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RADIO WORLD

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WORLD

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437th Consecutive Issue—NINTH YEAR

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NEW BATTERY TUBES IN SHORT-WAVE SET

A five-tube battery-operated short-wave set, using only one tuned circuit. Four 232s and one 231 are used. **See article on pages 6 and 7**

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Modern Radio Tubes

By J. E. Anderson

BATTERY-OPERATED TUBES

WD-11 AND WD-12

THESE tubes are identical in internal construction and have identical electrical characteristics. They differ only in their external mechanical features, particularly in the type of base. The WD-11 has a special base requiring a special socket, while the WD-12 has a standard UX base.

The normal filament terminal voltage of these tubes is 1.1 volts and the normal current is 0.25 ampere. Therefore the filament wattage is 0.275 watt. The filament used in these tubes, which is oxide coated, was designed to operate from a single No. 6 dry cell.

Since the WD-12 fits a standard socket and requires a filament voltage of only 1.1 volts, care must be exercised against putting one of these tubes into a socket across the filament terminals on which a higher voltage is impressed.

Uses of Tubes

The low voltage and current requirements of these tubes make them especially suitable for portable receivers and for other circuits in which filament economy is important.

These tubes are especially useful as detectors and audio frequency amplifiers, but may also be used in radio frequency amplifiers provided that plate-grid capacity has been neutralized. This capacity is moderately high for these tubes, being 5.5 mmfd., and therefore it is better to use another type of tube as radio frequency amplifier whenever operating conditions make this practical.

When one of these tubes is used as detector with grid leak and condenser, the grid leak resistance should be 2 megohms and the condenser should be of .00025 mfd. capacity. The normal plate voltage is 22.5 volts but this may be increased to 45 volts with some improvement in the signal strength.

The tubes may also be used as grid bias detectors. When so used the applied plate voltage may be either 45 or 90 volts. When the voltage on the plate is 45 volts the negative bias should be 7.5 volts and when the voltage on the plate is 90 volts, the grid bias should be 13.5 or 15 volts.

When either of these tubes is used as an audio frequency amplifier in transformer coupled circuits, voltages from 40 to 90 volts may be used on the plate. Suitable grid bias must be used for all plate voltages. For plate voltages between 40 and 45, the grid bias should be from 0.5 to 1.5 volts; for plate voltages between 60 and 70, the bias should be 3.0 volts, and for voltages on the plate between 80 and 90, the bias should be 4.5 volts. Exceeding a plate voltage of 90 volts should be guarded against, and no voltage higher than 67.5 volts should be used without the appropriate grid bias. If high plate voltages without the proper grid bias are used the filament emission will be high and the life of the tube will be short.

Ballast Requirements

When one of these tubes is used in the last stage with 90 volts on the plate and 4.5 volts on the grid, the maximum undistorted power output is 7 milliwatts. Clearly, the tube is not suitable for the operation of a loudspeaker.

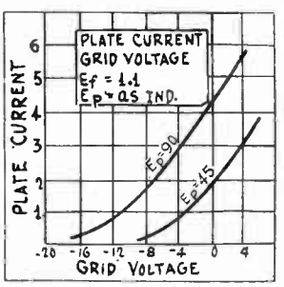


FIG. 1
GRID VOLTAGE, PLATE CURRENT CURVES FOR THE WD-11 AND WD-12 TUBES FOR RATED FILAMENT VOLTAGE AND TWO DIFFERENT PLATE VOLTAGES.

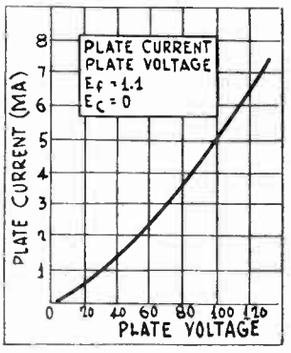


FIG. 2
PLATE VOLTAGE, PLATE CURRENT CURVE FOR THE WD-11 AND WD-12 TUBES AT RATED FILAMENT VOLTAGE AND ZERO GRID BIAS.

Since the filament voltage is 1.1 volts and the voltage of a new dry cell is about 1.5 volts, a drop of 0.4 volt must be introduced by means of a rheostat. The current for one tube is 0.25 ampere and therefore the resistance of the rheostat should be not less than 1.6 ohms. A two-ohm rheostat is recommended for each tube. If two or more tubes are put on the same rheostat, the total resistance required is obtained by dividing the resistance required by one tube by the number of tubes. Thus if there are two tubes on the rheostat the resistance need not be more than one ohm. This, however, does not mean that a two-ohm rheostat cannot be used for two tubes, or even for more.

When the source of the filament voltage is a 2 volt storage cell the excess voltage is 0.9 volt, and in such cases the rheostat used should be set to a resistance of 3.6 ohms. A six-ohm rheostat is therefore suitable.

If the voltage available for the filaments is higher than 2.2 volts it is usually better to connect filaments in series. For example, if the source is a 6 volt storage battery, as many as five of these filaments may be connected in series.

CHARACTERISTICS OF WD-11 AND WD-12

Filament voltage	1.1 volt
Filament current	.25 ampere
Filament supply voltage	1.5 to 2.0 volts
Amplification factor	6.5
Plate voltage, maximum	90
Grid bias at 90 volts on plate	4.5 volts
Grid-plate capacity	5.5 mmfd.
Grid-filament capacity	6.0 mmfd.
Plate-filament capacity	4.5 mmfd.

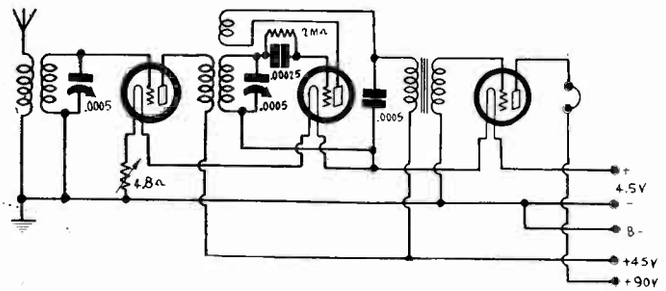


FIG. 3

THE CIRCUIT OF A SIMPLE THREE-TUBE REGENERATIVE RECEIVER INCORPORATING THESE THREE WD-11 OR WD-12 TUBES WITH THE FILAMENTS CONNECTED IN SERIES. THE FILAMENT VOLTAGE SUPPLY IS 4.5 VOLTS.

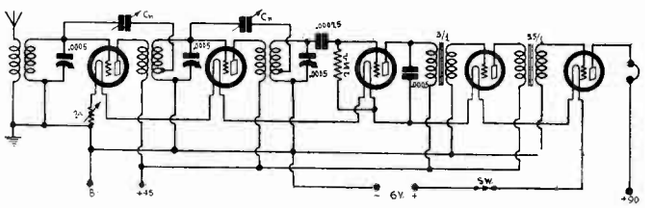


FIG. 4

THE CIRCUIT OF A FIVE-TUBE NEUTRODYNE RECEIVER INCORPORATING WD-11 OR WD-12 TUBES, WITH THE FILAMENTS CONNECTED IN SERIES. A SIX-VOLT FILAMENT SOURCE IS NEEDED, OR FOUR NO. 6 DRY CELLS IN SERIES.

In Fig. 1 are shown two curves giving the relationship between the grid voltage and the plate current at plate voltages of 45 and 90 volts for the WD-11 and WD-12. These curves are useful in determining the proper grid voltage for detection and for amplification as well as in determining the plate current that can be expected for different grid bias voltages.

In Fig. 2 is given the relationship between the plate current and the plate voltage when the grid bias is zero. One application of this curve is in determining the effective plate voltage applied to the tube when the plate current is known. The current is measured with a milliammeter in the plate circuit when the bias on the tube is zero, that is, when the grid return is made to the negative end of the filament. From the value of the plate current obtained we can read on the curve what the effective plate voltage is. Suppose, for example, that the current reading is 4.1 milliamperes. Referring to the curve in Fig. 2 we find the voltage opposite 4.1 to be 90 volts, which is the effective voltage on the plate. The accuracy of this determination depends on how close the tube in question is to the average tube of the type, since the curve in Fig. 2 is for an average tube. The reading will mean nothing unless the filament terminal voltage is 1.1 volt when the observation is made.

The filament of these tubes is of the oxide coated type and is rugged so that the tube is not microphonic. A minimum of cushioning is therefore needed to prevent mechanical vibrations from being communicated to the elements of the tube.

UV-199 AND UX-199

THESE tubes have the same electrical characteristics and differ only in the kind of base used. The UV-199 has a small base with short prongs while the UX-199 has a small standard UX base and prongs that fit into standard UX sockets. When we speak of the UX-199 we shall also mean the UV-199 except where otherwise stated.

The filament of this tube is of the thoriated type and is designed for a terminal voltage of 3.3 volts, with a current of from 60 to 66 milliamperes. The low current required by this tube makes it suitable for portable receivers, as well as for other receivers where economy of filament power is important. The maximum power consumption is 0.2178 watt, which is less than that of the WD-12.

Since the filament terminal voltage should be 3.3 volts, it is common to use either a 4-volt storage battery or a 4.5-volt dry cell battery to supply the current. A 6-volt source, such as a storage-A battery, may be used by increasing the resistance of the filament resistor.

The filament of this tube should be operated at the rated voltage of 3.3 volts, or at such a lower voltage as will give satisfactory results. While fixed filament ballast resistors may be used, it is preferable to use a rheostat, or a rheostat in addition to the fixed ballast resistors. It is particularly important to use a rheostat when the filament voltage source is a 4.5-volt dry cell battery or a 6-volt storage battery.

Ballast Adjustments

If the voltage is supplied by a 4-volt storage battery, the ballast resistor or rheostat resistance should have a value of not less than 11 ohms and not more than about 12 ohms. That is for each tube. If two or more tubes are put on the same ballast or rheostat, the resistance should be divided by the number of equal tubes on it. For example, if two tubes are put on it, the resistance should be not less than 5.5 ohms and not more than 6.0 ohms.

If the filament voltage source is a 4.5-volt dry cell battery, the maximum voltage that must be dropped in the resistance is 1.2 volts, and this requires a resistance of not less than 18 ohms and not more than 20 ohms, for each tube.

It is also possible to use a 6-volt battery for these tubes, and this is often done when the UX-199 is used in receivers also incorporating the larger, 5-volt tubes. In this case the voltage that must be dropped is 2.7 volts. This will require a resistance for each tube of not less than 45 ohms and not more than 50 ohms. A rheostat of 60 or 75 ohms is suitable, since it may be set so that the filament current is normal and also so that it is considerably sub-normal in case it is desired to use the rheostat as a volume control.

It is advisable to have a voltmeter in the circuit so that the filament voltage can be adjusted to the proper value regardless of the value of the supply voltage.

Uses of Tube

The tube is useful as a radio frequency amplifier, detector, and audio frequency amplifier.

When the tube is used as detector with grid leak and condenser, the grid condenser should have a capacity of .00025 mfd. and the grid leak should have a resistance of 3 megohms. When the signals are weak a somewhat greater detecting efficiency can be obtained by using a higher value of grid leak resistance, but if a higher value of resistance is used a lower value should be kept handy, for it may be needed on stronger signals to prevent blocking of the grid. The plate voltage should be 45 volts.

This tube also may be used as a grid bias detector, and when it is so used plate voltages of 45, 67.5, or 90 volts may be used. The grid bias values should be approximately 4.5, 7.5, and 12 volts, respectively, for these plate voltages. In any case the bias that gives greatest detecting efficiency can be found experimentally by varying the applied bias either side of those suggested above.

As an audio frequency amplifier it can be used both in transformer and direct coupled circuits. In resistance coupled circuits a voltage amplification of 5 per stage can be obtained, and in impedance coupled a gain of 6.2, provided that suitable coupling constants are chosen. In a transformer coupled circuit the voltage gain is considerably higher, the exact value depending on the ratio of turns of the transformer.

The plate voltage for amplification may be 45, 67.5 or 90 volts, depending on the signal level in any particular stage and on the purpose for which the amplifier is used. For portable sets the voltage may be as low as 45 volts and for home sets as high as 90 volts, the higher voltage being necessary only when the signal voltage is high as in the amplifier preceding the output tube.

The grid bias for amplification should be from 0.5 to 1.5 volts when the plate voltage is 45 volts, 3 volts when the plate voltage is 67.5 volts, and 4.5 volts when the plate voltage is 90 volts. The bias voltages are approximate only. A voltage higher than 90 volts should not be applied, and even this voltage should never be used unless the appropriate grid bias is used.

Use as Radio Frequency Amplifier

This tube has a relatively low capacity between the plate and the grid, and for that reason it is suitable for use in radio frequency amplifiers. While it is possible to use several stages of tuned radio frequency amplification without balancing out the plate-grid capacity, it is best to employ some system of neutralization to prevent feedback. Since the tube is suitable for both audio and radio frequency amplifiers, it is clear that it is also suitable for use in intermediate frequency amplifiers of Superheterodynes. A relatively high voltage amplification can be obtained before instability sets in due to regeneration through the tubes and through external stray coupling.

When the tube is used in multi-stage tuned amplifiers the voltage on the plates of the tubes should be increased progressively. That is, the voltage on the first tube may be 45, that on the second 67.5, and that on the third 90 volts. Indeed, it may not be necessary to use a higher voltage on any tube than 67.5 volts unless the detector operates on the high negative bias principle.

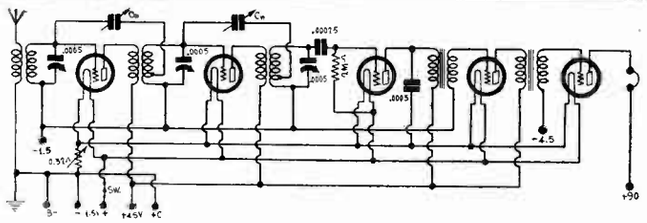


FIG. 5
THE SAME CIRCUIT AS IN FIG. 4. BUT WITH THE FILAMENT CONNECTED IN PARALLEL. FIVE NO. 6 DRY CELLS CONNECTED IN PARALLEL WILL SUFFICE TO OPERATE THE FILAMENTS OF THIS CIRCUIT.

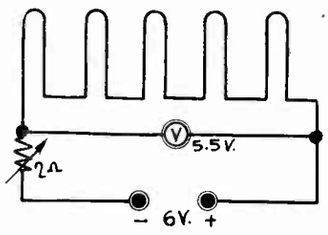


FIG. 6
THE FILAMENT CIRCUIT OF FIG. 4 SHOWING THE POSITION OF THE FILAMENT VOLTMETER AND WHAT THIS METER SHOULD READ WHEN EACH TUBE GETS ITS RATED VOLTAGE.

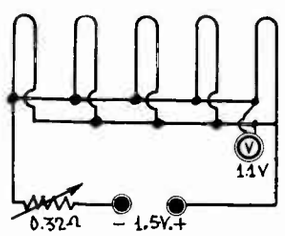


FIG. 7
THE FILAMENT CIRCUIT OF FIG. 5, SHOWING THE POSITION OF THE FILAMENT VOLTMETER AND WHAT THIS SHOULD READ WHEN EACH TUBE GETS ITS RATED VOLTAGE.

Since this tube is suitable for radio frequency amplification, it is also suitable for use as an oscillator in Superheterodyne circuits, and it has been used for this purpose in many well-known Superheterodynes.

In view of the fact that the filament of this tube is light, the tube is somewhat microphonic, and for that reason it should be mounted in an upright position on cushioned sockets. This precaution is particularly necessary when the tube is used as detector or as a first-stage audio frequency amplifier. In some instances it is also necessary to protect the tube from the sound from the loudspeaker, which may be done by loading the tube with a lead cap, or with any other acoustically dead material. When this is done care should be taken that ventilation of the tube is not impaired.

CHARACTERISTICS OF UX-199

Filament voltage	3.3 volts
Filament current	.066 ampere
Filament voltage supply	4.0, 4.5, or 6 volts
Amplification factor	6.25
Plate voltage, maximum	90 volts
Grid bias for 90 on plate	4.5 volts
Plate-grid capacity	4.2 mmfd.
Grid-filament capacity	3.8 mmfd.
Plate-filament capacity	3.8 mmfd.

Fig. 8 contains grid voltage, plate current curves for three different plate voltages as indicated, which are the most commonly used for this tube. These curves can be used to estimate the proper grid bias for amplification or for detection, and they can also be used to estimate an effective unknown grid bias by measuring the plate current.

For example, suppose that we know that the plate voltage is 90 volts and that the current in the plate circuit, as measured with a milliammeter, is 2.2 milliamperes. The curve then tells us that the grid bias is 5 volts. Again, if we find the current is 2.3 milliamperes we find from the curve that the effective bias is 4.5 volts. It is to be noted that the effective bias is not necessarily equal to the applied bias and that it is the effective bias that is of importance.

Coupling for UX-199

The curve in Fig. 9 gives the relation between the plate voltages and the plate current for an average tube of this type, or for what should be called a normal tube. The curve is given for zero grid bias and normal filament voltage of 3.3 volts. To get zero bias the grid may be connected directly to the negative end of the filament with a good conductor. The normal filament voltage can be obtained only by connecting a voltmeter across the filament and by means of a rheostat adjust the current until the meter reads 3.3 volts.

This curve is useful sometimes when it is desired to determine

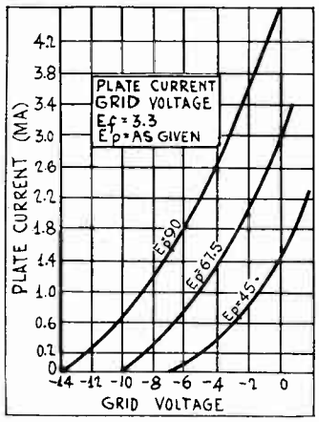


FIG. 8
GRID VOLTAGE, PLATE CURRENT CURVES FOR THREE DIFFERENT PLATE VOLTAGES FOR THE UX-199 TUBE.

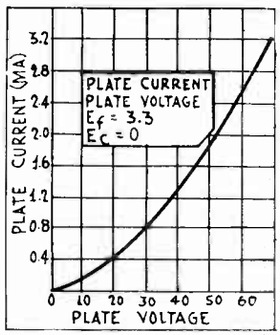


FIG. 9
THE PLATE VOLTAGE, PLATE CURRENT CURVE FOR ZERO GRID VOLTAGE AND NORMAL FILAMENT VOLTAGE FOR THE UX-199 TUBE.

