instead of across the condensers. Is this an improvement?

(3)—Can any form of audio frequency amplification be added to either of these sets?—EINAR JOHNS, Parkersburg, W. Va.

(1)—They are both about equal.

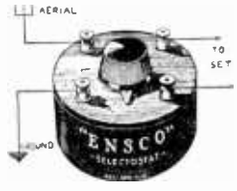
(2)—No. The results will be about the same.

(3)—Yes, simply use the phone posts as the output posts. The by-pass condenser across the phones in the condenser tuned plate circuit is not essential.

CERTIFIED PARTS and ACCESSORIES

"Ensco" Selectostat Gives Fine Selectivity

A simple device has recently been developed to fill the pressing need for obtaining selectivity without making any change in the set itself. This device as shown is merely connected between aerial and set. By means of low-resistance coupling between aerial and ground the tuning is sharpened. This phase of the operation of the device is accomplished without any adjustment. The setting of the first dial (in tuned radio frequency circuits) may be changed slightly, but the selectivity is obtained without further adjustment, and after learning the exact dial readings they never vary. You merely tune your set as before.



Another valuable use of this device is as a volume control. Here the adjusting knob is used to vary resistance inserted in the aerial circuit by use of the device. When the knob is at zero it is out of contact and the device is merely a means of obtaining selectivity. By turning the knob the resistance is inserted at maximum and gradually reduced until the volume is that desired for the particular program being received. This form of volume control is greatly to be desired as it permits the tubes to operate at best efficiency, which is seldom true when the rheostats are used to reduce volume.

The third feature of importance is the reduction of static effect by use of this device. The adjustment of knob for control of volume also controls a form of static leak between aerial and ground. During periods of heavy static the set is turned to full volume and then controlled by the knob. As the volume is slightly decreased the static is decreased in a proportionately greater way, thus increasing the ratio between static and signal volume and permitting clearer reception. It has been demonstrated that with this inexpensive piece of apparatus programs can be heard with good clarity even in severe electrical storms. Of course no claim is made that static will be entirely eliminated, but any means of reducing it certainly makes for more pleasant summer radio reception.

The Ensco "Selectostat," as this device is called, is the latest development of the Engineers' Service Co., producers of the famous Ensco unit and 36-inch cone kit, and full information on both of these products may be had by addressing the main office at 25 Church Street, New York City.

"Push Post" Added To Line of X-L Lab.

The X-L Radio Laboratories, 2424-26 Lincoln Ave., Chicago, Ill., manufacturers of the popular model G and N variodensers, which range in capacity from .0000018 mfd. to .001 mfd., are now producing a new type of binding post known as the X-L Push Post. It is very light, being made of aluminum, and has a high conductivity factor. All that is necessary to connect a lead to the binding post is to push the top down and insert the lead through a large hole. When you take the pressure off the top, the lead is rigidly held in place. The contact is positive and strong, no jarring of any kind being able to work it loose.

Concertone Appears In Upright Case

The Concertone audio transformer, made by the Jefferson Elec. Mfg. Co., 501-511 So. Green St., Chicago, is now assembled in a beautiful black enameled upright case. The windings of this transformer are vacuum impregnated and the whole assembly sealed into the case. This protection makes Concertone impervious to moisture even in humid climates. The extra heavy insulation throughout causes less resistance between the primary and the core, which lessens the possibility of electrolytic action.

Concertone is an original straight line "curve" audio transformer. It amplifies evenly all frequencies from 30 to 10,000 cycles. Its design—exact balancing of core and windings—enables the amplification of overtones and harmonies, so necessary in producing true and natural reproduction of voice or instrument.

Tonatrol is Latest Electrad Product

The Phasatrol, the rugged balancing device used in radio frequency amplifying circuits, manufactured by Electrad,

THE Electrad Phasatrol

Inc., 173-175 Varick St., New York City, although on the market for a short while, has become a real standby with home constructors.

The Tonatrol, the new Electrad volume control, is another popular device. The non-inductive variable high resistances, mica by-pass and filter condensers, lead in connectors, lamp socket antenna, metallic grid leaks and resistances, lightning arresters, filament switches, jacks, rheostats, potentiometers, complete aerial outfits, grid leak mountings, Audiohm and Variohm show the extent and versatility of the Electrad line.

Craftsman Filters

A new speaker filter, which works with sets using under 250 volts, has been developed by the Craftsman Radio Products, 9 Orchard St., Newark, N. J. A speaker filter for use on sets where 180 to 500 volts are used is also manufactured by this concern. Both units are contained within a crystallized brown finished case, and furnished complete with tip jacks and leads. The units are very compact and rugged, standing up well, when used on voltages much higher than those stated.

Abox Is Producing An A Eliminator

The Abox A Battery Eliminator is a rectifier and an Abox Filter built into one compact unit. It operates direct from the light socket and contains no storage battery in paste form or otherwise.

It operates on 110-120 volt AC and delivers enough current at 6 volts to operate eight large tubes. No change in set wiring is necessary. The Abox A Eliminator replaces the storage battery and charger and operates only while the set is in use.

The Abox is manufactured by the Abox Company, Chicago, under license granted by the Andrews-Hammond Corporation who have spent several years in development work on the Abox Filter and the Abox A Battery Eliminator.

Amsco Has Couplers For High Mu Tubes

In response to the demand created by the new Cunningham and R. C. A. high mu tubes, Amsco Products, Inc., of New York has added a resistor coupler to their line up resistance coupled amplifying apparatus particularly adapted to the requirements of these new tubes. The tendency to motorboat can be satisfactory counteracted by the use of properly designed resistor couplers.

Amsco now makes two types of resistor couplers, the RC1 for the 201A type of tube, and the RC2 for the high mu tubes. While either type can be used successfully with all tubes in the average case, the manufacturer recommends the following combinations for different amplifiers.

With tubes having an amplification constant below 20, the RC1 should be used throughout in two, three and four stage amplifiers.

With high mu tubes (above 20) two RC2's should be employed in a two stage amplifier. For three stages, two RC2's and one RC1 are recommended, the RC1 being used in the middle stage. This arrangement effectively reduces the tendency to motorboat even when the amplifier is operated from a "B" battery eliminator, the staggering of the couplers resulting in different time constants for the various circuits. Stabilization is achieved by the principle of detuning.

Speaker in a Globe

The Symphonic Sales Corporation, of 370 Seventh Avenue, New York City, are introducing to the trade the Symphonic Globe Radio loud speaker.

This is a decidedly different speaker in both appearance and quality of tone. In the ball shaped interior there is no vibration elsewhere than in the diaphragm of the powerful unit itself.

Lambert Friedl, president of the Symphonic Sales Corporation, explained the action of the speaker: "Speech or music is driven into the dome of the globe, in which space it expands and develops itself as in a tone chamber or horn. The clarified speech or well-rounded musical tones are emitted with all original fidelity and without the presence of foreign noises."

The globe itself is an accurate full-sized library globe, a post-war map.

Solderable Tips On El Menco Leaks

By RALPH A. SAYRES

The conventional type of fixed resistor used for a grid leak has invariably been manufactured with metal terminal caps which were slipped into the clips of a mounting. Very often the electrical resistance of such mountings is lower than that of the resistor it was designed to support. This type of construction was, at best, but a poor substitute for a permanent, positive, soldered connection. But, due to the low melting-point metals used in the construction of the conventional type of grid leak, soldering was absolutely out of the question. Of course, any attempt to solder the ordinary carbon paper resistor is absolutely out of the question. Yet the conventional clip-mounted grid leak and resistors have brought many a receiver back to its maker—express collect—when the only trouble was the simple mechanical problem of insecurely fastened units.

The Electo-Motive Engineering Corporation, 127 West 17th St., New York

"HY-WATT" El Menco fixed resistor, conservatively rated at 12 watts.