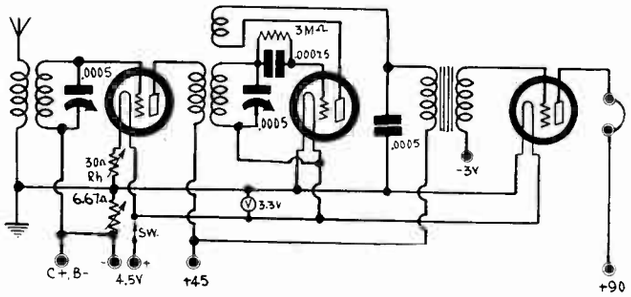


FIG. 10
A SIMPLE REGENERATIVE THREE-TUBE RECEIVER INCORPORATING THREE UX-199 TUBES. THIS CIRCUIT IS SUITABLE FOR HEADPHONE RECEPTION ONLY BECAUSE THE TUBE CANNOT DELIVER LOUDSPEAKER VOLUME.

the effective voltage on the plate of a tube. A milliammeter is put in the plate circuit of the tube, the grid is shorted as suggested, the filament voltage is adjusted to 3.3 volts, and then the current is read on the milliammeter. Suppose we find this current to be 1.8 milliamperes. Then we know from the curve that the effective voltage on the plate is 50 volts. This assumes that the tube used is normal. Such measurements are often convenient when the source of plate voltage is a B battery eliminator or a partly exhausted dry cell battery, or when there is a high resistance load in the plate circuit of the tube.

For radio frequency amplification the best coupler to follow the UX-199 is a transformer with tuned secondary and a moderate number of turns on the primary. Transformers designed to operate with any tube having a medium amplification factor are satisfactory. For audio frequency amplification any standard radio frequency transformer may be used successfully because the plate impedance of the tube is not much higher than that for tubes for which transformers have been designed.

For impedance coupled audio the choke coil used should have as high inductance as practical, say 200 henries or more, and the secondary of most audio frequency transformers is all right for substitute use as a choke.

When the tube is used in a resistance coupled amplifier, the plate resistance should not be greater than about 100,000 ohms, nor should it be smaller than 50,000 ohms. It is better to make the resistance too large than too small. In the case of resistance coupling the plate voltage may be increased considerably, but it is doubtful that a higher voltage than 90 volts is needed if the output tube is a 120 type. The grid bias to be used in resistance coupled circuits is governed by the voltage applied in the plate circuit and not by the net voltage across the plate and filament of the tube. Thus the bias voltages specified for transformer coupling apply also to resistance coupling.

[The series of articles begun with the foregoing will be published weekly until the full list of modern radio tubes is covered. Next week, in the August 16th issue, the 230, 201A and 240 will be discussed. Subsequently a consolidated table of tube characteristics will be published.—Editor.]

Single Tuned Circu

By Herbert

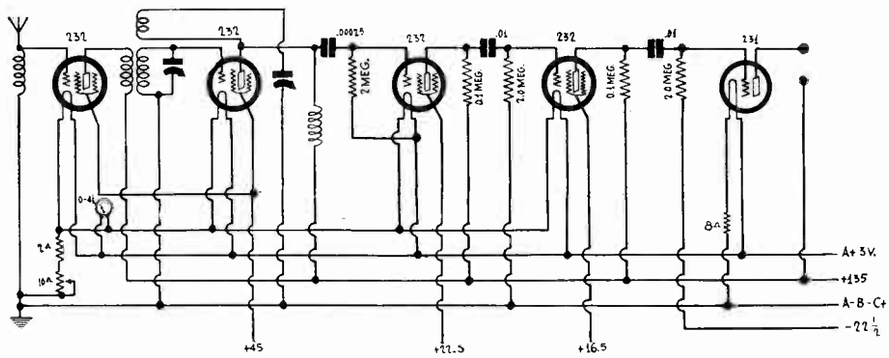


FIG. 1
THE CIRCUIT DIAGRAM OF A FIVE-TUBE SHORT-WAVE SCREEN GRID TUBE RECEIVER UTILIZING THE NEW 2 VOLT TUBES THROUGHOUT.

HERE is a five-tube short-wave receiver incorporating the new low voltage tubes. Two of the new screen grid tubes are used as radio frequency amplifiers, one of which is in a regenerative circuit, one of the same kind of tube as detector, one as audio frequency amplifier in a resistance coupled stage, and one of the new power tubes as audio output tube.

The first radio frequency stage is untuned, which is practically necessary because of the difficulty of tuning a short-wave receiver having more than one tuner. The second is tuned and regenerative. Plug-in coils are used to cover the short-wave band as well as the broadcast band. These plug-in coils are so constructed that the primary and secondary on each coil are wound on the plug-in form, which is of the four-prong type. The tickler is common to all the coils in the set and is mounted permanently so that when a coil is plugged in the proper coupling is secured between the tickler and the tuned winding.

The circuit is tuned with a .0005 mfd. straight frequency line condenser the rotor of which is turned with a slow-motion dial.

Coupling Before Detector

The coupling between the tuned stage and the detector is by means of a radio frequency choke coil which has been wound so that it remains an effective choke from the highest to the lowest radio frequencies that can be covered with the tuner.

The regeneration is controlled by means of a midget condenser connected in series with the tickler, both of which are in shunt with the coupling choke. The rotor of this midget is connected to ground, so that all hand capacity is eliminated, thus making the regeneration smooth and positive.

The detector, which is also a screen grid tube as has been stated, operates on the principle of grid leak and stopping condenser. The value of the leak is 2 megohms and the value of the stopping condenser capacity is .00025 mfd. The leak resistance is returned to the positive of the detector tube filament. This return should be moved to the negative end of the filament as an experiment, for sometimes better detecting efficiency is obtained with the negative return.

Whenever a screen grid tube is used as detector it is advisable that the load impedance on the tube be made a high resistance. In this circuit a plate load resistance of 0.1 megohm is used, but this value might be increased to advantage in some instances to a value as high as half a megohm. But the best value in any case depends on the effective screen, control grid voltages, and the plate voltages.

Screen Grid Audio Amplifier

A screen grid tube can be used to good advantage as an audio frequency amplifier in a resistance coupled circuit, provided that the load resistance and the voltages on the elements are properly adjusted. Since a rather high voltage gain is needed in this circuit the first audio amplifier is of this type. The output of this tube with suitable voltages on the elements is sufficiently high to load up the 231 power tube in the last stage of the circuit.

Since the new screen grid tube is used for three different purposes in this receiver, three different adjustments of the voltages must be provided for. The rated plate and screen voltages are 135 and 45, respectively, but these apply to circuits in which the load impedance is inductive. That is, it applies to the first two tubes in the circuit. Therefore the plate returns of these tubes go to the 135 volt line and the screen returns to a 45 volt tap on the plate battery.

It is not to be supposed that this combination of voltages works best in all instances, because in some cases either a higher or lower voltage on the screens will give better results. The screen returns of these two tubes are brought to a common binding post or flexible lead so that the screen voltage may be adjusted experimentally to that value which gives best performance. There is no necessity for changing the applied plate voltage.

Voltage on Detector Elements

The detector tube requires a different adjustment of voltages, first, because its function is different; second, because the load impedance is high, and third, because the grid bias is different. Hence it is necessary to bring the screen grid lead for this tube out separate so that it may be connected to that point on the B supply which gives best detecting efficiency. The suggested voltage of 22.5 volts has worked satisfactorily in many cases with the other adjustments of the circuit shown in the diagram. But both higher and lower voltages should be tried. As a rule, when the plate load resistance is increased, the screen voltage should be decreased, if the other voltages on the tube remain constant.

There is no by-pass condenser in the plate circuit of the detector tube, whereas it is customary to use a condenser of about .0005 mfd. from the plate to ground. In a screen grid tube there is relatively high capacity between the plate and the screen, and hence to ground, and for this reason no condenser is used. Another reason for omitting it is that this plate to screen capacity, though not large in absolute value, has a great effect when it is connected across a high resistance like the plate coupling resistor. The higher this coupling resistor is the more effective is the tube capacity. If a condenser is connected across the load resistance the high notes in the signal will be suppressed considerably. Of course, if the high notes are not regarded as essential, a condenser of about .00025 mfd. capacity could be connected across the resistance, thereby gaining a slight increase in the detecting efficiency on the low and medium audio notes.

Voltage on Audio Amplifier

In the screen grid resistance coupled stage we need still another combination of voltages. Again, this voltage depends on the plate and grid voltages applied and on the value of the plate

LIST OF PARTS

One set of three small plug-in short-wave coils.
Two radio frequency choke coils.
One .0005 mfd. straight frequency line condenser.
Two .1 megohm plate coupling resistors with mountings.
Three 2 megohm grid leaks with mountings.
One .00025 mfd. grid condenser.
Two .0 1 mfd. grid stopping condensers.
One midget condenser.
One 8 ohm filament ballast resistor.
One 2 ohm filament ballast resistor.
One 10 ohm rheostat with filament switch built in.
Six UX sockets.
One vernier dial.
Two tip jacks for output.
Two binding posts for antenna and ground.
One cable for battery leads.
One special metal cabinet.
One aluminum sub-panel.

it in 5-Tube SW Set

E. Hayden

coupling resistor. The suggested voltage of 16.5 volts should work well with the circuit adjustments shown. But it is not necessarily the best voltage, for differences will occur in the characteristics of the tubes, the grid voltages, and the plate coupling resistance. Since a separate adjustment of the screen voltage for this tube, a special lead is brought out. As in the case of the detector, the screen voltage on the audio amplifier should be reduced when the plate coupling resistor is increased. For an applied voltage on the plate of 135 volts, as in the illustration, the screen voltage should be reduced until the amplification is satisfactory, and the proper screen voltage is always considerably less than 45 volts, regardless of the value of the plate coupling resistor. And as was stated, the higher the resistance the lower the screen voltage must be.

Voltages on the Power Tube

The power tube is operated under standard and recommended conditions and therefore the voltage applied in the plate circuit is 135 volts and the negative bias is 22.5 volts. With these voltages on the elements the maximum undisturbed ouput of the receiver is 170 milliwatts, provided, of course, that the signal voltage impressed on the grid has an amplitude of 22.5 volts. This signal voltage can easily be extracted from the screen grid tube ahead of the power stage with the voltage adjustments suggested.

The only bias provided for the screen grid amplifier tubes is the voltage drop in the 2-ohm ballast resistor and the rheostat controlling the filament current in the four screen grid tubes. Since the applied filament voltages is 3 volts and since the normal filament voltage is 2 volts, there remains a voltage of one volt for the grids when the tubes are operated at normal filament current.

The filament current in each of the screen grid tubes is .06 ampere so the total current through the fixed resistance and the rheostat is .24 ampere. The 2-ohm resistor will drop .48 volt. Hence some of the resistance in the rheostat should always be used. For normal current 2.16 ohms should be cut in. The remaining resistance in the 10-ohm rheostat should be employed as a volume control.

As more than 2.16 ohms is cut in, the filament current is reduced below the normal, and grid bias is increased above one volt. Optimum results may not necessarily be obtained when the rheostat is set so that just normal current flows, but if it improves as the resistance is reduced below 2.16 ohms it is not advisable to increase the current for the tubes are endangered.

Mounting of Coil

As was previously stated, the tuning coil is of the plug-in type and fits into a UX socket. If the sub-panel is of metal, it is advisable to raise the coil socket above the panel so that losses due to induced currents in the panel will not reduce the sensitivity appreciably. The coils should not be closer than one inch from the metal. This applies not only to the tuned winding but also to the primary and the tickler windings. It is no less important to keep the coil away from other metal bodies, such as the sides and back of a metal cabinet.

The filament supply should have a voltage of 3 volts, which is given by two dry cells connected in series. Since the total current required by the five tubes is .37 ampere, two No. 6 cells will not operate the circuit economically, for the highest current that should be taken from a cell of this size is .25 ampere. However, four cells of this size, connected in series parallel, will handle the circuit, for then each cell will deliver only .185 ampere, which is well within the limitations of economical operation.

The B supply may be either a B battery eliminator or three medium size dry cell blocks of 45 volts each. Best results will undoubtedly be obtained with dry cell batteries unless the voltage control of the B battery eliminator is good and unless the various resistor taps are well by-passed.

No by-pass condensers are shown in the circuit diagram, but it is always well to use a condenser for each voltage tap even when dry cell batteries are used, because if they are not used results will not be good as soon as the internal resistance of the battery becomes appreciable. For radio frequency stages a condenser of .01 mfd. or larger will do, but for the audio stages and the detector a condenser of 2 or more should be used.

Housing of Circuit

This five-tube short-wave receiver is contained in a metal cabinet illustrated in Fig. 2. The lid of this cabinet swings open

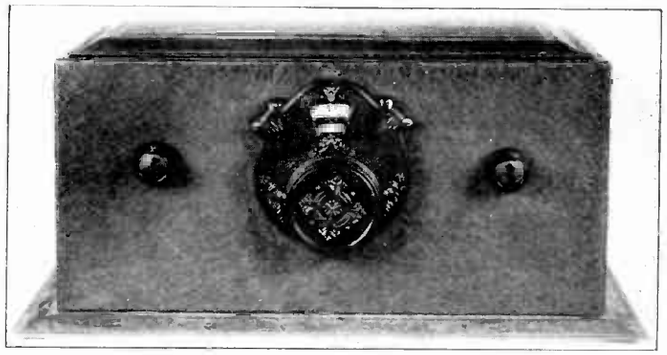


FIG. 2
FRONT VIEW OF THE FIVE-TUBE SHORT-WAVE RECEIVER.

on piano hinges giving access to the tubes and the coil. The back, together with the lid, is also removable in case it should become necessary to gain better access.

The regeneration condenser, the tuning condenser, and the filament rheostat are mounted on the front of the metal box. The regeneration condenser is at the left, the tuning condenser in the center, and the rheostat at the right. The filament switch is built into the rheostat. Thus there are only three controls on the set.

The bottom of the box is open so that the sub-panel wiring may be done after the parts have been assembled in the cabinet. There are only a few connections to be made in the cabinet from the top and these are easily accessible even without removing the back, although they are more easily reached if the back is removed.

Avoid Crowding Coil

In order to provide room under the sub-panel for coupling resistors and condensers the sub-panel is raised above the normal position of the sub-panel. This is done by means of four long brass screws, one in each corner. If the sub-panel is raised too high in this manner the tops of the screen grid tubes will come too close to the lid of the box. If it is not raised enough the parts underneath the sub-panel will not clear the table top. The proper position is that which safely clears the parts under the sub-panel so that nothing would be short-circuited if the cabinet were placed on a flat sheet of metal.

The tuning condenser is placed on the front panel so that when the sub-panel is at the proper height it practically touches the bottom of the condenser.

The tuning condenser should be so mounted that in case you wish to mount a dial illuminator the movable condenser plates will not hit the dial lamp socket assembly.

Also it is suggested that care in spotting holes for the dial mounting be observed in order that the condenser shaft will fit into the ¼ inch dial hole without any side strain on the condenser or dial assembly.

Overcrowding Called Set-Builder Complex

The idea that a radio receiving circuit should be engineered or even assembled so as to fit a certain style and size of cabinet is an antiquated one, and not worthy of serious consideration.

If you are going to make your six circuit tuner a power operated unit, then you must provide the necessary additional cabinet space, or sell the present cabinet and buy a bigger one. There is no compromise.

Most constructional fans suffer from an overcrowding complex. They need not have frequented congested metropolitan centers to acquire it, either. What they need to learn is that greater respect must be paid to the invisible ruler of radio circuit stability, namely, stray magnetic field.

A good many pages on this subject have been written but when a circuit is newly published, and constructional inquiries come in they are nearly always concerned with questions on circuit parts grouping, or associated mechanical details, and the really important feature, the attributes of the circuit involved, or shall I say its properties, are apparently overlooked.

Circuit diagrams all look very much alike. Also a hasty glance at a green-colored dollar bill and a $100 bill might convince an uninitiated person that they were alike.—M. L. J.

Converter with B Supply

By Herman Bernard

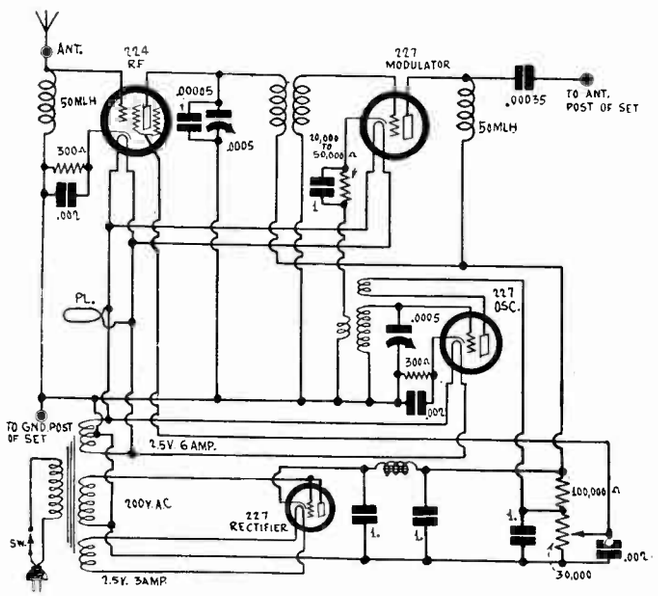


FIG. 1.
A SHORT-WAVE CONVERTER WITH B SUPPLY AS WELL AS HEATER SUPPLY.

NEARLY all short-wave converters require that a B voltage be obtained from the receivers in conjunction with which they are to be used. Persons familiar with radio technique find it easy enough to obtain this B voltage. Once in a while, however, if one has a closely-made commercial set, and not much technical radio knowledge, he will be at a loss for a convenient means of getting at a B voltage. For such a situation a short-wave converter with B supply built in is advisable.

Fig. 1 shows the diagram of such a converter. The conversion principle is the same as that which has been featured in these columns recently. The first tuning condenser tunes in the short-wave signal, the lower tuning condenser establishes a frequency of oscillation not far removed from that of the other, and the difference between the two is fed into the broadcast receiver. This difference frequency is the intermediate frequency. The operation is such that the short-wave converter is the mixer of a Super-heterodyne, while the broadcast receiver is the intermediate channel, second detector and audio amplifier. The entire broadcast receiver is used by this method, and the sensitivity, hence result, depends on the receiver almost exclusively.

Low Current Drain on B Supply

The added feature is the B supply, in which a 227 tube is used as a single-wave rectifier. Of course, the current drain will be extremely low; in fact, less than 10 milliamperes total. The voltage after the rectifier will be about 185 volts, and after the choke about 180 volts, assuming 400 ohms DC resistance in the choke. The voltage divider consists simply of the 30,000 ohm potentiometer volume control and a 100,000 ohm plate type resistor, the familiar 0.1 meg. The only current flowing through the 0.1 meg. is the bleeder current, and that is less than 1.4 milliamperes.

The same consideration of low current permits you to use even the secondary of an old audio transformer as the filter choke coil. If the primary is good or even if it is burnt out, disregard it and use only the secondary. Should the secondary be defective, and the primary good, use the primary as the choke coil and disregard the secondary. The inductance of the choke need not be any larger than what you will obtain by use of either primary or secondary. And the filter condensers are simply 1.0 mfd. condensers of paper dielectric that are commonly called bypass condensers. Their rating may be as low as 200 volts DC continuous working voltage. This is about the lowest voltage rating at which commercial 1.0 mfd. condensers are made.

From all of the foregoing it is obvious that the B supply will not entail any large extra cost.

227 as a Rectifier Tube

The method of using the 227 tube as a rectifier for the B supply is standard, in that the grid and plate are joined for the negative, while the cathode is positive. Perhaps this is the first time you have ever seen a 227 tube used that way, although the use of other "small" tubes as rectifiers at small current drain is familiar. The only difference, therefore, is that since the grid-plate is negative, the electron emitter, called the filament in other type tubes, is positive. But in the 227 tube the emitter is the cathode, and that is used as positive.

Single-wave rectification is ample for the circuit shown.

By having the B supply built in we can easily use a screen grid tube as the detector in the radio frequency amplifying stage. Under these circumstances, it is advisable to tune the primary in the plate circuit, but the winding is that commonly used in grid circuits. The coil is turned about for this purpose, the smaller winding being in the grid circuit of the modulator tube.

The modulator is used in a negative bias hookup. The bias is obtained from the drop in a 50,000 ohm resistor, which should be bypassed by a 1.0 mfd. condenser of the same type used as filter condensers in the B supply. The return to ground is completed through the pickup coil, which is the second largest winding on the three-winding or oscillator coil. Putting the pickup coil in that position enables the use of a three-winding coil that has only five outlets for six terminals, since two of the terminals go to the same outlet, ground. Hence, coils wound on UY tube bases may be used, although somewhat better results may be expected when coils of larger diameter are used.

While the converter is AC operated, it can be used with any kind of broadcast receiver, including battery-operated sets and all sorts of tuned radio frequency, Neutrodyne, screen grid or Super-heterodyne receivers. The measure of performance is the sensitivity of the receiver used. The converter is little more than a mixer, and of itself should contribute only a relatively small amount of the amplification.

Coils may be wound on 3-inch diameter bakelite tubing as follows:

RF Transformer

Primary, 3 turns; secondary, 3 turns; tickler, 2 turns.
Primary, 17 turns; secondary, 8 turns.

Oscillator

Primary, 3 turns; secondary, 3 turns.
Primary, 8 turns; secondary, 17 turns; tickler, 10 turns.

If the coils are to be wound on tube bases, the number of turns should be three times as great as that specified above. The directions apply to .0005 mfd. tuning condensers. If the oscillator doesn't oscillate, reverse the wiring connections to the plane winding of the oscillator.

The use of a .0005 mfd. straight frequency line condenser is recommended, as the usual band, from about 15 meters to 150 meters, then can be covered with two coils for each tuned circuit. If smaller tuning capacity is used, say .00014 mfd., then the number of turns may be the same as prescribed, but a third coil must be used to fill in the frequency gap, and this would have a ten-turn tuned winding, with the other windings proportionate to those of the largest coil.

Frequency to Choose

With this converter, using either tuning capacity, the intermediate frequency may be any frequency to which the receiver may be tuned, but choose a channel free of broadcast reception, and preferably one near the high frequency end of the dial. The higher the frequency, usually, the higher the amplification.

LIST OF PARTS

Two .0005 mfd. straight frequency line tuning condensers, used tandem.
One coupler to unite condensers.
Two modulator (RFT) plug-in coils, precision type.
Two oscillator (three-winding) plug-in coils, precision type.
Two plug-in receptacles.
Two 50 millihenry RF choke coils.
Two 300 ohm flexible biasing resistors.
Three .002 mfd. or larger fixed condensers.
One 50 mfd. (.00005 mfd.) midget condenser.
One 50,000 ohm biasing resistor.
Four 1.0 mfd. 200-volt by-pass condensers.
One .00035 mfd. fixed condenser.
One power transformer; primary, 110 v. 50-60 cycles; secondaries, 2.5 volt 3 amperes, 2.5 volt 6 amperes, 200 volt AC at 10 ma.
One 30,000 ohm potentiometer with AC switch attached.
Four UY sockets.
Three binding posts.
One vernier dial with 2.5 volt pilot lamp.
One 0.1 meg. resistor.
One 7x12 inch front panel, 6½x12 inch subpanel, and cabinet to fit.

The Thyratron Tube

By William T. Meenam

FROM a series of original investigations of electron discharges in gases which Dr. Irving Langmuir carried out in 1914 in the research laboratory of the General Electric Company has come the Thyratron tube, one of the most recent additions to the tube family.

It has inherent advantages as a means of controlling electric power, and has begun to be used most effectively in this manner in such unique applications as the system of operating the stage lighting of the Chicago Civic Opera House from in front of the footlights, and the spectacular method of decorating with light the walls and ceilings of rooms, known as colorama.

But scientists believe that the possibilities of the Thryatron tube are not confined to the function of control. The men who have been responsible for its creation and development believe it may also become the means at some future time of accomplishing power transmission under more advantageous electrical conditions than those at present prevailing.

Expect Long-Distance DC Transmission

This idea is based on the expectation that the Thyratron tube may make it possible to transmit electrical energy over relatively long distances by means of direct current instead of alternating current.

Seeking to develop this proposition, an experimental miniature transmission line has been set up in the General Electric research laboratory and equipped with Thyratron tubes. The artificial transmission line itself was represented by a copper bar about seven or eight feet in length. Electrical conditions were imposed, in the matter of ohmic resistance, which made this line equivalent to 400 miles of transmission conductor in a commercial system.

As the longest commercial system now in existence is 250 miles in length, this experimental line, in its electrical characteristics, was more than 50 per cent. beyond present practice.

At the sending end of the line was installed a bank of Thyratron tubes functioning as rectifiers, to convert alternating current into direct current for transmission purposes. At the receiving end of the line were installed other Thyratron tubes which functioned, in pairs, as inverters. They inverted, or changed back, the direct current into alternating current. The source of current supply for the experimental system was a bank of transformers which furnished alterating current at 15,000 volts.

Transmission Without Difficulty

When this interesting experiment was tried it was found that transmission of the power was accomplished without difficulty and that the Thyratrons, operating at one end as rectifiers and at the other end as inverters, handled successfully the current at 15,000 volts. At the receiving end the tubes delivered the energy to transformers, which reduced the pressure to the voltage of the working circuits in the laboratory shop, and through these circuits it was put to work in motors just as is done in every-day practice everywhere.

As a further demonstration the experiment was later repeated with the addition of a double-conversion process at the receiving end of the experimental line. After having been inverted and sent through step-down transformers, the current was passed through a motor-generator set and reconverted again into direct current at working voltages. Thence it was supplied to shop circuits which required direct current, for regular work in direct-current motors.

The experiment was regarded as significent of what may be in store at some future period in electrical engineering developments. It is quite possible, from the present trend as revealed by this experiment, that within the next decade—precisely how soon laboratory men do not care to speculate—direct-current transmission on a scale comparable with or at least approaching the present practice with alternating current will go into commercial usage.

Revives Old Hope

Not since the earliest days of commercial application of electricity has direct-current transmission been considered practicable. In the electrical beginning of things, when arc lights first came into use, followed a few years later by Edison's incandescent lamp, almost all transmission in commercial systems was by direct current. That was 50 years ago, before the era of widespread electrical networks which serve an overwhelming majority of the nation's population.

The arc-lamp systems operated on the series circuit and started in 1879 and 1880 with pressures of 2,000 volts, although in more recent times they have gone as high as 8,000 volts. The incandescent system utilized the multiple circuit and transmission was at the low pressure of 110 or 220 volts.

These represent two methods of transmitting economically by direct current, but their disadvantages would be so pronounced if employed under present-day conditions that the development of the transformer and the alternating-current systems that came in shortly before 1890 was little less than the salvation of electrical practice at that period. If transmission by direct current at high voltages can be accomplished, with the aid of the Thyratron tube, the benefits, both electrically and economically, will be decidedly noteworthy.

15 Years in Process of Development

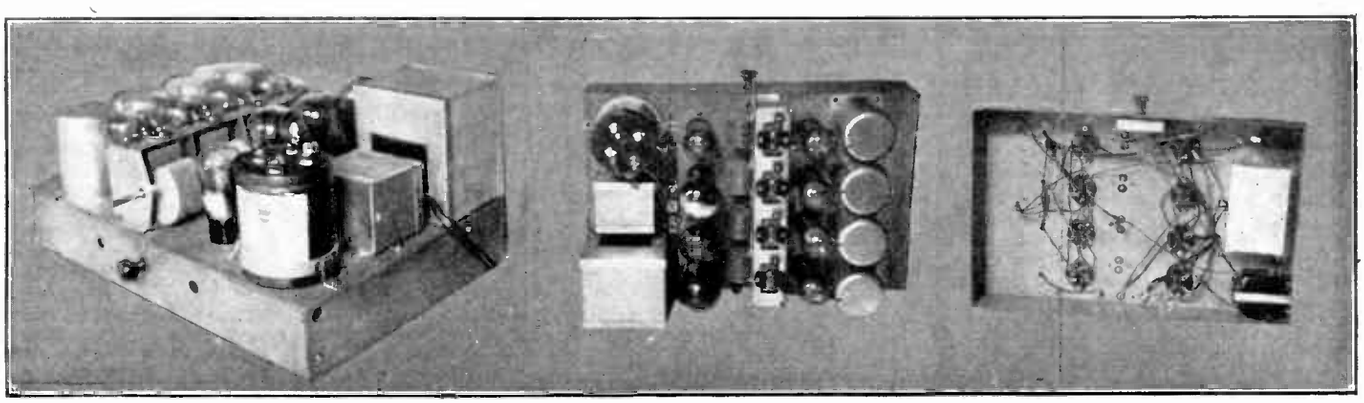
The Thyratron tube has been 15 years in reaching its present state of development as a perfected and effective control device, with latent possibilities in transmission mentioned above.

After Dr. Langmuir had conceived the idea of making use of the characteristics displayed by electron discharges in gases for controlling an electric arc by means of a grid, Toulon, in France, experimented in 1922 with Langmuir's process and devised an improvement on his method. Later Langmuir and his assistants made other improvements.

About 1926 Langmuir envisioned the broad practical possibilities of the principle, and thereafter Dr. A. W. Hull, in the same laboratory, developed the tube to its present status, making its commercial use in controlling power supply a reality.

The tube, of the three-electrode type, differs from the familiar Pliotron tube in being an arc rectifier in which a power arc is controlled electrostatically by the grid. In its control function it will economically handle relatively large amounts of electric power.

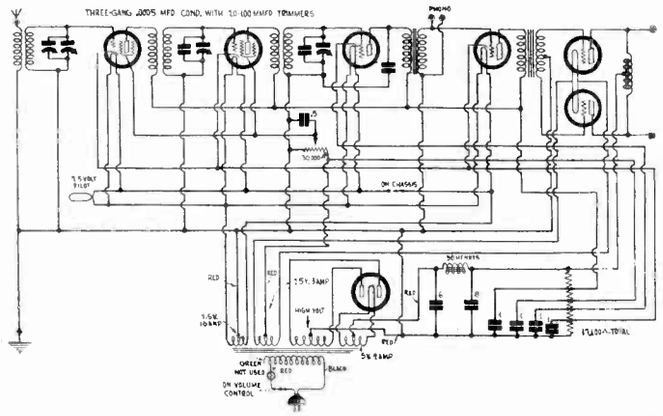
Three Views of the HB-44



THESE VIEWS SHOW THE MECHANICAL CONSTRUCTION OF THE HB-44 RECEIVER. THE MIDDLE PHOTO GIVES THE PLAN OF THE RECEIVER, WHILE THE RIGHT HAND PHOTO SHOWS PARTS AND WIRING UNDER THE PANEL.

Shoot Trouble with an

By John C.



CONDENSERS 6 AND 8 ARE FILTER CONDENSERS, THAT IS, HIGH-VOLTAGE TYPES, WHILE THOSE NUMBERED 1 ARE BYPASS CONDENSERS, OR LOW-VOLTAGE TYPES. THE POWER SUPPLY IS AT BOTTOM, RADIO-AUDIO AMPLIFIER AT TOP.

IF the assembly of radio receivers consisted merely of the proper combination, mechanically and electrically, of the designated component parts, and if sets played and tuned in a satisfactory manner directly, and if the necessary connections were completed and the required operative voltages were applied there would be no need for the "service man." And also if the location of circuit operation difficulties consisted mainly in pointing your finger at the source of the indicated trouble there would be no trouble at all in connection with trouble shooting.

There are those who attempt the nearly impossible job of trying to analyze the cause of their particular radio set grief via the route of "listening to the loudspeaker output." This method, though slightly useful, is greatly overworked, as also is the mere interchanging of similar style tubes in the hope that the set will sound better.

In most cases there is no change for the better and there's likely to be a change for the worse.

The safe and correct procedure in the case of nearly all radio parts or assembly inspections is to use the simplest and most accurate electrical testing equipment.

Use Good Meters

One can buy the proper type and scale range of voltmeter that combines accuracy with a reasonable price. The same may also be said of the ammeter and milliammeter, although the microammeter and portable galvanometer will cost real money.

Radio fans who build sets, or who intend building them, should familiarize themselves with all of the above instruments.

A little judicious experimentation will show the radio set builder the real value of the use of simple circuit measurements, as it is only by this means that troubles can be located quickly. Finding the trouble is often the harder part of the work. The fault known, the remedy is usually easy.

Take the case of the enthusiast who prefers to buy parts and assemble and wire them himself. When he contemplates the assembly of a radio receiver from parts as described in any periodical he can avoid a lot of trouble by buying the parts as specified, or if substitution is to be made, get expert advice before venturing on any dubious substitution. One of the evils of the set assembly from parts is the substitution of unsuitable or even defective left-over parts in an otherwise new assembly. The results are disappointing.

Let us assume that an all-electric set is to be built.

The parts are received and are unpacked ready for inspection.

Test of Tubes

Tubes may be tested for grid to heater and plate to grid or screen grid shorts by a dry cell and a DC voltmeter. Connect the battery in series with the voltmeter and touch the two connecting leads issuing from the other two free terminals to the heater prongs first. A deflection will indicate that the heater is O.K. Then shift one to the plate. If all is well, there will be no deflection.

Next try the screen grid and the control grid (cap terminal). If all's well there should be no deflection. Then test between the plate and screen grid, and lastly the control grid, and if all was well there should have been no deflection. All this is to avoid the possibility of blowing out the rectifier tube. The 227 and the rectifier tube may also receive a similar test and the only complete circuit should be the heater.

If the tubes can be checked under operative conditions at this time so much the better, but if not, then we have to wait until the receiver is done. The next important test is to check for the possibility of a "grounded" transformer winding as well as the usual continuity test.

Use of High-Voltage Voltmeter

Test the power transformer by applying the rated primary voltage and then apply the leads of a high voltage AC voltmeter between the case and either high voltage secondary lead. There should be no deflection. The voltmeter should be of 0-1,500 volts range. Then test for secondary high voltage. If the transformer is to operate a 280 tube the "open" voltage will be around 660 volts AC. If a 281 tube the voltage will be around 800 volts AC.

The secondary winding that supplies the tube heaters may be rated at 2.5 volts at a 16 ampere load, therefore it's best to make a simple load test here.

Have your 0-7 volts AC voltmeter and an 0-30 ampere AC ammeter and some coarse resistance wire. Select the high density current secondary leads and connect the voltmeter first. Then connect the ammeter in series with one of the leads and some of the resistance wire and adjust the current value shown by the ammeter until it reads the rated current output. The voltage then should be 2.5 volts.

If there is another lower current density secondary winding it is simple to repeat the above test to determine whether this winding delivers its rated output.

If the AC voltage and current rating should appear on the nameplate, for the high voltage secondary the output tests described above could be made here too. But in some cases the maximum rectified rating is given, i.e., the filtered AC rating for voltage and current. This may be measured by a high-resistance DC voltmeter.

Over-Voltage Tests

When the set is operating there is usually high voltage between the audio transformer's windings and the cases, if the cases are grounded to the metal chassis, therefore it's a good plan to test between the audio transformer binding posts and the shell or case with at least twice the normal operative voltage. If the transformer primary is connected in a 90-volt circuit in this case use 180 volts for test. (Underwriters insulation breakdown test specifies at least "three times the normal operative voltage to ground.")

The push-pull audio input and output transformers should receive proportionally higher test voltages, principally as a means of assuring ample insulation at the points where binding posts are mounted on the case.

If a voltage divider is used it should be ground tested and also checked for continuity.

The ground test here is very important because a grounded divider post that should be at positive potential means all kinds of mysterious trouble.

Small by-pass condensers are generally employed on the lower voltage range circuits and these may be most conveniently tested by connecting a 25-watt lamp in series with a low-range ammeter and a source of 90 to 110 volts DC. The ammeter may be of 0 to 2 amperes range or if of higher range, a bigger lamp may be used.

I would not advise using a lamp larger than 100 watts as the arc in the event of a defective condenser might be destructive.

Voltage Values Differ

But the condensers that form a part of the rectifier filter system are subject to much strain and therefore should be tested for several minutes at their continuous working rated voltage at least.

This means that on a circuit that carries pulsating current there is generally some peak value for the voltage, and it's usually best to try to estimate the approximate value of this voltage, using the AC voltmeter, if you suspect that there is any likelihood of high voltage condenser breakdown.

The high-voltage AC voltmeter will indicate nearly the peak value of the pulsating voltage of the raw rectifier output, and the high voltage condenser's DC rated breakdown voltage should approach one-third more than the previously stated peak value for the pulsating raw output, because when the high tension condenser is shunted across the rectifier tube output the steady voltage component rises, with the result that the difference between the aforesaid peak value and the new steady voltage component is not as great as it was previously.

It will now be realized that this shunt condenser, or buffer as it is called, must be of such rating that the danger of breakdown is very remote, as, if it does short-circuit, the inevitable

Artillery of Good Meters

Williams

result is that the rectifier tube plate (or plates) will get red hot, causing the filaments to collapse.

In a case like this tube breakdown is preceded by the sudden appearance of an intense blue discharge which permeates the tube's interior.

The choke coils associated with the filtered rectifier output circuit likewise should be high-voltage tested from windings to case, and the usual continuity test made. The 110-volt DC lamp test will do in this case.

Temperature Affects Resistance

Flexible grid suppressors usually are enclosed in a colored fabric casing, the color in some cases representing a definite resistance value. But if ordinary methods of inquiry don't reveal this relationship, the ammeter-voltmeter method of measuring resistance must be resorted to if you don't own a portable ohmmeter or some form of wheatstone bridge.