City, has overcome this difficulty in their new "Hy-Watt" resistors, grid leaks and heavy duty resistors. And engineers, manufacturers and experimenters have quickly grasped the importance of these new "solderable" resistor units.

A conductive, metallized deposit is fused, at high temperature, into the outer surface of a vitreous tube. The ends of this tube are then silver-plated. Silver-plated because silver is recognized as the best electrical conductor and affords perfect contact. The "Hy-Watt" unit is then "spiralled" to the exact resistance desired. A method far more satisfactory than any in which an attempt is made to gauge the resistance accurately by mechanical means. Tinned terminal caps with lugs are then eyeletted onto the silver-plated ends of the unit and the finished product having positive, non-arcing contact from lug to lug give an absolutely noiseless, permanently accurate Grid Leak or Resistor.

"Hy-Watt" units are then treated with a special paint which "seals-in" their matchless accuracy and renders them absolutely moisture-proof.

The ordinary grid-leak type of "Hy-Watt" is conservatively rated at 6 Watts while the standard ranges of "Hy-Watt" Heavy Duty Resistors dissipate up to 12 watts.

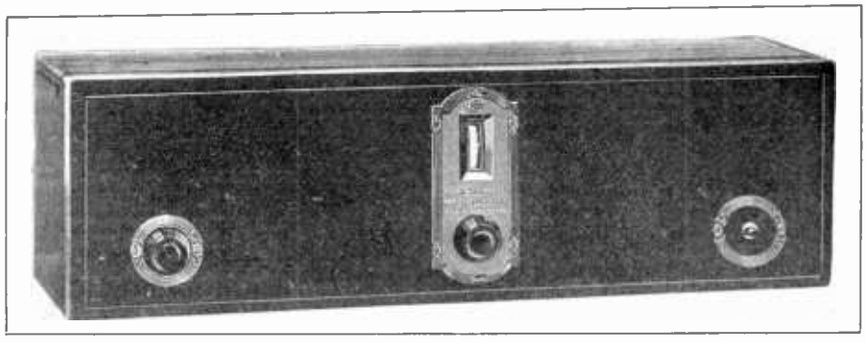
Freshman to Raise Price of Sets July 1

In a telegram sent out to all authorized Freshman dealers, the Chas. Freshman Co., Inc., of New York and Chicago, manufacturers of Freshman Masterpiece radios, states that list prices on all receivers will increase 10 per cent on July 1.

The telegram also notifies the trade that all orders received for immediate delivery prior to July 1 will be shipped at the present list prices.

This price increase applies only to the receiving sets and not to the Freshman line of power accessories.

R. C. A. Has an AC Set; Announces New Line



(Courtesy of R. C. A.)
RADIOLA 17, the first AC set to be marketed by the Radio Corporation of America. It uses the new tubes, UX226 and UY227.

An AC set, using the new tubes, UX226 and UY227, is among the new receivers of the Radio Corporation of America, which recently announced its line for 1927-1928.

This set is the culmination of years of research in set and tube design aimed to produce, for a moderate price, a receiver completely AC operated with a minimum of operation controls. It is called Radiola 17, and has three stages of tuned radio frequency amplification, tube detector and two stages of transformer coupled audio frequency amplification. The UX226 are used in the radio frequency stages and in the first audio frequency stage. The UY227 is used as a detector, and the last audio frequency stage employs a UX171 power tube.

The B and C voltages are obtained from a power supply unit built into the set, which employs the new high power UX280-full wave rectifier. Simplicity of operation and of maintenance are the main features of Radiola 17. There are only three controls on this set. Tuning is accomplished entirely with one knob. There is a volume control to regulate the output of the receiver. A power control switch is provided to turn the power on and off. Inside the receiver is located a switch whereby adjustment may be made for any variation in local line voltages from 105 to 125 volts.