When making an ammeter-voltmeter resistance measurement care must be exercised not to employ a current value that will result in the measured resistor getting warm. Ohm's law in its simplest form $R = \frac{E}{I}$ (resistance equals voltage divided by current) is only true when no temperature change is involved. This simple detail is easily provocative of error of observation when fine wire wound resistors are being measured.

On this account accurate resistance measuring instruments are calibrated under conditions of a constant temperature, usually 20 degrees Centigrade or 68 degrees Fahrenheit.

The remaining continuity tests are of course the radio frequency coils, both secondary and primary windings. Be sure that there is no short circuit between these two windings, and inspect the variable condensers, too.

The more critically minded have a megohn voltmeter to make all the high resistance checkovers on leak resistors. A megohm voltmeter is an instrument that contains a resistance of 1,000,000 ohms at 68 degrees Fahrenheit when a full-scale deflection of the needle is obtained. One commercial form of this device requires an operative potential of 90 volts, usually furnished by a B battery.

Tests Help One to Succeed

The success in completing a first-class set assembly is based considerably on the performance of the routine tests briefly sketched above. The often hasty conclusions arrived at by those who build sets from parts may be directly due to the omission of care in first-hand inspection of received parts.

The broadcast receiver as we know it to-day is composed of four main assembly groups: the radio frequency amplifier, the audio frequency amplifier, the combined heater, plate and grid voltage source and the reproducer.

In order that the separate functions of these four groups should not be confused in their combined relationships in the operative state it is a good plan whenever possible to keep them segregated as much as possible.

One of the groups that is always best kept segregated is the power pack, because by so doing you tend to avoid undesirable pickup of many kinds within the confines of the chassis.

The power transformer usually has around its core a fairly strong so-called leakage field and this field's distribution may not be very symmetrical. In fact it is often anything but that and the danger of undesirable hum pickup is then present. Therefore you have to explore the immediate external region of the transformer with a search coil connected to earphones and find out thereby something about the shape and extent of the field.

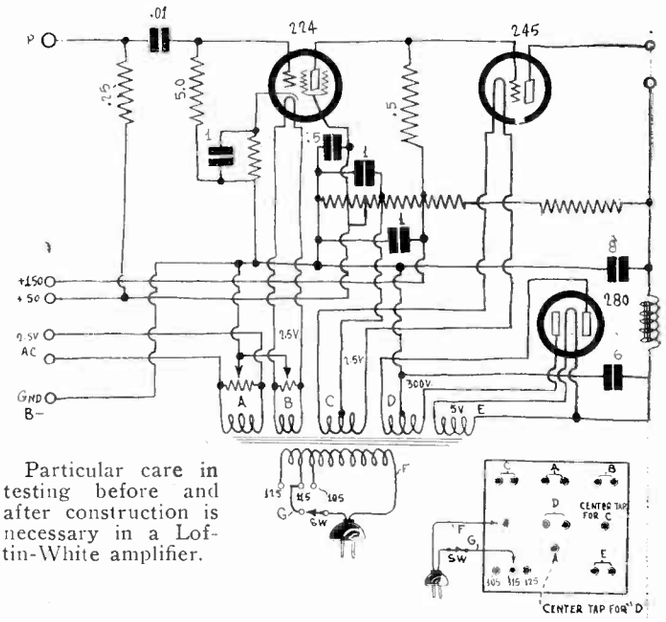
Making a Search Coil

A search coil suitable for the above may be made by winding 10 to 15 turns of No. 26 silk or cotton covered wire around a small piece of bakelite tubing, and cementing the finished turns in place with a little collodion.

Merely connect the earphone terminals to the terminals of the search coil. This coil when placed near the transformer's exterior surface develops a hum voltage that is registered in the earphones as a 60 cycle note, and by moving the coil around to different parts of the external field of the power transformer the shape of its external field can be studied at first hand.

A little examination will show what the distribution is and the transformer then can be appropriately located..

The filter chokes, members of this group, are supposed to assist in smoothing out the DC ripple hence these should be located in such way and be so connected that the weak hum currents set up in each by the effect of the external field will be mutually opposite, and the voltage divider (especially if it is inductively wound) should be kept as far away from a strong external field as possible.



Particular care in testing before and after construction is necessary in a Loftin-White amplifier.

If the receiver is in an oscillating condition and there's too high a hum level in the B supply you hear what you think is modulation hum, and this nice hum-m-m is being developed right at home.

Wire for Heater Circuit

Heater wiring should be of rubber-covered stranded tinned copper wire equivalent at least to No. 18 B. & S. (6 ohms per 1,000 feet) and if the run from the transformer is in excess of 10 inches inclusive the gauge size should be increased to No. 16 B. & S. (4.01 ohms per 1,000 feet) or extra feeders should be twisted in with the regular heater line, and the twisting should be close and tight in order to reduce the stray AC field around this line to a limited area. All this is to guard against excessive voltage drop along the heater line, which in turn militates against the establishment of the maximum emission current.

When the detector tube's output feeds into a 1-to-3-ratio audio transformer and the rest of the audio amplifier consists of input and output push-pull transformers, it is doubly important to go scouting around with the search coil if you want to find the best location for these three transformers.

Aim to locate the first audio transformer (the one fed by the detector output) as far away as possible from the stronger part of the external field of the power transformer and in addition to this put it in such position that the hum pickup by the secondary of this transformer is an absolute minimum. This detail is of utmost importance if you want to build up a hum-free assembly and as most of us desire this I think the hint given is sufficient.

It is likewise important to locate the push-pull transformers with care, no matter what kind of a set you assemble, but if these happen to be of the unshielded type, it will be necessary to observe the precautions of the previous paragraph.

Shielded Transformers

If, however, these transformers are well shielded it may be found that a location more advantageous mechanically may be found. And if the pickup at the secondaries of these last two transformers does not exceed that of the first stage transformer you may safely assume that you are on safe ground and should mount them here.

The relative positions of the two transformers may be of some importance. Orientate the cores of input and output transformers, if possible, so that whatever leakage field each may possess will tend to oppose the other's.

It is just as important to observe the fundamentals of what has been written where the assembly of a large battery-operated receiver is contemplated, because the inherent sensitivity of a multitude battery set may exceed that of an AC screen grid set, and it may easily be shown that stray magnetic fields in this latter case actually require a much greater degree of trouble-shooting skill. Regarding the radio frequency amplifier: quite a little has been written lately about sensitivity curves, sensitivity of the order of ¼ micro-volt per meter, effects of shielding, coil tuning characteristics.

In broadcast radio frequency amplifiers, as in the short-wave type, short and direct leads generally give best results.

Resolved, That Anten

AFFIRMATIVE

By Thomas Follower

THERE can hardly be any doubt about the fact that antennas are directional, that is, that they receive better from one direction than from other directions. At least there should be no doubt after the reception characteristics of different types of antennas are known.

Under antennas many forms of signal collectors fall. We have the regular open antenna consisting of a vertical wire, the vertical wire with a flat top, or the inverted L, the vertical wire with a flat portion extending each way from the top of the wire, and the umbrella antenna. Then we have loop collectors and condenser antennas and combinations of loops and vertical wire antennas.

What are the characteristics of the antennas? That is, what is the reception or transmission pattern of each? If the pattern is circular there is no directional effect. If it is elongated there is a directional effect.

In theory, perhaps, some of the signal collectors have circular patterns, but in practice there is scarcely a single one that does not show a distortion of the circular form. Hence practically every antenna is more or less directional.

Pattern of Vertical Wire

In theory the vertical wire antenna has a circular pattern. But this is predicated on the supposition that the ground surrounding the base of the vertical wire is homogeneous in respect to its electrical conductivity. The ground, it must be remembered, is just as much a part of the antenna system as the aerial wire. Suppose, for example, the aerial wire is perfectly vertical but that on one side of the base of the wire the ground is flat and moist and that on the other it is hilly and sandy. Theoretically, the vertical wire has a circular pattern but radiation or reception from that antenna will show marked directional qualities. In the direction of the flat and moist ground the transmission will be much greater than that in the direction of the hilly and sandy ground. Likewise, the reception from the moist ground will be better than that from the opposite direction. Thus, in practice, a vertical wire antenna is directional.

Now consider a vertical wire with a flat portion extending from the vertical wire in one direction. That is, consider an inverted L type of antenna. Measurements of the pattern around such an antenna show conclusively that the directional effect is very strong. Measurements have been made on many such antennas and in every case the directional effect is pronounced. Hence it is strong enough even to overcome any directional qualities that might be due to a non-homogeneous ground under and surrounding the antenna. In some instances, of course, the ground and the flat portion of the antenna work in the same direction to accentuate the directional effect.

Pattern of T Antenna

What is the pattern around a T antenna? It is somewhat like a figure 8, showing that it has directional qualities. And why should it not be directional if the inverted L antenna is directional? After all, it is equivalent to two inverted L antennas placed back-to-back.

An inverted L antenna transmits better in the direction opposite to that of the flat portion, and it receives better from the same direction. Therefore if the flat portion runs East from the vertical wire transmission to and reception from West is better than in the opposite direction. When we have two flat wires, as in the case of the T antenna, the flat portion running East and West, reception and transmission will be about equally poor East and West, but transmission and reception North and South will be good. Hence this form of antenna is strictly directional, although less so than the inverted L antenna.

The umbrella type antenna is somewhat like the vertical wire but neither as good transmitter or collector as the vertical wire. It would be as nearly non-directional as the vertical wire if there were an infinite number of wires extending from the top downward. But since there is only a finite number there will be some directional qualities. And just as in the case of the vertical wire, the nature of the ground adds to the directional qualities, for it is rarely that the ground is homogeneous. The only case where there is symmetrical conductivity is around a ship antenna where there is water all around. But ship antennas are either of the inverted L or the T types.

The loop antenna has always been recognized as directional, and greatly so. The pattern is in the form of figure 8, and it is a much more pronounced 8 than the pattern around a T antenna. In fact, it is the form obtained by placing two equal circles in contact with each other at the point of the loop. True, in all practical cases the figure 8 is distorted, but this distortion only makes the loop more directional, for it increases one of the loops while it decreases the other.

But surely the condenser antenna is non-directional. Why should it be? A condenser antenna is just a modified form of the vertical wire, the inverted L, the T, and the umbrella antenna. All of these are condenser antennas. The condenser antenna is made up of a metal plate or screen mounted over the earth. This plate may be directly over another and similar plate forming the second plate of the condenser. Or the ground itself may constitute the second plate. These two plates are connected with a wire, which is the vertical wire elongated in the other forms of antenna. Merely shortening the vertical wire does not change the characteristics greatly as far as directional qualities are concerned. It may be non-directional but the chances that it is directional are overwhelming.

Combination Loop and Vertical Wire

The antenna made up of a vertical wire and a loop is the most directional of all. With a little adjustment of the amounts of signal collected by the two portions of the antenna, or until the two signals are equal, the pick-up from one direction is zero while from the opposite direction it is the sum of the pick-ups of the two parts. From other directions the amount of pick-up varies between zero and the maximum. Therefore no three positions about the antenna have the same pick-up or the same transmission. However, the pattern is symmetrical about a line passing through the two extremes and the center and hence for every point having given value of pick-up there is another point having the same pick-up, except the two positions at which the pick-up is either zero or maximum.

Effect of Flat Top

The longer the flat top portion of the antenna in comparison with the vertical wire, the more directional is the antenna, that is, the greater is the pick-up from the direction opposite to that toward which the flat top points, and the more of the total transmitted energy is sent out in the direction opposite to that toward which the flat top points. Therefore an antenna of the inverted L type can be made strongly directional.

Under the same conditions the T antenna is made more directional, since in reality this is only equivalent to two inverted L antennas placed back-to-back.

It is easy to imagine an antenna that is non-directional but it is practically impossible to realize such an antenna, for even the vertical wire antenna, which in theory and under ideal conditions is non-directional, is directional, as we have seen, because the ground surrounding it is non-homogeneous in respect to electrical conductivity.

Use of a Meter f

THERE are many instances when a visual method of indicating resonance is preferable to the customary aural method. Many visual methods are much more sensitive than aural methods, that is, capable of indicating resonance more accurately. Then when the aural method is used there is always that terrific noise when the tuning control passes through the signal of a local transmitting station and when the set is adjusted to high sensitivity. When a visual method is used, the adjustment need not be accompanied by a noise at all, for the loudspeaker may be disconnected momentarily. Yet the meter or other visual indicating device shows resonance at least as accurately as the aural method, and in most instances much more keenly.

One resonance indicator that is used frequently is a thermo-couple milliammeter connected in a tuned circuit where the signal intensity is high, say in the tuned circuit preceding the detector. This indicator is sensitive, for it is easy to see when the needle on the meter is the highest. With a little care the maximum position can be determined within the breadth of a hair.

The thermo-couple milliammeter is not the only type of meter that can be used in this manner. Any sensitive alternating current meter can be so used. However, the thermo-couple is most frequently used because it is accurate, sensitive, and not too expensive. Very simple indicators of the same type

ınnas *Are* Directional

NEGATIVE

By Lester Wickersham

NO one can deny that antennas are directional if we mean by this term that transmission in or reception from certain directions is greater than that from some other directions. For example, a certain transmitting antenna may lay down a signal strength of 5 millivolts per meter at a certain distance West of the transmitter and a strength of 4.99 millivolts per meter the same distance South. Of course, no one can deny that such an antenna shows partiality between West and South. And since it does not treat the Southerners with the liberality it treats the Westerners, we may assume without verifying the assumption with experiments that it also mistreats the Northerners. However, we cannot be sure that it favors the Easterners, for it is possible that the antenna is such that nothing at all is transmitted eastward. Still it is reasonable to suppose that even the Easterners, be they nothing but fish in the Atlantic Ocean, is favored by 0.2 per cent. more signal strength than the Southerners and the Northerners.

We cannot deny that an antenna that discriminates to this extent shows favoritism, but we do deny that the Southerners and the Northerners will protest to the Federal Radio Commission. If it is the receiving antenna that shows this discrimination, nobody could possibly object because for one to do so would be objecting to something for which he himself was responsible. When the receiving antenna is so erected that stations East come in better than those West, the simplest thing to do is to move to another part of the country. It would be two much to expect anybody to rearrange the layout of the antenna.

Loop Receiving Antennas

We concede that a loop antenna is directional. But what of it? It does not bother anybody as far as broadcasting stations are concerned, for no broadcast station operates on a loop. If it did, it would not be a broadcast station. A receiving loop is used for the express purpose of taking advantage of the directional effect. Surely nobody objects to getting up and turning the loop around if it is so oriented that a certain desired station does not come in satisfactorily. If he does, let him hire somebody to put up an antenna that is not directional. Let us amend that statement. Let him hire a man to erect an antenna that does not discriminate more than 0.2 per cent. If he has such an antenna he will not object to the discrimination, for he will not be aware of it.

There is an advantage in this state of unawareness, for if it should happen that a member of Congress, or a friend of a member of Congress should become aware of the fact that receiving antennas are directional, a law would be proposed, and probably passed, that no antenna should be erected within the jurisdiction of the United States that should show any partiality in favor of any section, North, South, East, or West. Or the law might even be wider in its scope and read north, south, east or west.

Question of Ground Conductivity

The possibility that such a law would be proposed, and probably passed, is not remote, except for this fortunate unawareness, because at one time a member of a State legislature introduced a bill providing that the ratio of the circumference to the diameter of a circle should be equal to 3 and 1/7th. This bill failed because no one was able to see how the provision could be enforced, not even the man who introduced the bill. But this would not be a deterrent now, and it is only this blessed unawareness that saves us.

It has been pointed out that an antenna is sometimes directional because of the nature of the surrounding terrain even when the same antenna would be nondirectional if the terrain were uniformly conductive and uniformly level or hilly. It is conceded that the transmission pattern, and hence the reception pattern, around an antenna is affected by the terrain. But what has that to do with the directional quality of the antenna? An antenna radiates energy in some manner or other, and when that energy is radiated the antenna is through with it. What reasonable man can blame the antenna for something that happens to the radiated energy from 100 to 10,000 miles away? If the antenna radiates energy equally in all directions, it is non-directional regardless of what the ground, or anything else, does to it afterward.

A Revolving Antenna

Of course, there are types of antennas that do not radiate equally in all directions. Such antennas are directional. Some broadcast stations have such antennas. Indeed, all have, for they are either of the inverted L or the T types, and both are more or less directional. It may be that one transmits 10 per cent. more energy in one direction than in some other direction. That difference may be great enough to be appreciated if there were any way of making comparisons. About the only way that that could be done is to put the entire receiving installation on a revolving platform and take observations on every point of the compass. Fortunately, broadcast receivers are not arranged that way. Neither are broadcasting stations arranged in that manner so that the signal at any receiver cannot vary because of any directional quality that the transmitter antenna may have.

ɔr *Visual Tuning*

utilize a miniature lamp in the tuned circuit. At resonance the lamp lights up brightly, provided the radio frequency current in the tuned circuit is high enough, and the greatest brightness occurs at exact resonance. Of course, this indicator is not much more sensitive than the aural, because the eye is not a keen discriminator between differences in brightness, especially when the two brightnesses do not occur simultaneously but successively. The ear is about as good a judge of differences of sound intensities. Yet the lamp is a silent resonance indicator and it is cheap.

Another accurate resonance indicator is a microammeter in the grid circuit of the detector tube. This, however, is expensive and works only when the circuit is adjusted so that the grid takes current part of the carrier cycle. The maximum reading indicates resonance.

Still another indicator is a milliammeter of suitable range in the plate circuit of the detector tube. This works with either type of detector, although it works differently in the two cases. Hence the readings of the meter must be interpreted according to whether the detector operates on the grid bias principle or on the grid condenser and leak principle. In the grid bias detector the meter shows the highest deflection at exact resonance and in the other detector it shows the least. The reason for this difference is that one detector modulates upward and the other downward.

A Continuous Tone Control

IN A RECENT issue you showed how high and low notes could be suppressed by means of shunt and series condensers. As I see it, this method permits only of changes in definite steps. Is there not some method by which the change can be made gradually in minute steps or continuously?—W. H. F.

If a variable resistance is put in series with any condenser, whether that condenser be used in series for the purpose of cutting out the low notes or in shunt for cutting out the high, that resistance can be used for varying the effect of the condenser, and this change is either continuous or gradual in small steps, depending on the type of variable resistance used. This was discussed in the article referred to in connection with variation of the grid leak.

* * *

Short-wave Antenna Coupler

WHICH DO YOU consider the best aperiodic coupler between the antenna and the first tube in a short-wave converter, a high resistance or an impedance coil?—G. N. R.

There is little difference between the two. Perhaps the impedance coupler gives a greater sensitivity at some frequencies, but it is likely to give less at other frequencies, depending on the distributed capacity of the coil. The resistance coupler takes less room and it is just as effective at one frequency as at another.

* * *

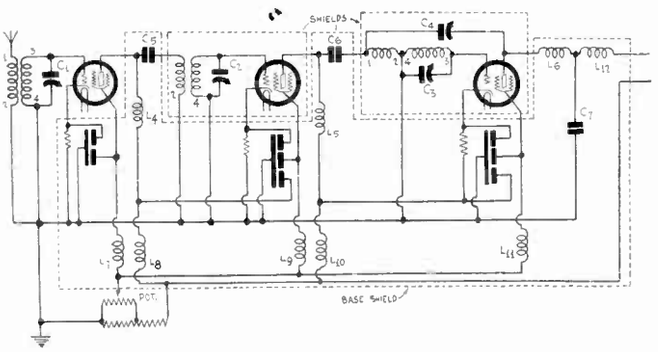
Power Consumption of Tube Filaments

WHAT is the power consumption in the filament of the new 232 tube? What is it in each of 230 and 231?—. A. C.

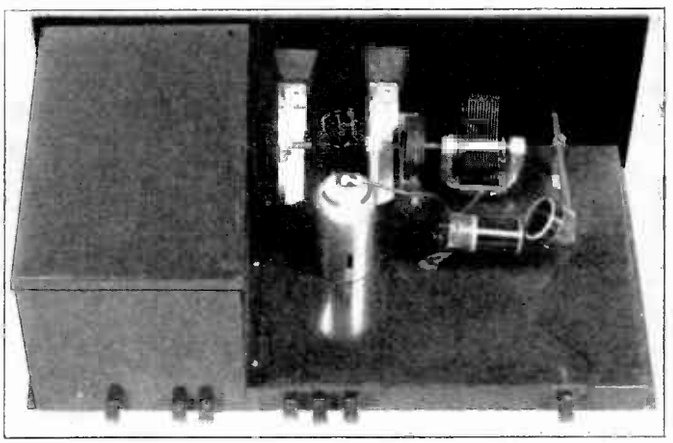
In the 230 and 232 filaments the power consumption is .12 watt. In the filament of the 231 it is .26 watt.

The Moore AC Tuner

By E. Bunting Moore



THE DIAGRAM OF THE MOORE TUNER. THE ANTENNA STAGE IS INDEPENDENTLY TUNED AND THE COUPLING BETWEEN THE ANTENNA COIL AND THE SECONDARY IS ADJUSTABLE.



REAR VIEW OF THE MOORE SUPER DX AC TUNER.

[*Constructional data on the Moore Super DX Tuner were published last week, issue of August 2nd. The following is the concluding instalment.—Editor.*]

* * *

IT is an axiom in radio that the simpler the circuit the more efficient it is. The reason for the truth of this statement is that every bit of apparatus put into a receiver adds resistance and every bit of resistance introduces loss. Wherever there is loss, the efficiency is low in proportion to the amount of loss.

Of course, this does not mean that a higher sensitivity cannot be obtained with a circuit using many tubes and many tuners. But it does mean that one has to pay a relatively higher price for the greater sensitivity of a multi-tube receiver than for the simple circuit. It also means that, if the simple circuit is properly designed, practically all the sensitivity that is needed can be obtained from it.

As an example of a relatively simple circuit that is highly sensitive we might mention the Moore Super DX AC Tuner, described in detail in the Aug. 2nd issue. This circuit has three tuners controlled by the two major knobs. That is, two of the tuner condensers are ganged and one is adjusted independently. This dual tuning combines the advantages of separate control for the condensers and convenience of gang control in a manner that insures accuracy of tuning and hence high sensitivity and selectivity.

Moreover, the circuit is regenerative, a fact which adds both to the sensitivity and the selectivity. The regeneration is controlled by means of a small condenser connected between the plate of the detector and the plate end of the primary of the coupling transformer preceding the detector. The connection is such that the usual third winding is omitted, which is in harmony with the axiom that the simpler the circuit the more efficient it is.

Regeneration Assured

This method of feed-back imposes the condition that the usual by-pass condenser in the plate circuit of the detector be omitted and that radio frequency currents be prevented from escaping to ground through the load on the detector before they have done their regenerative work in the primary winding. For this reason a choke coil L6 has been put in the plate feed line to the detector. The only by-pass capacity in the plate circuit, therefore, is that between the plate and the screen grid of the detector tube. This capacity is small in comparison with that of the regeneration condenser C4, except, possibly, when the condenser is set at minimum. Hence the regeneration condenser is effective in controlling the amount of feed-back.

In view of the fact that it is desirable to prevent radio frequency currents from entering the audio amplifier, another choke coil, L12, is put in series with the plate feed line to the detector. A by-pass condenser C7 of .002 mfd. capacity is connected between the junction of the two choke coils and ground to provide a path of those radio frequency currents which get past the first choke coil L6.

Stability Precautions

The Moore Super DX AC Tuner is unique in the manner and thoroughness with which it has been stabilized against stray feed-back. First note the choke coil L4 in the plate circuit of the first screen grid tube. This coil is a coupler as well as a filter. It is a coupler because a high signal voltage develops across it and this voltage, through C5, is impressed on the primary of the RF transformer. It is a filter because only a very small signal current can flow through it. The major portion of the signal current flows through C5 and the primary of the transformer, and this current flows directly to ground after it has done its work in the primary. Therefore, there is practically no signal current flowing into the B supply.

But some current must flow through L4 for otherwise there would be no voltage across it, and therefore no voltage across the primary. To prevent this small current from getting into the B supply a large by-pass condenser is connected from the low end of L4 to ground. And this is not all. Another choke coil L8 is connected in series with the feed line to take out any residual current and to force the current that gets passed L4 through the by-pass condenser.

The plate circuit of the second screen grid tube is treated exactly as that of the first, and here we find condenser C6, the choke L5, a large by-pass condenser, and finally the choke coil L10.

The screen circuits have also been treated so as to prevent signal currents from straying into the B supply or into other channels where they have no business. There is a radio frequency choke coil in each screen lead, namely, L7 in the first, L9 in the second, and L11 in the third. And for each choke there is a large by-pass condenser connecting the screen to ground.

The grid bias resistors also have been by-passed with large condensers. The object of these condensers is not so much to prevent stray coupling as to prevent the bias resistors from exerting a depressing effect on the sensitivity. It is not often realized just how much a bias resistor can reduce the sensitivity by feeding signal voltages to the grid in reverse phase, and it is still more infrequent that the effect is counteracted with adequate condensers.

Shielding Judiciously Done

Shielding occupies a unique position in a radio receiver. Except in the very simplest receivers, it is necessary. Yet shielding may render a receiver insensitive. However, the advantages of shielding may be retained without sacrificing sensitivity, provided that the shields are made large compared with the tuning coils, and also provided that the coils be not placed near the shielding. By studying the circuit diagram of the receiver, as well as the photograph published on the front cover of the Aug. 2nd issue, it will be observed that only two of the tuning coils are shielded and that the shields are so large that they not only encompass the coils but the complete stages. Further it will be noted that the first and unshielded coil is mounted as far away from any metal as practical. It is set back of the metal panel and raised above the sub-panel considerably. In fact, it is almost centered in the space outside the shields and with respect to the metal surfaces comprising the panel, the sub-panel and the metal cabinet, if such a cabinet is used.

Another feature of the receiver is the variable primary with a knob on the panel for varying the couping. This serves as volume control as well as a control for selectivity. It will be recalled that by means of arrangements like this some of the greatest reception records were made in the early days of broadcasting. The principle that made those sets sensitive and selective is just as valid now as it was then.

Besides the variable primary there is an additional control in the potentiometer by means of which the screen voltage on the three tubes may be varied. This is made up of two parts, a high value resistance connected from the high voltage line serving the plates of the tubes and a lower value voltage divider shunted across the lower portion of the high resistance. This arrangement provides a smooth control of the screen voltage and hence of the volume.

Right or Wrong?

QUESTIONS

(1)—A vacuum tube voltmeter takes current from the voltage source that is measured and for that reason the meter is not truly a potential difference meter.

(2)—The current required to operate the indicating device in a vacuum tube voltmeter comes from the voltage source that is measured, and therefore only a highly sensitive indicating device can be used when accurate results are required.

(3)—A potentiometer is a device by means of which any portion of a given voltage may be taken.

(4)—Television signals come in at an audio frequency lying in the range where audio frequency transformers are most effective and for that reason transformer coupled amplifiers can be used for receiving satisfactory television signals.

(5)—The sparks sometimes seem between a free antenna and grounded objects when a thunderstorm is passing over are due to direct discharges between the clouds and ground.

(6)—Remote controls of radio receivers can be made on the rebroadcast principle. That is, the signals are received with a very small receiver and then impressed on a frequency to which the broadcast receiver located some distance away has been tuned. A single wire connecting the two parts, such as the antenna of the broadcast receiver, is sufficient to couple the two.

(7)—The reactance of a coil or a condenser is the same as its impedance.

(8)—The admittance of a coil or a condenser is the same as the conductance of either.

(9)—Critical coupling between two tuned circuits is that which gives the highest selectivity.

(10)—The intensity of the field strength laid down by a broadcast station varies inversely as the square of the distance from the station.

(11)—The emission current of a gas-filled tube flows in the opposite direction to that of an electron emitting rectifier.

(12)—A gas filled rectifier tube must necessarily be a full wave rectifier, that is, the operative tube elements must be so arranged.

(13)—Corona discharge always precedes condenser breakdown, a corona being an electrical discharge in gases.

(14)—Corona discharge is not the same phenomenon as ionization by impact in a partly evacuated glass tube, usually known as a blue glow in the tube.

(15) If a telephone line is designed and built so that speech and music transmitted over it are practically perfect, that line is also capable of handling television signals of good quality.

(16)—An automatic colume control should vary the amplification inversely according to the strength of the audio signal on the grid of the output tube.

(17)—A wave that is modulated with a pure tone frequency is one in which the amplitudes of the modulated wave go through cyclic variations in a simple harmonic manner.

(18)—The degree of modulation is never reduced by a sharp tuner accurately adjusted to the carried frequency.

(19)—It is better to use a separate grid bias resistor for each tube than to put two or more tubes on one resistor.

(20)—Shielding of coils and tubes in a multi-tube receiver is of little avail unless the plate and screen circuits are thoroughly isolated from each other by means of individual chokes and by-pass condensers.

ANSWERS

(1)—Wrong. A vacuum tube voltmeter that is properly constructed takes no current from the voltage source. There is some current when the frequency is high, but this can be reduced to negligible proportions.

(2)—Wrong. The current used to operate the indicating meter comes from the plate battery. While it is desirable to use a highly sensitive indicating meter it is not necessary to insure accurate results. A high resistance indicator permits the use of a high resistance in series with it and the plate of the tube and this in turn lengthens the life of the tube and of the accuracy of the calibration.

(3)—Wrong. A potentiometer is a meter that measures the potential difference. Popularly, the term has been applied to a voltage divider but it is not correct to call anything a meter that does not measure anything. A voltage divided is used in most potentiometers.

(4)—Wrong. Television signals cover a wide range of frequencies, a range so wide that no transformer coupled amplifier can cover it adequately. There is a strong frequency component lying in the range at which audio transformers are efficient but this component is far from the most important one.

(5)—Wrong. They are radio signals transmitted by some discharge at a distance. They are static crashes made visible by jumping across short gaps. They are also audible directly through the air. Incidentally, severe shocks can be obtained by touching the antenna under such conditions, especially if the thunderstorm is close. A direct discharge from the clouds to ground through the antenna wire would not leave the antenna, but would burn it up.

(6)—Right. This is being done all the time, particularly for receiving short-wave signals. It can also be adapted for broadcast reception. One way is to set up a small receiver with one or two stages of audio, then impress this audio on an oscillator adjusted to a frequency to which the broadcast receiver has been tuned.

(7)—Wrong. This would be true if the coil or the condenser had no resistance. But there is always some resistance associated with both the coil and the condenser. The impedance takes into account both the resistance and the reactance and for that reason the impedance is always greater than the reactance. In the case of a good condenser the resistance is so small that it is customary to assume that the reactance is equal to the impedance. In a coil this assumption is seldom permissible.

(8)—Wrong. The admittance of a circuit is the reciprocal of the impedance and the conductance is the reciprocal of the resistance. Therefore the admittance is always smaller than the conductance.

(9)—Wrong. Critical coupling is that which gives the greatest current in the secondary for a given primary current, the primary and secondary circuits being tuned to the same frequency. When the coupling is less than the critical the selectivity is greater and it increases as the coupling decreases. Conversely, the selectivity decreases as the coupling increases.

(10)—Wrong. The field strength varies inversely as the distance and not inversely as the square of the distance. This inverse variation assumes that there are no losses of energy but merely a spreading out over the surface of the earth.

(11)—Right. If a milliammeter with a central zero scale be connected in the external circuit of a 280 operated B voltage supply in resistor and the current (100 volts AC source) applied, the meter may read to the right. If the gas filled rectifier be now substituted the meter will indicate current flow in the reverse direction.

(12)—Wrong. Half wave rectification designs are quite possible, though the full wave type is much more common.

(13)—Right. Especially if the condenser has been operating near its voltage breakdown point for a long time and is growing excessively warm as a result. A cold condenser will puncture with little or no corona effect even when inspected in a dark room.

(14)—Wrong. The blue glow in a tube is due to the breaking down of the gas molecules under the electric stress, or voltage. The molecules are torn apart, that is, the negative ions are torn away from the positive nuclei and in the process a light is emitted which is characteristic of the gas. Ionization by impact is a similar phenomenon caused by high velocity ions, or electrons, striking molecules and knocking out more electrons. The corona around conductors in free air is due to a similar phenomenon. Due to the fact that air under normal pressure is a better insulator it takes a much higher voltage to cause a break-up of the molecule. Ionization by collision is more difficult because the air molecules are so close together that an ion cannot gain sufficient velocity to cause ionization on impact unless the voltage is exceedingly high.

(15)—Right. If a line is constructed so that it will transmit high quality speech and music the the high frequencies are transmitted just as well as the low, and this is one condition for the transmission of good quality television signals.

(16)—Wrong. The automatic volume control should vary the amplification inversely, as the strength of the radio frequency signal on the detector grid, or any other grid ahead of the detector. The capacities between the elements act as shunts, which are more effective on the high frequencies than the low. In transformer coupled circuits the capacities of the windings also enter to shunt out the high frequencies.

(17)—Right. The amplitudes of the radio frequency wave rise and fall in such a manner that if a smooth line is drawn through all the peaks the resulting wave is of the same shape as the wave that represents the pure tone.

(18)—Wrong. It is always reduced because the tuner is not adjusted to the side frequencies and these frequencies are tuned out just as any other frequency not equal to the carrier. Since the side frequencies represent the modulation, it is suppressed.

(19)—Right. It is far better if two or more tubes are put on the same bias resistor there is a common impedance through which feedback will take place. In a sensitive circuit it takes only a very small feedback to upset the stability of the circuit.

(20)—Right. Shielding alone will not stop feedback in a receiver because if all the tubes are served by the same batteries of B supply there is a common impedence which will upset stability. There should be a radio frequency choke coil in every screen and plate lead and a by-pass condenser for

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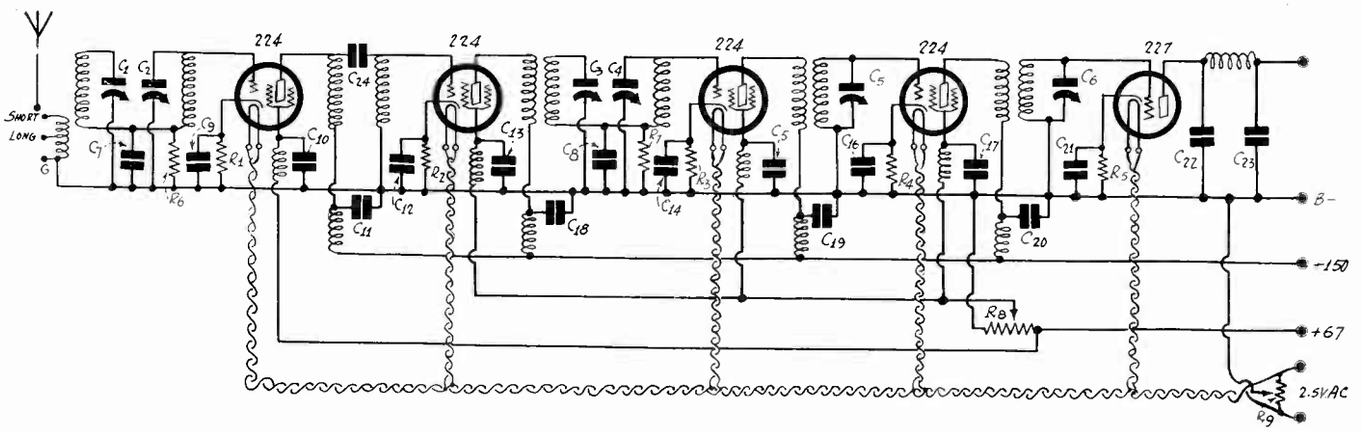

FIG. 838

THE DIAGRAM OF THE MB-30 TUNER AND RADIO FREQUENCY AMPLIFIER, AN EXAMPLE OF THOROUGH FILTERING TO ELIMINATE COUPLING AMONG THE STAGES.

The Use of Stabilizing Filters

WILL YOU KINDLY publish a diagram of five-tube tuner and radio frequency amplifier showing clearly which leads should be twisted and in what leads filters should be placed. I plan to build such an amplifier, utilizing screen grid tubes for amplification and a 227 for detection?—W. H. C.

A good illustration of a well-filtered circuit is the MB-30, the diagram of which is shown in Fig. 838. Only the AC heater leads need be twisted. Filters should be placed in every screen and plate circuit and a by-pass condenser should be put across every bias resistor.

* * *

Shielding Auto Ignition System

I HAVE CONSTRUCTED an automobile receiver and plan to take it on a trip. I do not want to tamper with the ignition wires and am wondering whether satisfactory results will not be obtained without the shielding. The radio set will not be used when the car is in motion, but only at long stops.—J. L.

There is no reason at all for shielding the leads unless the radio set is to be used while the engine is running.

* * *

Television Limitations

IF THE DETAIL in television pictures improves with the number of lines to a frame, what is the reason the number is not increased beyond 60? Why don't they increase the number to 600 lines per frame?—H. A. C.

One reason for the limitation is mechanical difficulties of making scanning devices with a large number of holes. Another reason is the difficulty of transmitting the wave band resulting from a system utilizing a large number of scanning lines. A television channel is now limited to 100 kc and within this band both the upper and lower sidebands of the television signal must come. That limits the highest frequency to about 50 kc, and this limitation does not permit a large number of lines per frame, or a large number of frames per second.