Antenna and ground leads, as well as lighting socket cord and plug, are also provided. The entire set and power unit are entirely self-contained in a mahogany finished cabinet, 25 5/16 inches long, 7⅞ inches deep and 8⅛ inches high. The weight is 36½ pounds.

Another receiver, Radiola 16, employs six tubes, five of which are UX201-A. The UX-112 power tube is employed in the last audio amplifier stage. This set can be operated either by batteries or a battery eliminator. There is only one tuning control, of the drum type. A small volume control knob and on-and-off switch are the only other regulators.

A completely operated alternating-current receiver of the console type, Radiola 30-A, is scheduled to be placed on the market about July 1. It is a standard eight-tube superheterodyne circuit, equipped to operate with a specially designed rectifier-power-amplifier unit made possible by the new line of alternating-current tubes. This set may be operated from either direct or alternating current. It requires a short indoor antenna or outdoor wire.

In addition to the new sets, an improved clock-shaped loud-speaker was announced. It is the 100-A. Several new principles are said to be embodied in this reproducer, including a specially prepared corrugated paper designed to prevent rattling and improve acoustic properties. A newly designed driving mechanism, which is said to be more sensitive than formerly used, also is introduced in the new instrument.

The 25 and 28 super-heterodynes and the 104 power speaker are retained in the line.

A DC power speaker is another addition to the line of house current operated apparatus.

Polymet Exhibit Offered Big Variety

Much attention was given by the Polymet Manufacturing Co. to their booth and display at the Chicago trade show. They featured a full line of filter condensers and condenser blocks in various styles and designed for different working voltages, from 300 to 1000 DC. Of special interest was the new fixed mica condenser, moulded in attractive brown Bakelite with convenient soldering tabs. A complete line of wire-wound resistances, ranging in value from 750 to 100,000 ohms, was also displayed.

New metal base rheostats and potentiometers, together with Bakelite and composition types, were shown. These new rheostats and potentiometers were also made with an attractive filament switch arrangement. The very latest design in better grid leaks and resistors, a leak with a pure metal resistance element was given prominent display space. The standard line of Polymet phone plugs, extension connectors and claroplugs were also be found there.

LITERATURE WANTED

Donald Kelley, Route 7, Box 99, Leipsi, O.
John Neilson, 608 8th Ave., Seattle, Wash.
C. J. Terhune, 48 Central Ave., Asheville, N. C.
John L. Langer, 1214 Cottman St., Philadelphia, Pa.
A. J. Page, 317 Michigan Ave., Duluth, Minn.
George Criss, 1224 44th St., Brooklyn, N. Y.
Benjamin M. Huyeley, 1307 La Belle St., Wilkinsburg, Pa.
Lloyd Henderson, 514 Broad St., Grinnell, Ia. ffl
W. B. Lawson, 306 Cherry St., Waco, Tex.
Frank Leepart, Box 36, Glenwillow, O.
Theodore F. Haurik, 3341 North Syndenham St., Philadelphia, Pa.
Robert DeRose, 1567 Nostrand Ave., Brooklyn, N. Y.
J. Matthew Stevenson, 25 Clarendon St., Newtonville, Mass.
Ralph R. Kratz, 2306 North Ninth St., Pennsylvania, Pa.
John H. Sexton, Box 143, Sparrowbush, N. Y.
A. J. Lewis, 1449 7th St., Milwaukee, Wis.
W. M. Webster, 4848 Indiana Ave., Chicago, Ill.
Harry Weiss, 19 Morton St., Belmont, N. Y.
James C. Schusseler, 1903 East Pratt St., Baltimore, Md.
Thomas F. Creed, 111 East 130th St., New York City, N. Y.
E. C. Haslett, 624 Merton Ave., Akron, Ohio.
W. N. Wildon, Box 2, Aransas Pass, Tex.
Albert H. Jones, 14 Centre St., Roxbury, Mass.
Robert Goodwin, 401 Wisconsin Ave., Mobile, Ala.
Kenneth Runge, Box 242, Ableman, Wisc.