* * *

Colored Television

IF ONLY THREE colors are transmitted in natural colored television, how is it possible to transmit a portion of a picture having a different color, or a white portion of the scene?—O. T. O.

The three colors used are so chosen that when they are combined in the proper proportion white light results. If they are combined in other proportions, any two at a time, or all three, other color combinations result. For example, if yellow and red are transmitted, orange results; when yellow and blue are transmitted, green results. The various shades of color are produced by using different proportions of two or three of the three fundamental colors.

* * *

Grounding the Pick-Up Coil

IS THERE any way of coupling an oscillator to the grid circuit of a 227 tube so that the modulator tuning condenser may be grounded? I know that the pick-up coil can be put in the grid lead but I don't want to do this. In fact, I want to ground the pick-up coil, too, on one side. The idea is that I want to wind the oscillator and pick-up coils on a UY tube which has only five terminals.—K. K. L.

This method was shown in the August 2d issue of RADIO WORLD, on page 4. The pick-up coil is simply connected in the cathode lead. If grid bias detection is used in the modulator the same connection is used but the pick-up coil is put below the grid bias resistor, as shown in this week's converter article.

* * *

WHY SET HOWL STOPS

PLEASE EXPLAIN why my set howls while the tubes are warming up and then settles down to good performance. Is this due to a defect that could be remedied easily?—W. E. B.

This trouble often occurs when the detector is of the 227 type and the audio amplifier tubes are of the directly heated filament type. The directly heated filaments heat up almost instantly and attain their full amplifying property. The detector requires some time to heat up. Before the detector is operative the rest of the audio amplifier acts as an oscillator by virtue of feedback through the B supply. As soon as the detector begins to function the plate resistance of the tube lowers and this stops most of the feedback, just enough to stop the oscillation. Perhaps if you listen carefully there is blasting on the notes equal in pitch to the howl frequency even when the set seems to be operating perfectly. Use more by-pass condensers in the B supply.

* * *

Set Plays For a While

WHEN I first turn on my set it plays all right for a while, but gradually it dies down until the volume is very low and the distortion is very great. What is the trouble?—D. C. M.

This happens frequently when the receiver is operated from dry cell batteries. During a rest the batteries partly recuperate but as soon as the load is put on them they quickly run down. In other sets this behavior is usually due to a defective grid leak or to excessive leakage over the insulation between the plate and the grid. The grid goes positive and the grid leak resistance is too high to permit the positive charge to leak off. Hence the grid operates on a positive bias and the low volume and distortion result.

* * *

AC on New Tubes

WOULD IT BE practical to use the new 2 volt tubes in AC circuits; that is, heating the filaments with AC from a 2 volt step-down transformer. If not, why not?—T. N. U.

It would hardly be practical, although the terminal voltage is only 2 volts. One condition for the successful operation of directly heated tubes on AC is that the filament be rugged and designed for heavy current. The filaments of the new tubes are very light and are designed for current economy. When AC is available there are more suitable tubes from which to choose. However, the power tube, the 231, could be operated on AC without much hum, but there is little reason for doing it.

High Mu Tube in Short-Wave Set

WOULD YOU recommend the use of a 240 high mu tube in untuned short-wave radio frequency amplifiers in preference to 222 or 232 screen grid tubes? If not, what makes them unsuitable?—O. R. G.

The 240 high mu tube has a high input capacity and for that reason it is not suitable for amplification of short-wave RF signals. The amplification will be low when the couplers are untuned, and the wave band covered by a tuner will be narrow if the coupler is tuned. Moreover, the plate to grid capacity is high so that stabalization will be difficult, and that is another reason why the tube is not suitable for short-wave amplification.

* * *

More Winding Data

I HAVE A long bakelite tubing 1.5 inches in diameter from which I wish to make coils for .00035 mfd. condensers to tune the broadcast band. I have a quantity of No. 26 double silk covered wire which I want to use. Please give the number of turns required on the tuned windings and the approximate number on the primaries.—R. H. Q.

For the tuned windings use 103 turns wound as closely as the insulation permits. The primaries depend on the position of the transformer; that is, whether it is next to the antenna or follows a tube, and if it follows a tube, what kind of a tube. Since the coil will be over two inches long it is advisable to put the primary of each coil on tubing that fits snugly inside the 1.5 inch tubing. If this is not done the coupling will be too loose, especially if the transformer is to follow a screen grid tube. For a screen grid tube, use half as many turns on the primary as on the secondary. For a general purpose tube, use about one-fourth as many turns. If the coil precedes the antenna the primary may have still fewer turns and it may be wound with heavier wire.

* * *

An Auxiliary Oscillator

SOME TIME ago you suggested a method of adjusting short-wave coils with the aid of an auxiliary oscillator. What kind of coil is needed for such an oscillator and what size tuning condenser do you suggest?—G. A. C.

You would probably need three coils similar to the coils you are adjusting, but if you have a set of three coils to be adjusted for overlapping you may be able to do the work with only one oscillator coil, one equal to the middle coil in the set. It should have two windings, one for grid circuit and another for the plate circuit. Tune the grid coil with a condenser which is no smaller than the condenser you use in the short-wave set with the coils you are adjusting.

* * *

About Pentodes

WHAT IS THE difference between European and American pentode tubes? I understand that they are designed for different purposes.—A. R. S.

The European pentodes, as a rule, are output tubes, designed to give out a good deal of power at moderate plate voltages and medium grid bias. The American pentode tube is a voltage amplifier, a modified screen grid tube, requiring high plate voltage and low grid bias. The tubes are not interchangeable.

* * *

Band-Pass Filter

WOULD IT BE possible to make a band pass filter by connecting two parallel-tuned circuits in series and tuning the two to slightly different frequencies? I mean that these two circuits should be used as a tuned impedance between two amplifier tubes.—J. F. A.

Yes, this is one type of band filter. The two maxima fall, of course, at the tuning points of the two circuits. By suitably placing these the band passed can be made any width. However, if the band is made too wide there will be a valley in the middle where there will be little transmission. Also, if the maxima are placed too close together it is likely that the two circuits will not act independently as tuners. If the amplifier is a Superheterodyne this method of filtering is very simple. It is also very effective in a voltage amplifier.

* * *

Power for Dynamic Speaker

ABOUT HOW many watts from a 115 volt AC line does it take to run a 120 volt dynamic speaker using one 280 rectifier tube? Does a 120 volt dynamic speaker have any advantage over a low voltage one?—L. B.

There are speakers of this type ranging in wattage from 5 to 15 watts. A usual field current is 40 milliamperes. This would make the power 4.8 watts. Some fields are wound so that the resistance is 2,500 ohms. If the voltage across the winding is 120 volts, the power is 5.76 watts. Of course this is not the only power taken from the line. Due to losses in the rectifier and the transformers and chokes the power consumption in the high voltage circuit may be twice as high as that delivered to the speaker field. That is, the power would be 10 to 12 watts. Then we must also count the filament power in the rectifier tube, which is 10 watts. The main advantage in using a high voltage, low current field is that it is easier to remove hum from the low current.

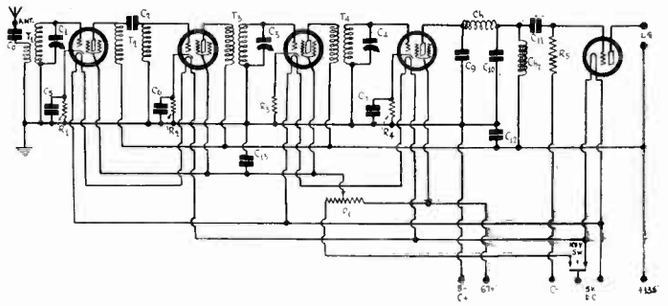

FIG. 839

THIS CIRCUIT WAS ESPECIALLY DESIGNED FOR USE IN AUTOMOBILES. THE HEATERS OF THE 224 TUBES ARE CONNECTED IN SERIES PARALLEL SO THAT THE CURRENT FROM THE CAR BATTERY WILL BE MINIMIZED.

* * *

An Automobile Set

I SHOULD LIKE to have a diagram of five-tube circuit using three 224 amplifiers, one 224 detector, grid bias type, and one stage of audio, impedance coupled to the detector.—F. B. L.

Fig. 839 seems to meet all your requirements. It is designed for automobile use and for that reason the heaters of the 224 tubes are in series parallel. If the circuit is to be used on a transformer, two separate windings are necessary, one of 5 volts for the last tube and one of 2.5 volts for the rest, after the heaters have been connected in parallel.

* * *

Synchronization With Stroboscope

WOULD IT BE possible to use a stroboscope for synchronizing a television scanning disc just as a stroboscope is used for adjusting the speed of a phonograph turn table?—P. O. W.

Surely. But the stroboscope is of little aid if the scanning disc of the transmitter is driven by one power system and the stroboscope by another. There would be the same difficulty as if the receiver scanner were driven by a synchronous motor connected to a power system different from that which the transmitter scanner is connected. If the stroboscope could be illuminated by a flickering light derived from the television signal isochronism could be maintained more easily. In one system devised by Baird this is being done, but the arrangement is electro-mechanical rather than stroboscopic.

31 INFRACTING STATIONS PUT ON PROBATION

Washington.

Thirty-one stations that radio supervisors of the Department of Commerce had found infracting regulations were granted a license extension by the Federal Radio Commission, until the common expiration date of October 31st, but with the proviso that meanwhile a hearing is to be held on the charges. Renewal of the licenses for the ensuing three months would depend on the results of hearings to be conducted prior to October 31st.

The complaints are for frequency variation (wobbling), operating with excessive power, operating without a license, operating without licensed operators, failure to announce phonograph records as such, failure to announce call letters and locations, failure to operate in the public interest, but operating solely for private gain.

The thirty-one stations and the owners of record were:

WBRE, Louis G. Baltimore, Wilkes-Barre, Pa.
WCLS, WCLS, Inc., Joilet, Ill.
WCOA, City of Pensacola, Pensacola, Fla.
WDAE, Tampa Publishing Co., Tampa, Fla.
WELL, Enquirer-News Company, Battle Creek, Mich.
WEVD, Debs Memorial Radio Fund, Inc., New York, N. Y.
WGCM, Great Southern Land Company, Gulfport, Miss.
WHEC, Hickson Electric and Radio Corporation, Rochester, N. Y.
WKBO, Camith Corporation, Jersey City, N. J.
WKBQ, Standard Cahill Company, Inc., New York, N. Y.
WLTH, Voice of Brooklyn, Inc., Brooklyn, N. Y.
WMAC, Clive B. Meredith, Cazenovia, N. Y.
WMAN, The Columbus Broadcasting Company, Columbus, Ohio.
WMAY, Kingshighway Presbyterian Church, St. Louis, Mo.
WMBJ, Rev. John W. Sproul, Wilkinsburg, Pa.
WMBQ, Paul J. Gollhofer, Brooklyn, N. Y.
WODA, Richard E. O'Dea, Paterson, N. J.
WRBI, Charles A. and Milton U. Kent, doing business as Kent's Furniture & Music Store, Tifton, Ga.
WSMB, Saenger Theatres, Inc., and Maison Blanche Co., New Orleans, La.
WWRL, Long Island Broadcasting Corporation, Woodside, N. Y.
KBPS, Benson Polytechnic School, Portland, Oreg.
KFQW, KFQW, Inc., Seattle, Wash.
KFUL, Will H. Ford, Galveston, Tex.
KGAR, Tucson Motor Service Company, Tucson, Ariz.
KBBZ, Dr. George R. Miller, York, Nebr.
KGFG, Faith Tabernacle Association, Inc., Oklahoma City, Okla.
KGMP, Homer F. Bryant, trading as Bryant Radio & Electric Co., Elk City, Okla.
KMPC, R. S. Macmillan, Beverly Hills, Calif.
KTNT, Norman Baker, Muscatine, Iowa.
KTRH, Rice Hotel, Houston, Tex.
KVOA, Robert M. Riculfi, Tucson, Ariz.

Television Seen in London Theatre

London.

A demonstration something like that given by Dr. E. F. W. Alexanderson at Schenectady, N. Y., recently, when television was shown on a screen in a vaudeville theatre, was made here by the Baird Television Company on a screen 3x6 feet. The actors appeared in a studio, the images were sent by land wire to a broadcasting station, and the station's wave was picked up by a receiver at the theatre.

Heretofore the Baird system was confined to viewing television through a lens, so that one person at a time saw the reproduction, but now the system has been improved to include projection, so that many can see the images at the same time on a screen.

There was no sound track in the demonstration, which took place at the Coliseum, a vaudeville house. Alexanderson however, used sound, to constitute television talkies. Work along the same line is going forward in Great Britain.

STATE SOLVING RADIO TEACHING

Washington.

Alabama is making progress in utilizing radio for educational and civic service, according to information made available by Armstrong Perry, specialist in education by radio, United States Office of Education.

Through the Alabama State Department of Agriculture one radio receiver has been installed in every county court house of the State so that Government broadcasts may be diffused directly to the citizens of every important community center. It is believed by Governor Bibb Graves that information on the markets will be of inestimable value to the farmers, while other facts given out by the appropriate departments will render incalculable civic benefits.

In order to stimulate the use of radios in the public schools, the State pays one-third of the cost of each receiving set installed in every county high school, Mr. Perry's report discloses.

The State has been authorized to aid the schools in placing receiving sets in the rural school buildings so that the students may profit by the broadcasts planned for the future, according to "The United States Daily." A million dollar high school under construction in Montgomery, Ala., will be wired for radio, the report states.

The building program involved in the erection of nine State institutions of higher learning, including three teacher training colleges, calls for radio equipment, it was pointed out.

The State government, according to the Governor, will provide $40,000 annually for the maintenance of the radio equipment.

The program contemplated by the State, the report of Mr. Perry explains, would centralize State radio broadcasts in a State radio station located at Birmingham under the charge of three institutions of higher learning. Already remote control has been established between the University of Alabama and the radio transmitter at Birmingham, and between the department of agriculture at Montgomery and the radio station. These arrangements were made on the assumption of the procurement of a future license, Mr. Perry pointed out, but the application was refused by the Federal Radio Commission.

BAR GETS PLEA FOR A REVISION OF RADIO LAW

Washington.

The standing committee on communications has submitted a report to the American Bar Association in which the following recommendations are made:

1. Withdrawal of objections to the Couzens bill, but with the provision that such action is not to be construed as implying either approval or disapproval by the association "of any such bill or of any provision therein contained."

2. Repeal of the Davis amendment, providing for the equal distribution of radio facilities among the States and five radio zones, according to population; because it is arbitrary, and because strict compliance with it means a "deplorable waste of the very limited total of available broadcasting facilities."

3. Opposition to the Hill "yardstick plan" as a substitute for the Davis amendment, which provides that facilities be distributed 25 per cent. equally among the States and the District of Columbia, 25 per cent. according to their respective geographical areas, and 50 per cent. according to their representative population.

4. Legislation which would eliminate the "defects remaining in radio act of 1927," proposing consolidation of the divided functions of the Radio Division of the Department of Commerce and the Commission; repeal of the "zone system" under which radio commissioners are appointed from each of the five zones, and correction of procedural provisions having to do with radio litigation.

5. Repeal of section 17 of the radio act of 1927, forbidding the merger of wireless and wire companies in external communication, in the light of testimony adduced before the Senate Committee on Interstate Commerce in connection with the proposed fusion of the radio facilities of the Radio Corporation of America entering more than 30 foreign countries, and the radio, cable, telephone and telegraph facilities of the International Telephone and Telegraph Corporations.

6. Elimination of the anti-monopoly provisions, as embodied in section 13 of the radio act of 1927, as a "threat to the foreign wireless communication system of the United States. It provides that any holder of a radio license finally adjudged guilty of violation of any of the anti-trust laws shall forever be ineligible for a radio license.

7. The necessity for ratification by the United States of the convention on safety of life at sea, and of the international convention for the regulation of aerial navigation.

A THOUGHT FOR THE WEEK

A MAN never knows how well or how badly he speaks until he stands before a microphone, gives word to his thoughts and then learns the reaction of his hearers. Many a voice was born to croon unheard and waste its sweetness on the desert air far, far from the broadcasting stations. That saves us many aural agonies and leads to less sulphurous language and a happier frame of mind on the part of the listener-in. As for some of those singers of "blues"—but the weather's hot, so let's think of something else!

STATE BAN ON CAR SET CITED AS UNLAWFUL

Washington.

Outright prohibition by a State of the use of radio sets in automobiles is regarded as being of doubtful constitutionality, at the offices of counsel to the Federal Radio Commission. The administration and control of radio are vested in the Federal Government, and State governments are deemed not to have the right to interfere, particularly since the right to prohibit sets in automobiles would constitute the right to prohibit sets anywhere in the State, and thus States could prohibit the reception of all programs, and destroy broadcasting.

A Way Out

However, while outright assumption of power to prohibit the use of radio sets in or out of automobiles is questioned, it is regarded as legally practical to predicate the issue of a driving license on the non-use of radio sets in automobiles driven by the licensee.

The question whether the police powers of the State, as invoked in the banning of auto sets, can supersede the interstate commerce powers of the Federal Government has not been settled in the courts.

Instances Cited

In Massachusetts radio sets were prohibited in automobiles for a while, then only the operation of the sets while the car was in motion, and then the whole matter was put off indefinitely, so that now sets are used in automobiles. In St. Paul, Minn., a local ordinance has prohibited the use of sets in automobiles.

In New York City a taxicab company requesting permission to install sets in cabs met with denial on the ground the "city is noisy enough as it is."

3 Magazines Merged Into New 'Radio Digest'

Edward Lyman Bill, Inc., a publishing organization, announces the formation of the Radio Digest Publishing Corporation, which has purchased "Radio Digest," "Radio Revue" and "Radio Broadcast." Effective with the September issue these three magazines will be merged and published under the name "Radio Digest," as "a national magazine serving the American radio public."

Mr. Bill will be president and publisher of the new corporation. J. B. Spillane and Randolph Brown will be vice-presidents. The executive editorial staff will consist of Raymond Bill, editor; Henry J. Wright, formerly of the N. Y. "Sun" and the N. Y. "Globe," advisory editor; Charles R. Tighe and Harold P. Brown, the latter editor of "Radio Digest" under its prior ownership, associate editors.

Headquarters of the former "Radio Digest" were in Chicago, but the new magazine will have its publishing office in New York City.

The price and frequency of publication of the magazine were not announced. Mention of the "September issue" indicated that it would be a monthly. "Radio Digest," in its previous form, was a quarterly, at 35 cents a copy.

"Radio Broadcast," formerly a set-builders' magazine, became a trade engineering monthly until its recent cessation of publication.

50 kw. Fever Spreads to Cuba

Cuba is planning the erection of a 50,000 watt station so that programs can be heard in the United States and also in Central and South America. The object is to create greater interest in tourist trade to Cuba, to increase the radio parts, sets and accessory business on the island and give Cuba even better programs than it has been enjoying locally.

The station would be located at Havana, would cost $250,000 to install and $140,000 a year to operate, and is backed by the Cuban telephone interests, a large American broadcasting company and the Cuban Tourist Commission.

STATIONS MUST TELL FINANCES

Washington.

A questionnaire has been sent by the Federal Radio Commission to all the broadcasting stations asking financial reports. This action followed inquiries made by a Senate committee regarding the financial status of broadcasting, to which inquiries the Commission could give only incomplete reply.

The financial situation of many stations has been improving. At first broadcasting was a heavy drain on the station's treasury, but the growth of the sponsored program has made it possible for many stations to begin to show a profit. In fact, for the first time the Commission recently put a station on probation, on the charge that it was operated exclusively for profit.

The authority for the questionnaire is the radio act of 1927. The Federal Radio Commission has power to inquire into the financial status of stations, in the same manner as does the Interstate Commerce Commission in regard to railroads and other common carriers.

After the broadcasting field has been covered the Commission plans to send questionnaires to stations engaged in sending and receiving messages for hire, and experimental licensees, including television transmitting stations.

The 600 broadcasting stations must have their filled-in questionnaires in the Commission's hands by August 20th.

Stations are required to reveal how much they pay for salaries of officers, wages for employees, fees for artists, talent, rent, insurance and "overhead." Under "income" must be shown amounts obtained from sale of time on the air, sale of apparatus, investments, etc. All assets and liabilities must be listed.

California Farmers Plead for Air Freedom

Los Angeles

Eugene O. Sykes, Federal Radio Commissioner, held a hearing here on the petition of the State of California to retain short-wave channels used for disseminating produce market news. The Commission had intended to refuse to renew the licenses. California is the only State using this type of service.

The California Department of Agriculture, backed up by the farmers, pleaded for the retention of the channels. An announcement by the Department of Agriculture began with the assertion: "The American farmers' campaign for freedom of the air was begun here to-day."

110 VOLUNTEERS SILENCE STORE LOUDSPEAKERS

The active enforcement of an anti-noise ordinance that went into effect May 30th as part of the Sanitary Code, was begun recently in New York City, with radio and music store owners as the first objectives. The Noise Abatement Commission, formed under the law, obtained 110 volunteer unpaid investigators, largely from the ranks of those who had written to the Commission complaining about noise-producing radio speakers outside the stores.

Quick action resulted from these efforts. Investigators, possessing no authority, were not to enter any store, but were to report to the nearest police station any infraction of the ordinance, which forbids loud playing of a store speaker outdoors. The police lieutenant in charge would send a uniformed policeman around to the store, and no difficulty was experienced in obtaining compliance.

Loudest Radio Row Is Subdued

One of the noisiest sections, that in and around Cortlandt and Greenwich streets, known as Radio Row, quieted down without any fuss. Until recently, by common agreement, dealers would tune their sets to the same station, so that the environs were free from competing strains, but a few months ago the agreement broke down, and after that it was a case of every man for himself, until the ordinance was enacted, or at least until the unofficial inspectors got busy.

Edward F. Brown, director of the Commission, said:

"Most of the offending stores were in residential neighborhoods. We found no violations along the main arteries. The complaints were turned over to the police as soon as reported to us. A check-up later revealed that every dealer complained against had silenced his outdoor loudspeaker.

Wants 100% Compliance

"Our investigation leads us to believe that of the 3,009 radio stores in the city all but 15 per cent. have been obeying the law. We expect to have 100 per cent. compliance."

Mr. Brown said that of 11,000 complaints in six months about noisy conditions 13 per cent. concerned store radio loudspeakers.

RCA-Victor Adds 7,000 Employes

The RCA Victor Corporation recently put on 7,000 additional employes, about 65 per cent. of them on piecework, at its Camden, N. J., plant. Soon the total number of employes at the plant is expected to reach 20,000, the goal being the production of 9,000 radio sets a day. The employes enjoy a five-day, forty-hour week.

E. E. Shumaker, president of the company, said:

"If the pessimists will go back to work and realize that there is nothing fundamentally wrong with this country everybody would be better off. We are proceeding on the basis that people will spend more money, and we are going to continue on that basis until we are convinced that we are wrong."

THUNDER ARC IN AERIAL USED FOR DETECTION

Schenectady, N. Y.

Musical thunder, accompanied by a vivid electrical display, has been encountered by radio engineers of the General Electric Company in their investigations near Schenectady, of high-powered, short-wave broadcasting.

In these miniature artificial thunder storms, which occur during any kind of weather, daylight or darkness, clear or overcast skies, the thunder is converted into music which corresponds to the input at the radio microphone.

WGY engineers have solved the problem of handling 200 kilowatts of modulated power on long waves, but new difficulties are presented in the use of powers above 15 kilowatts on the short waves.

Coronas Flashed

In these mhiniature artificial thunder the antenna no unusual phenomena have been observed, but when it was first attempted to increase the power to 35 kilowatts in the antenna vivid coronas flashed. wavering like ghostly spectres in mid-air. This corona demonstration didn't appear as long as the carrier alone was on, but as soon as the engineers attempted to modulate, the arc was struck in the surrounding air.

This arc generally started about three or four feet from the antenna and shot upward four feet in the air.

Since the power supplying the arc was modulated with music, the arc alternately collapsed and built up in size corresponding to the modulation. This action set up air wave vibrations similar to thunder, but instead of the roar and roll of thunder it was a musical sound similar to the music being broadcast.

Thought They Heard Loudspeaker

Men working 300 or 400 feet away thought they were hearing the output of a giant loudspeaker. If the arc were allowed to continue it moved out toward the end of the antenna, due to the movement of the hot gases, arced across the insulators, cracking them open and finally the intense heat melted the copper and caused the antenna to drop.

The trouble was solved in two ways. Antenna wire of larger diameter was adopted and a large corona plate or half sphere was placed at each end of the antenna. These measures reduced the voltage gradient at the wire surface due to the increased radius of curvature of conducting surface. It is now possible to get 35 kilowatts of power, modulated 100 per cent. in the antenna without wasteful and destructive coronas.

Amos 'n' Andy's Music Identified

The musical piece used by Amos 'n' Andy, for opening and closing their famous nightly sketch, is presumed by some to have been composed especially for the team, and by others to be of undetermined ancient origin, while a few know it to be in fact "The Perfect Song," composed by Joseph Carl Briel.

It was part of the music accompaniment of the motion picture, "The Birth of a Nation," but had been well known among musicians for years prior to that.

Forum

Wants to Pay More for More

QUITE often during the past few months I have noticed in Forum that some of your readers would like to see all the technical articles excluded from your magazine, or at least everything that might be of any interest to a professional set-builder or a service man.

Anybody who ever gave a serious thought to his experiments realizes that no successful experimenting is possible without sufficient fundamental technical knowledge, and there are enough fiction magazines and newspapers of all kinds already published for those who would care for them.

Since "Radio" became a strictly trade magazine last Fall and since "Radio Broadcast" has suspended and changed hands, we have hardly a technical publication on radio left.

Really, I do not expect you to exclude anything of interest even to a novice, but I would like to see many more additional and more detailed technical articles on latest developments in radio with all the necessary mathematics and formulas, in your magazine, even if it would mean an increased price up to 25—even 35 cents per copy.

Beyond doubt, anybody to whom your magazine has been really of any value would not object to spending a few extra pennies weekly on something worth while.

What I really do object to is Forum as long as it serves present purposes of bringing up arguments of this kind.

Also I consider that ten pages of news against nine pages for technical articles, as for instance in your issue of June 28th, is not a good balance.

It would be of great help to include a table of contents, so that in referring to a certain article one would not have to go through the whole copy, or even through a series of copies.

I believe that all those arguments about excluding the technical section either entirely, or part of it, or of extending the news section, could be settled by distributing among your readers some kind of questionnaire just to find out what kind of publication they really do want.

Although not a regular subscriber, I have not missed a copy of your magazine during the past year and a half, and hardly will as long as it remains a technical publication.

BARTON WORSHIP,
Miami, Fla.

* * *

Not Interested

WHAT has happened to RADIO WORLD? It used to be a real radio periodical, but has lately degenerated into a radio newspaper. As such it has lost its compelling interest to the home set builder almost entirely. What is the matter with our tried and true circuit builders, Herman Bernard and J. E. Anderson, not to mention many others who have furnished interesting circuits for us in the past few years?

As a radio newspaper it might interest a few broadcasters and trades people but certainly not the home set builder such as myself.

Thanking you for many pleasant set building hours in the past and awaiting your return to that policy, I am

W. W. GOODWIN,

* * *

Suspects "Catch" in Many Grounds

YOU have printed two news stories about a man using a lot of grounds. Where is the catch? I have tried twelve and I can see very little difference, if any. I am wondering if you cannot get something more on this system.

W. C. COOMBS.
Indianapolis, Ind.

FOUR STATIONS GET LICENSES; 19 MORE APPLY

Washington.

The following stations have been granted a license to operate:

1070 KC

WDZ, James L. Bush, Tuscola, Ill. .....100 watts

1200 KC

KXO, E. R. Irey and F. M. Bowles, El Centro, Col.....100 watts

1210 KC

WALR, Roy W. Waller, Zanesville, Ohio .....100 watts

1500 KC

WRDW, Warren C. Davenport, Augusta, Ga. .....100 watts

Applications for constructional permits for new stations were received by the Federal Radio Commission as follows:

570 KC

Radio Service Co., Russellville, Ala. .....10 watts

590 KC

Metropolitan Broadcasting Co., Paterson, N. J..... 50 watts

600 KC

George William Sullivan, Hardin, Montana ..... 10 watts
Crawford Avenue. (Sundays only.)

880 KC

State Journal Co., Lansing, Mich.100 watts

1120 KC

Ber-Bailey Broadcasting Co., Rayne, La. .....5 k.w.
Starr Piano Co., Richmond, Ind..500 watts
J. C. Liner, Monroe, La. ..... 50 watts

1210 KC

Denman Music Store, Paris, Tex.100 watts
Edwin W. Kruse, New Castle, Pa. 50 watts

1220 KC

Lake Placid Broadcasting Co., Lake Placid, N. Y.....500 watts
Key Broadcasting Co., Sterling, Col. .....150 watts

1240 KC

Lester J. Barry, Newark, Ohio.. 50 watts

1310 KC

Martin C. Newman, Sturgis, Mich. .....100 watts

1370 KC

Central Illinois Broadcasting Co., Browning, Ill. ..... 15 watts
Neal Parker and Herbert Metcalf, Glens Falls, N. Y..... 50 watts
Shaap, C. M., Fort Collins, Col... 15 watts

1380 KC

Radio Advertising Co., Pittsburgh, Pa. .....500 watts

1420 KC

Pace's Radio Service, Vicksburg, Miss. ..... 10 watts
(Daily except Sunday)

1430 KC

H. L. Spencer, North Platte, Neb.500 watts

NATIONAL RADIO WEEK

The radio industry will be the official hosts of the entire nation during the week of September 22d to 28th. That is the time set for National Radio Week, which has been indorsed by the National Federation of Radio Associations and will be observed by the local trade associations in every part of the country.

DEJUR-AMSCO MOVES

DeJur-Amsco Corp., formerly located at Broome and Lafayette Streets, New York City, has moved to new quarters at Morton and Washington Streets.

WJZ REQUESTS 50,000 WATTS

Washington.

WJZ, owned by the Radio Corporation of America, and operated by the National Broadcasting Company as a key station, has applied to the Federal Radio Commission for a license to install 50,000-watt transmitting equipment. The station at present uses 30,000 watts.

A station representative said there was no present intention of actually increasing the wattage, but that the higher rating was requested so that the best available apparatus could be installed, and the way opened to the use of 50,000 watts should this ever become advisable.

The main desire of the station, it was said, was to improve its transmitter, so that even better quality output could be assured than has been enjoyed to date.

WEAF, the other NBC key station, is installing new 50,000-watt equipment. There has been a delay in finishing the work, because it is done without interruption of broadcasting service from WEAF, which has been a 50,000-watt station right along.

The application by WJZ brings the total of stations using or petitioning for 50,000 watts to thirty-nine. Nine stations are now on the air with 50,000 watts, six stations hold construction permits to use that power, but are awaiting licenses, while twenty-four stations have filed applications, on which no action will be taken until the Fall.

The 50,000-watt operation is on the basis of 25,000 watts granted outright and 25,000 watts experimentally, so that at any time the Commission could restrict the station to 25,000 watts.

Burglar Gets Kit of Parts Piecemeal

White Plains, N. Y.

An absent-minded burglar intent on building a radio set broke into the Thrift Shop on Church Street. He helped himself to all the parts he thought he needed, after ransacking the radio department. However, he forgot some that were vital to the success of the receiver, so he paid a second visit to the place the next night, entering through a rear window, as formerly.

The proprietor of the store thought that the visits were over, but he was wrong. As a final cleanup, and to bring the list of parts up to the circuit requirements, on the fourth night the burglar paid his third and final visit. He then helped himself to a few parts only.

Engineer of Board Inspects Police Radio

Washington.

The growth of police radio, for the solution of crimes and capture of offenders, has necessitated that the Federal Radio Commission obtain first-hand information, and to that end Lieut. E. K. Jett, acting chief of the commercial communications section of the Commission's engineering division, is making a tour of stations in the Great Lakes section.

While he will observe actual conditions in many commercial stations in the area, he will pay particular attention to police radio. His trip will last a month.

De Forest Moving Lab to Hollywood

Dr. Lee DeForest, president of the Institute of Radio Engineers, who has been living in New Jersey, soon will move to Hollywood, Calif., where he will experiment with television, ultra short-wave transmission and reception, and talking pictures.

The motion picture industry is worried over the prospect of television upsetting the great film establishments and ruining theatres, particularly as entertainment of the same type now given in theatres could be enjoyed in the home as soon as television with sound track is developed commercially.

The tube that Dr. DeForest, inventor of the three-element vacuum tube, intends to use in his ultra short-wave work, at 1 meter and lower wavelengths, has a filament and two plates. He points out this type of tube is more suitable for such low waves, because of the low grid-to-plate capacity.

In Palo Alto, Calif., in 1907, DeForest discovered that he could make his three-element tube oscillate. This faculty of oscillation makes broadcasting possible.

POWER OF TWO STATIONS CUT

Washington.

A 30-day extension of the existing license held by the airplane "City of New York," owned by John H. Mears, for a round-the-world flight, was granted.

Cancellation of the permit granted to Station WTAX of Streator, Ill., to transfer its location to Springfield, Ill., is requested in a petition filed by WCBS, of Springfield, Ill.

The petitioner claims that WTAX is a "stock selling proposition" and that the application for the transfer contains many misstatements.

Reduction by one-half of the licensed broadcasting power of two broadcasting stations was ordered without prior hearing, because the actual capacities of the transmitters of the two stations do not equal the previously licensed output.

The stations are KMO, Seattle, Wash., and WRAW, Reading, Pa. KMO was licensed for 500 watts during evening hour, and 1,000 watts during daytime. But in the new license the rating is 500 watts daytime power.

WRAW is now licensed for 100 watts, but its power has been curtailed for the next three months to 50 watts.

WRAW now has pending before the Court of Appeals of the District of Columbia an appeal from the decision of the Commission denying it authority to install a new transmitter, to operate on unlimited time with a power of 500 watts, and to share time with station WGAL, Lancaster, Pa.

Renewal of the television license of station W9XAD, at Chicago, operated by the Western Television Corporation, was granted.

This station's experimental work was recently commended by officials of the radio division of the Department of Commerce.

A Safety Measure

When you complete an electric set assembly, it is a good plan to include either a 25 watt lamp or an equivalent current carrying capacity fuse inserted in the B-leg of the 280 tube.

WABC and WHK SYNCHRONIZE IN MORNING TESTS

Washington.

Authorization has been given by the Federal Radio Commission to WABC, key station of the Columbia Broadcasting System, located in New York City, and WHK, Cleveland, to operate simultaneously on WABC's frequency, 860 ks. (349 meters) between midnight and 6 a. m., Eastern Standard time, as a synchronization test.

WABC uses 5,000 watts, while WHK uses 1,000 watts. Normally WHK operates on 1,390 kc (215.7 meters).

Can Maintain Constancy

Recent advances in synchronization methods have resulted in success in other experiments along the same line. The constancy of the frequency is maintained at plus or minus 25 cycles, by two specially ground quartz crystals.

Two stations about 190 miles apart, owned by the same company, have been synchronized for several weeks. They are WOC, Davenport, Ia., and WHT, Des Moines, Ia. Their result has been one of the most successful of all synchronization efforts, due to the extreme accuracy of the constants and circuits used. These were developed by the Bell Telephone Laboratories.

Other Method Fairly Successful

WGY, Schenectady, N. Y., and KGO, Oakland, Calif., have been synchronized for a much longer time, but used a different method. The whole width of the Continent separates them. The experiment has been fairly successful.

Synchronization, when successful, reduces interference by enabling frequency separation between stations.

Seize 3 Bootleg Transmitters, 7 Men

Raids by Federal agents on five houses at Quogue, Southampton, Hampton Bays and at Mattituck, all in Suffolk County, Long Island, N. Y., yielded three wireless transmitting stations and seven defendants. The wireless equipment, valued at $20,000 was taken to the sub-treasury building in New York and placed under guard. The defendants were taken before United States Commissioner Nichols Pette in Brooklyn and were held in $7,500 bail each, some on charges of conspiracy to violate the prohibition laws and others on charges of violation of the Federal radio act of 1927.

The raids were the result of a six-months' hunt to locate the unlicensed transmitters.

The seizure of the wireless plants gives a possible clue to the source of the false SOS call which caused Coast Guard vessels along the Long Island shore to leave their posts and rush to the assistance of the yacht Florida, supposed to be in distress, with Mayor Walker of New York and a fishing party on board.

LITERATURE WANTED

J. J. McDermott, 224 Salem Ave., Dayton, Ohio.
J. A. Gendry, Good Hope, La.
Jas. A. Booth, 1827 Pacific, Bakersfield, Calif.
C. D. McCary, 2616 Bomar Ave., Dallas, Texas.
Joseph Peters, 17134 Welland, Detroit, Mich.
G. S. Gourley, 918 Cabell St., Lynchburg, Va.
Wm. Smith, 517 Cook St., Denver, Colo.
E. R. Klonfer, R. No. 2, Snohomish, Wash.
N. B. Priest, Box 104, Everglades, Fla.