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in back issues of RADIO WORLD: 1926-1927:

Oct. 9—A Practical "A" Eliminator, by Arthur H. Lynch. Building the Equamatic, by Capt. P. V. O'Rourke.

Oct. 16—The Bernard, by Herman Bernard. How to Box an "A" Supply, by Herbert E. Hayden

Oct. 23—The 5-tube P. C Samson, by Capt. P. V. O'Rourke. Getting DX on the Bernard by Lewis Winner.

Oct. 30—The Singletrol Receiver, by Herbert E. Hayden. How to Get Rid of Squeals, by Herman Bernard.

Nov. 6—Reduction of Interference, by A. N. Goldsmith. Variations of Impedances, by J. E. Anderson

Nov. 13—The 4-tube Hi-Power Set, by Herbert E. Hayden. A Study of Eliminators, by Herman Bernard.

Nov. 20—Vital Pointers About Tubes, by Capt. P. V. O'Rourke. The 4-tube Diamond of the Air, by Herman Bernard.

Dec. 4—The regenerative 5-tube Set, by Cap. P. V. O'Rourke. The 8-tube Lincoln Super, by Sidney Stack.
Winner's DC Eliminator, by Lewis Winner.

Dec. 18—Selectivity on One Tube, by Edgar Speare. Eliminating Interference, by J. E. Anderson.

Dec. 25—A New Coupling Device, by J. E. Anderson. Function of Eliminators, by Herman Bernard.

Jan. 1, 1927—The 2 Tube DeLuxe Receiver, by Arthur H. Lynch. The Twin-Choke Amplifier, by Kenneth Harkness.

Jan. 8—Tuning Out Powerful Locals, by J. E Anderson. A Choice Superheterodyne, by Brunsten Brunn. The 2-Tube De Luxe Receiver, by Arthur H. Lynch (Part 2).

Jan. 15—The DeLuxe Receiver, by Arthur H. Lynch (Part 3) The Simple Meter Test Circuit by Herbert E. Hayden. The Superheterodyne Modulator Analyzed, by J. E. Anderson.

Jan. 22—The Atlantic Radiophone feat. by Lewis Rand. An Insight Into Resistors, by J. B. Anderson. A Circuit for Great Power, by Sidney Stack.

Jan. 29—The Harkness KH-27 Receiver (Part 1), by Kenneth Harkness. Use of Biasing Resistors, by J. E. Anderson.

Feb 5—5-Tube, 1 Dial Set, by Capt. P. V. O'Rourke. The Harkness KH-27 (Part 2), by Kenneth Harkness. What Produces Tone quality, by J. E. Anderson.

Feb. 12—Phone Talk Put On Speaker, by Herbert E. Hayden. All Batteries Eliminated, by Herman Bernard. The Harkness KH-27 Receiver, by Kenneth Harkness (Part 3). Conclusion.

Feb. 19—The 6-Tube Victoreen, by Herman Bernard (Part 1.) The Big Six Receiver, by Wentworth Wood. "B" Eliminator Problem, by Wm. P. Lear. The Phasatrol Circuit, by Capt P. V. O'Rourke. The 5-Tube Victoreen, by Herman Bernard (Part 2). Conclusion.

Feb. 26—The 5-tube Diamond in a Phonograph, by Hood Astrakan. How To Read Curves, by John F. Rider. Proper Tubes for 5-Valve Receiver, by J. E. Anderson.

Mar. 5—Introduction of 4-tube Universal, by Herman Bernard. Discussion on DX, by Capt. P. V. O'Rourke. Sensible Volume Control, by Chas. Gribben.

Mar. 12—Ten Tell-Tale Points, by J. E. Anderson. How To Figure Resistors, by Frank Logan. The 4-tube Universal, by Herman Bernard. (Part .)

Mar. 19—Psycho-Analyzing Circuits by Thomas L. McKay. The Universal, by Herman Bernard (Part 2). How To Use a Wave Trap, by James H. Carroll.