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COLOSSAL BARGAIN—A 4-tube AC 105-120 Volt, 50-60 cycle, custom made receiver, in table model cabinet, with Mayolian B eliminator, A battery, Westingbouse trickle charger, C bias batteries, Relay switch, 5 tubes (includes Raytheon rectifier). One dial finger tuning, 171 output. Operates dynamic. Humless, sturdy performer. Can be heard by appointment. Will install free in residence if in or around New York City. A. Bashein, 1116-56 Street, Brooklyn, N. Y.

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Address Tommie Malie, RW4215 North Ave., Chicago.

CUSTOM-BUILT SETS: Loftin-White Amplifier $30. MB29 $55. S-M 712 Tuner $55. All makes. Complete list free. J. T. Boyer, Jr., 853 Piedmont Ave., Winston-Salem, N. C.

BARGAINS in first-class, highest grade merchandise. B-B-L phonograph pick-up, theatre type, suitable for home, with vol. control. $6.57; phono-link pick-up with vol. control and adapter, $3.50; steel cabinet for HB Compact, $3.00; four-gang .00035 mfd. with trimmers built in, $1.95; .00025 mfd. Dubilier grid condenser with clips, 18c. P. Cohen, Room 1214, at 143 West 45th Street, N. Y. City

BOOKS FREE!

"AUDIO POWER AMPLIFIERS"

by J. E. Anderson and Herman Bernard, begins with an elementary exposition of the historical development and circuit constitution of audio amplifiers and sources of powering them and proceeds to an exposition of circuit laws, including Ohm's laws and Kirchhoff's laws. The determination of resistance values to produce required voltages is carefully expounded. All types of power amplifiers are used as examples: AC, DC, battery operated and composite. But the book treats of AC power amplifiers most generously, due to the superior importance of such power amplifiers commercially. Full technical data on tubes, 193 pages..(APAM)

"FOOTHOLD ON RADIO"

In English that any one can understand, the technical side of radio is presented by Anderson and Bernard. It is intended for the sheer novice. The treatment is non-mathematical. The origin of the broadcast wave, its radiation, reception, amplification and rectification are set forth in clear language. Published June, 1930; 59 pages.....(FOR)

"THE SUPERHETERODYNE"

This is a volume by Anderson and Bernard, published July, 1930, dealing with the principles and practice of the Superheterodyne method of receiving. It explains the function of the oscillator, the modulator, the pre-modulator selector, and the intermediate frequency amplifier. It explains the cause of repeat points and gives methods for avoiding them or minmizing their effect. It expounds the relative advantages and disadvantages of high and low intermediate frequencies, and shows the effect of selectivity on the quality. Constructional circuits included, 112 pages .....(ABSH)

115 LATEST COMMERCIAL SET DIAGRAMS

Compiled by John F. Rider. Contains, each on separate 9 x 12" sheet, schematics of Audiolas 30B and 330; Balkite F; Crosley 41A, 42 A.C., 609, 600 A.C., 20, 21, 22, 31S, 30S, 33S, 804 A.C., 40S, 41S, 42S, 82S, 60S, 61S, 62S; Sonora 7P, A30, A32, B31, A30, A40, A44; Kennedy 80, 10, 20; Stewart-Warner 900 A.C., 950 battery, 950 A.C., 950 D.C., Model B; Radiola 44, 47, 66; Majestic 90, 9P6 power unit, 9P3 power unit; Stromberg-Carlson 641, 642, 846; Edison R1, R2, C2 (50 and 25 cycles), R5 and C4, C1; American Boscr 54 D.C.; Victor R32 and RE45; Grebe SK4 A.C. (early model), SK4 A.C. (late model), SK4 D.C., 428; Traveler A.C. power pack; Eria 224 A.C. screen grid; Silver-Marshall 30B, 30C, 30D, 30E; Eveready 1, 2 and 3, Series 30, Series 40, Series 50; Steinite 40, 50 and 102, 50 power unit; All American Mohawk 96 (60 cycle), 90 (25 cycle), 90 (60 cycle), 70, 73 and 75; Gulbranson Model C (early model), Model C (late model); Bremer-Tully 7-70 and 7-71, 81, 82; Earl 21, 22, 31, 32, 41, 42; Philco 65, 76, 87, 95 screen grid; Peerless Electrostatic series, screen grid; Fada 20, 20Z, 22 battery, 25, 252, 25, 25Z, M250, M250Z, Electric units, 35, 35Z, 75, 77; Brunswick 5 NC8 Radio Chassis Schematic, NC8 Audio Chassis Schematic, NC8 and 3 NC8, Audio Chassis Schematic, 5 NC8 cabinet wiring, 3 NC8 Radio Chassis Schematic, 3 NC8 cabinet wiring, S14, S21, S31, S81, S82 screen grid Radio Chassis Schematic, S14, S21, S31, S81, S82 screen grid Radio Chassis Actual, S14, S21, S31, S82 Audio Chassis Schematic (25 cycle), S14, S21, S81, S82 Audio Chassis Schematic (60 cycle), S14, S21, S81, S82 Audio Chassis Actual (25 cycle), S14, S21, S81, S82 Audio Chassis Actual (60 cycle), S31, Audio Chassis Schematic (60 cycle) S31, Audio Chassis Actual (60 cycle), 3 KR8 cabinet wiring, 3 KR8 Radio Chassis, 3 KR8 Audio Chassis Schematic, 3 KR8 Audio Chassis Actual, 5 NO Radio Chassis Schematic, 5 NO Socket Power Schematic, 5 NO Socket Power Actual, 3 KRO and 3 KR6 Radio Chassis, 3 KRO and 3KR6 Socket Power, 5KR, 5KRO, 2KRO Socket Power, 5KR, 5KRO, 3KRO, 2KRO, 5KR6 Socket Power, 5KR, 5KRO, 2KRO, 5KR6 Radio Chassis; Amrad Bel-Canto series; Spartan 89, 89A, 49, ensemble, 931, 301 D.C., 931 A.C., 110 A.C., 301 A.C.....(SUPP. NO. 1)

OTHER BOOKS

"Radio Receiving Tubes," by Moyer & Wostrel..(MWT)
"Practical Radio," by Moyer & Wostrel.....(MWPR)
"Practical Radio Construction and Repairing," by Moyer & Wostrel (new edition).....(MWPRC)
"Principles of Radio Communication," by Prof. Morecroft .....(M-PRIN)
"Elements of Radio Communication," by Prof. Morecroft .....(M-ELEM)
"Radio Manual," by G E. Sterling, U. S. Go't...(MAN)
"A B C of Television," by R. F. Yates.....(TEL)
"Drake's Encyclopedia," new edition.....(DRA)
"Experimental Radio," by Prof. Ramsay.....(REX)
"Fundamentals of Radio," by Prof. Ramsay.....(RFM)
"Principles of Radio," by Keith Henney.....(PRK)
"Trouble Shooter's Manual," J. F. Rider.....(TSM)
"Mathematics of Radio," by J. F. Rider.....(MOR)
"Testing Units," by Rider.....(TTU)

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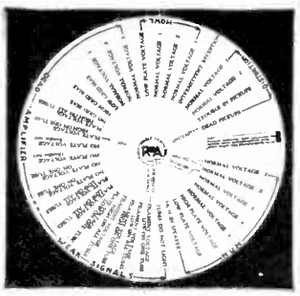

Here is an 8" diameter dial that you slide around to shoot trouble in an audio circuit or B supply or power amplifier. Trouble is divided into five groups: distortion, howl, dead amplifier, weak signals and hum. By sliding the dial to one of fifty different positions the cause of the trouble is read in the slotted opening. Invented by John F. Rider. Send 50 cents for four weeks subscription for Radio World and get a Trouble-Finding Dial free with instructions on back. If extending an existing subscription please so state.

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☐ 224 AC screen grid $1.43
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Works on 110-120 volts, AC or DC; power, 50 watts. A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for Radio World and get these free! Please state if you are renewing existing subscription.

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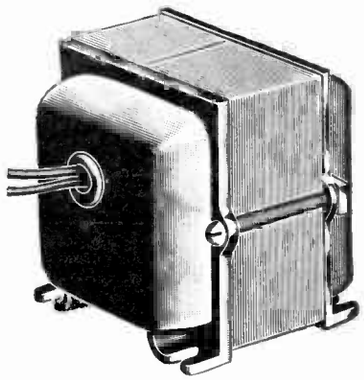
New Polo Power Transformers and Chokes

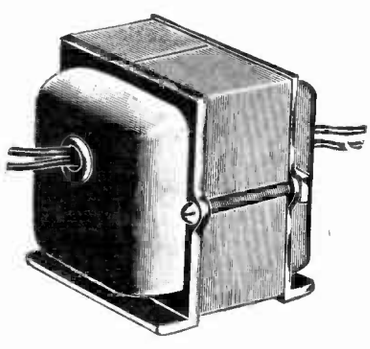


Shielded single choke, 200 ohms D.C. resistance, non-saturable at 100 milliamperes, with two black outleads, each 6 inches long. For filtration of B supplies. Inductance, 30 henrys.
Cat. SH-S-CH, price.....$5.00

The shielded single choke will pass 100 ma. One will suffice if the current is 100 ma. or less, for filtration of B supplies, provided the capacity at the filter output is 8 mfd. or more. Use two such shielded chokes if less than 8 mfd. is used at the filter output. Also, the shielded single choke may be used as in the power tube circuit for an output filter. In this connection use at least 2 mfd. for the capacity section of the filtered speaker output. Order Cat. SH-S-CH @.....$5.00

The shielded double choke may be used for filtration where the B current is 60 ma. or less, with relatively small filter capacities, no less than 4 mfd. at the output, however. This choke consists of one winding, center-tapped. Its use is especially recommended for 171, 171A, 245 or 210 push-pull output. Connect the black leads (extremes of windings) to plates of the push-pull tubes, **red center tap to B plus, and the speaker may be connected directly to plates without any direct current, but only signal current, flowing through the speaker.** This system is applicable only to push-pull. Order Cat. SH-D-CH @.....$6.00

In the same type of case a 20-volt secondary filament transformer, for 110 volts, 50-133 cycle, may be obtained for use in conjunction with dry rectifiers, such as Kuprox, Westinghouse, Benwood-Linze and Elkon, in dynamic speakers or A battery eliminators. Not made for 25 or 40 cycles. Order Cat. SH-F-20 @.....$2.50



Twenty-volt filament transformer, 110 v. 50-133 cycle input, for use in conjunction with dry rectifiers. It will pass 2.25 amperes.

In a different type case, square, of cadmium plated steel with four mounting screws built in, size 4½ inches wide by 3¾ inches high by 4 inches front to back, a 50-60 cycle filament transformer is obtainable with the same windings as the 245 power transformer, except that the high voltage secondary is omitted. Order Cat. 245-FIL, @.....$4.50
For 40 cycles order Cat. 245-FIL-40 @..... 7.00
For 25 cycles order Cat. 245-FIL-25 @.....8.50
[Any of the above three in the same case as the 245 power transformer, @ $1.00 extra. Add PTC after the Cat. number.]

A single choke, unshielded, 65 ma rating, 30 henrys inductance, for B filtration or single output filter of speaker, is our Cat. US-S-CH @.....$1.25

Polo Engineering Laboratories, 143 West 45th St., New York, N. Y.

Enclosed please find $_____ for which ship at once:

☐ Cat. 245-PT @...$8.50	☐ Cat. 245-FIL @..$4.50
☐ Cat. 245-PT-40 @ 9.50	☐ Cat. 245-FIL-40 @ 7.00
☐ Cat. 245-PT-25 @ 12.00	☐ Cat. 245-FIL-25 @ 8.50
☐ Cat. SH-S-CH @ 5.00	☐ Cat. SH-F-20 @. 2.50
☐ Cat. SH-D-CH- @ 6.00	☐ Cat. UN-S-CH @. 1.25
☐ F-2.5-D @ 3.75	

Note: Canadian remittance must be by post office or express money order.

☐ If C.O.D. shipment is desired, put cross here. No C.O.D. on 25 and 40 cycle apparatus. For these full remittance must accompany order. The 25 and 40 cycle apparatus bears the 50-60-cycle label, but you will get actually what you order.

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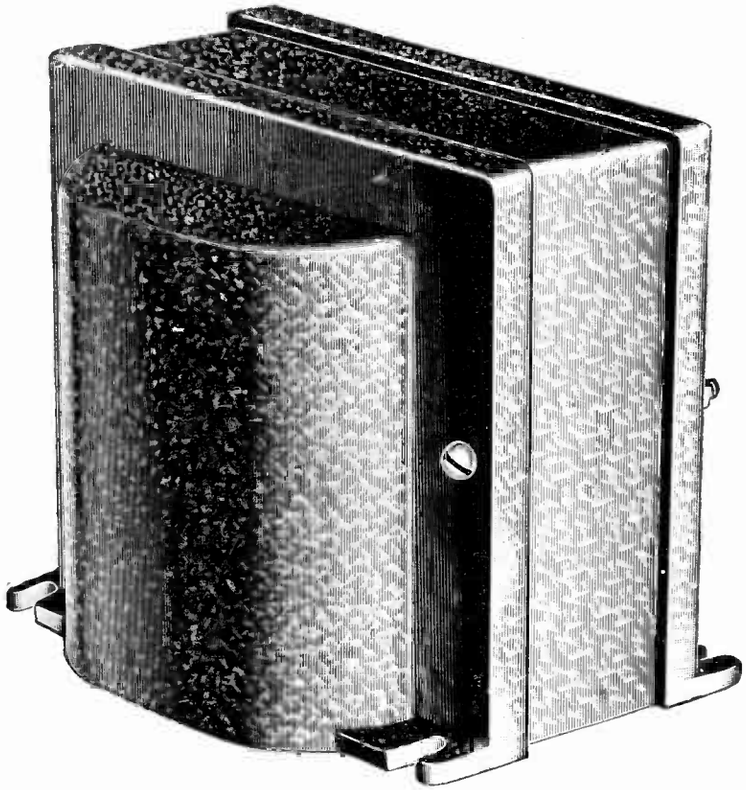
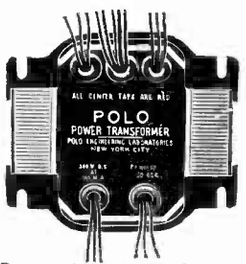


245 Power Transformer for use with 280 rectifier, to deliver 300 volts D.C. at 100 milliamperes, slightly higher voltage at lower drain, and supply filament voltages.
Cat. 245-PT price $8.50

The Polo 245 power transformer is expertly designed and constructed wire silicon grade A steel core and air gap large enough to stand the full rated load. The primary is for 110v A.C., 50-60 cycles, tapped for 82.5 volts in case a voltage regulator, such as a Clarostat or Amperite, is used. The black primary lead is common. If no voltage regulator is used, connect black lead to one side of the A.C. line, green lead to the other side of the line, and ignore red lead, except to tape the end For use with a voltage regulator (82.5-volt primary) use red lead and ignore the green except to tape the end. The secondaries are: high voltage for 280 plates, with red center tap to ground; 2.5 volts, 3 amperes, red center tap to C plus, for 245 output, single or pushpull; 5 volts, 2 amperes, red center tap, as positive B lead, for filament of 280 tube; 2.5 volts, 16 amperes, red center tap to ground, for 224, 227 and pentode tubes, up to nine heater type tubes. Hence there are five windings.



Bottom view of the 245 power transformer. All leads are plainly marked on the nameplate, including the top row.

A special filament transformer, 110 v., 50-60 cycles, with two secondaries, one of 2.5 v. 3 amp. for 245s, single or push-pull, other 2.5 v. 12 amperes for 224, 227, etc., both secondaries center-tapped. Shielded case. 6 ft. AC cable, with plug. Order Cat. F-2.5-D @.....$3.75

The conservative rating of the Polo 245 power transformer insures superb results even at maximum rated draw, working up to twelve tubes, including rectifier, without saturation, or overheating due to any other cause. This ability to stand the gaff requires adequate size wire, core and air gap, all of which are carefully provided. At less than maximum draw the voltages will be slightly greater, including the filament voltages, hence the 16 ampere winding will give 2.25 volts at maximum draw, which is an entirely satisfactory operating voltage, increasing to 2.5 volts maximum as fewer than a total of nine RF, detector and preliminary audio tubes are used.

The avoidance of excessive heat aids in the efficient operation of the transformer and **in the maintenance of good** regulation, for excessive heat increases the resistance of the windings.

The transformer is equipped with four slotted mounting feet and a nameplate with all leads identified. **It is one of the** very finest instruments on the radio market.

Highest Capacity of Filament Secondary

SPECIAL pains were taken in the design and manufacture of the Polo 245 power transformer to meet the needs of experimenters. For instance, excellent regulation was provided, to effect minimum change of voltage with given change in current used. Also, the 2.5 volt winding for RF, detector and preliminary audio tubes, was specially designed for high current, to stand 16 amperes, the highest capacity of any 245 power transformer on the market. Hence you have the option of using nine heater type tubes. **The shielded case is crinkle brown finished steel, and the assembly is perfectly tight, preventing mechanical** vibration.

The power transformer weighs 11½ lbs., is 7 inches high, 4⅞ inches wide, and 4¼" front to back, overall.

Elevating washers may be used at the mounting feet to clear the outleads, or holes may be drilled in a chassis to pass these leads, and the transformer mounted flush.

Advice in Use of Chokes and Condensers in Filter

With the 245 power transformer either one or two single chokes should be used, or a shielded double choke, depending on the current drain and the capacity of filter condenser used. Where the capacity **at the output is 8 mfd. or more for a drain of 65 to 100 ma., a single choke will suffice (Cat. SH-S-CH),** but where smaller output capacity than 8 mfd. is used on such drain, two such chokes should be used in series. Next to the rectifier, in either instance, use a 1 or 2 mfd., 550 A.C. working voltage rating condenser (D.C. rating, 1,000 volts). You may use your choice of capacity at the midsection.

If the drain is to be 65 milliamperes or less, the double choke, Cat. SH-D-CH, may be used for filtration, instead of two single shielded chokes.

The Polo 245 power transformer may be obtained for 25 cycles or 40 cycles on special order, as these are not stocked regularly, and remittance must accompany order. The same guaranty attaches to them as to all other Polo apparatus—money back if not satisfied after trial of five days. In these the primary and secondary voltages and taps are the same, only the case is deeper (front to back) because of larger core and wire for lower frequency.
For 40 cycles order Cat. 245-PT-40.....@ $9.50
For 25 cycles order Cat. 245-PT-25.....@ $12.50
[Note: The filter for 40 cycles should consist of two shielded single chokes, Cat. SH-S-CH, with 2 mfd. next to the rectifier and 4 mfd. minimum at the joint of the two chokes and at the end of the filter. For 25 cycles the same holds true, except that the output capacity at end of chokes should be 8 mfd. minimum.]

We Make Special Transformers to Order