Mar. 26—The Universal, by Herman Bernard, (Part 3). Flow of Current in a Vacuum Tube, by Radcliffe Parker. Broadcasting Hypnotism.

April 2—Facts Every Experimenter Should Know, by J. E. Anderson. A Ship Model Speaker, by Herbert E. Hayden. The 3-tube Compact, by Jasper Henry. The Nine-in-Line Receiver, by Lewis Rand (Part 1.)

April 9—A 5-tube Sleided Set, by Herbert E. Hayden. The Power Compact, by Lewis Winner. The Nine-in-Line Receiver, by Lewis Rand, (Part 2.)

April 16—The Schoolboy's Set, by Wally Frost. The Melo-Heald 11-tube Set, by Herbert E. Hayden. The Nine-in-Line Circuit (Part 3), by Lewis Rand.

April 23—The Melo-Heald Set, by Herbert E Hayden (Part 2). The Nine-in-Line, by Lewis Rand. (Conclusion). How Frequencies Are Cut-off, by J. E. Anderson.

April 30—A 1-tube Portable, by Jasper Jellicoe. A Ship Model Receiver, by Smedley Farnsworth. A Double Three Foot Cone, by W. H. Sinclair.

May 7—The Adams-Griffin 6-tube Set, by Dana Adams-Griffin (Part 1). A 2-tube Portable, by Hood Astrakan. How to Improve Super-Heterodyne Sets, by John L. Barrett.

May 14—A 3-tube Portable, by Herbert E. Hayden. The Adams-Griffin Receiver, by Dana Adams Griffin. (Conclusion).

May 21—The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. A Low-Pass Filter, by J. E. Anderson.

May 28—The Console Cone, by Thorvald Larsen. The 3-tube Reflex by Edgar B. Francis. The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. (Part 2).

Any copy, 15c. Any 7 copies, $1.00. All these 32 copies for $4.00, or start subscription with any issue. Any 7 of these numbers sent as premium with NEW yearly subscription. No other premiums allowed. RADIO WORLD, 145 West 45th Street, New York City.

The Equamatic Six-Tube Receiver

(*Concluded from page 4*)

the secondary coils to which they are connected. Extremely short leads are possible with this placement of the coils. The .0001 mfd. by-pass condensers are placed similarly under the sub-panel.

The grid leak and condenser are placed next to the grid binding post of the detector socket and between that socket and the tuning condenser to which it is connected. The neat panel layout can be seen in Fig. 3.

LIST OF PARTS

Three Karas Equamatic coils.
Two Samson 85 millihenry choke coils.
Three Karas Orthometric straight line frequency condensers, .00037 mfd.
Two Electrad .0001 mfd. by-pass condensers.
Three Electrad .001 mfd. by-pass condensers.
Two Muter neutralizing condensers.
One Sangamo .00025 mfd. grid condenser with clips.
One Yaxley 15-ohm rheostat.
One Yaxley 25-ohm rheostat.
Two Lynch ½-ampere Equalizors.
Four .25 megohm Lynch metallized resistor.
One 2-megohm Amsco grid gate.
One 2-megohm Lynch metallized resistors.
One 1-megohm Lynch metallized resistor.
Three Lynch double mountings.
Three .006 mfd. Electrad stopping condensers.
One Yaxley filament switch.
Six Benjamin sockets.
One Yaxley gold single circuit jack.
One Jones multi-plug.
One Equamatic panel (7x28x3-16").
One subpanel and three Karas brackets.
Three Karas Micrometric dials.
One Yaxley pilot light.

WATCH EXPIRATION OF YOUR SUBSCRIPTION

Subscribers will note that the end of their subscriptions is indicated on the labels on wrappers. If your wrapper shows a date earlier than the current issue, please send payment for renewal. Changes in expiration dates on wrappers appear two weeks after receipt of renewal. PLEASE ALWAYS INDICATE WHEN SUBSCRIPTION IS A RENEWAL.

RADIO WORLD, 145 West 45th Street, New York City (Phones: Bryant 0558-0559)

FILL OUT AND MAIL NOW

SUBSCRIPTION BLANK

RADIO WORLD

RADIO WORLD *145 West 45th Street, New York City (Just East of Broadway)*

Please send me RADIO WORLD for.....months, for which please find enclosed.....

SUBSCRIPTION RATES:
Single Copy .....$ .15
Three Months 1.50
Six Months 3.00
One Year, 52 Issues 6.00
Add $1.00 a Year for Foreign Postage; 50c for Canadian Postage.

KFNF and KMA Waves Stir 8,000 to Protest

Washington.

As a result of a change in the wavelengths of stations KFNF and KMA, in Shenandoah, Ia., the Federal Radio Commission was swamped with mail from fans condemning the action. Approximately 8,000 letters were received.

Commissioner Bellows, who hails from Minnesota, was sharply criticized for allowing such action to take place. A few letters were received, however, commending the change. One stated that the locals had spoiled many good programs from WJZ in New York.

Spokane Show

Spokane, Wash.

Plans for a radio show to be held in Spokane September 28 to October 1 will be on a more extensive scale than last year, according to an announcement made at a recent meeting. The show will be educational in character and will provide a more convenient opportunity than ever before for the public to see and compare the newest in radio, according to C. W. Bell, president of the Spokane Radio Trades' Association.

THE EARTH DOES REVOLVE

Richmond, Calif.

E. .Granbacks, amateur operator of station 6CTX, got in touch with an amateur station in Belgium. The Belgian gave Granbacks a message to Hawaii, the time in Belgium being 4.45 a. m. Granbacks hooked up with the Hawaiian at 9:30 p. m., of the day before, in Hawaiian time. The distance was 7,500 miles.

GET RADIO WORLD ON YOUR VACATION

Be sure to take RADIO WORLD along with you on your vacation, or read it while you are at your summer home so that you will not miss a copy; send $1.50 for three months subscription and RADIO WORLD will be sent to you all summer. RADIO WORLD, 145 W. 45th St., N. Y. C.

4,000,000 Receivers Have Cone Speaker

Cone speakers are among the fastest selling accessories in the industry, according to D. F. Goldman, sales manager of the North American Radio Corporation, metropolitan distributors of products of the Farrand Manufacturing Company, manufacturers of radio cone speakers.

More than 4,000,000 radio sets in the United States are operated with cone speakers, according to figures recently made public by George H. Kiley, vice-president of the Farrand Company, which, with the total of 6,500,000 radio sets in use, is considerable proof of the growing favor the cone finds with the radio listener today.

Nearly 1,750,000 speakers were manufactured in 1926.

POLAND HONORS ENGINEERS

P. A. Baker and E. L. Mash, construction engineers of the General Electric Company, have each been awarded the Silver Cross of Merit by the President of Poland for "meritorious services rendered to my country." The work for which the awards were made was the installation of radio equipment in Warsaw.

COMPLETE LIST OF STATIONS

With the new wavelengths, frequencies and power. All the 694 stations in the United States given alphabetically by call letter with the location cited and also the identity of station or stations which share time on the air. Send 15c for the June 11 issue that contains this complete list. Radio World, 145 W. 45th St., New York City.

NOW!!

The Complete Listeners' Guide to Radio Programs

NEW YORK RADIO PROGRAM WEEKLY

For the first time

a really COMPLETE program will be printed for New York and its environs. Not only will all the features be listed, by their full name, but we aim to print the program in such a way that the title of *every* selection to be rendered, be it vocal or instrumental, will be printed, so that if you wish to listen-in to a certain station you will know in advance just what its program will be to a detail.

RADIO PROGRAM WEEKLY is also a weekly magazine in which you will find reflected everything that happens or will happen in broadcasting that is of interest to you. You who listen constantly to radio programs must often feel curious as to what goes on behind the scenes, and what the process of broadcasting entails. You can not help but be interested in the artists, the radio station directors, and the announcers. All of this and more will be represented each week in RADIO PROGRAM WEEKLY in a non-technical interesting manner. The magazine has been built in such a way that it will be of interest to every one of the family.

ALTOGETHER RADIO PROGRAM WEEKLY
Can be summed up as follows:

1st, A non-technical radio magazine, published and edited for the radio listener;

2nd, Brings to all radio listeners correct and exhaustive radio programs;

3rd, Keeps listener informed of each and every phase of radio broadcasting of interest to him;

4th, Serves as an effective link between the listener and the broadcaster;

5th, Helps uphold the listener's rights; and

6th, Is fair to broadcasters and artists.

10c. THE ISSUE

RADIO PROGRAM WEEKLY

ON ALL NEWSSTANDS

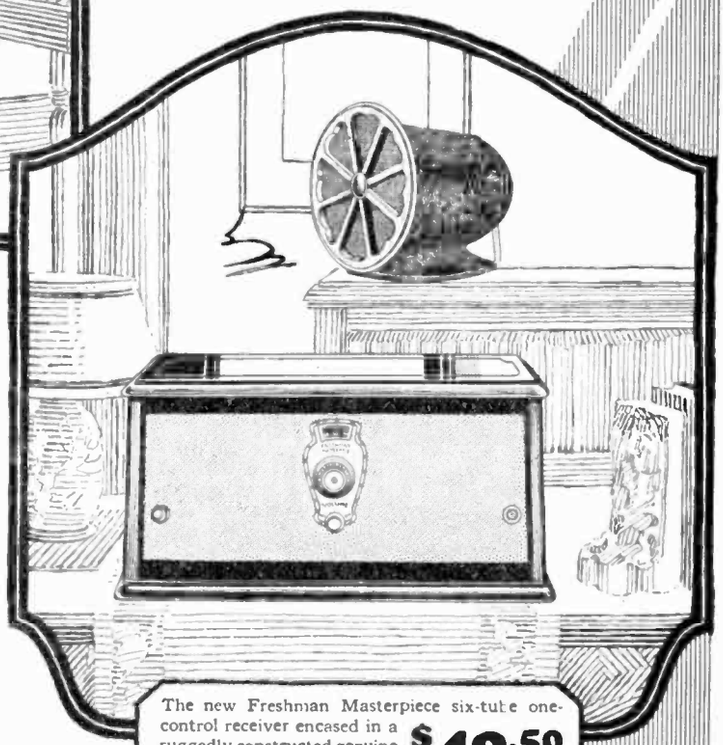
EXPERIMENTER PUBLISHING CO., INC.

230 Fifth Avenue **New York, N. Y.**

you can enjoy a fine radio at these *low* prices

Ever increasing manufacturing facilities, made possible by the great public demand for the Freshman Masterpiece, enables us to produce these Quality Radios at very moderate cost.

This sturdy console is panelled entirely of genuine mahogany. Contains built-in cone speaker and spacious compartments for all accessories. Model 7-F-3. **$79.50**



The new Freshman Masterpiece six-tube one-control receiver encased in a ruggedly constructed genuine mahogany cabinet. Model 7-F-2 **$49.50**

Freshman Master Speaker, as illustrated, ten dollars

A new radio that "gets" everything

SIX TUBES — ONE CONTROL

Merely turn the dial from point to point and station after station comes in separately, clearly and distinctly. The one dial is the only tuning device on this new Freshman radio. Its amazing power assures reception from great distances with "hair-line" selectivity and fine tone quality.

The powerful new line of

Six tubes ~ One Control

FRESHMAN MASTERPIECE

radio receivers now provides a model for every home — and for *every* pocketbook.

Sold on convenient terms

BY AUTHORIZED FRESHMAN DEALERS

CHAS. FRESHMAN CO., INC.

Freshman Building New York