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RADIO WORLD

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413th Consecutive Issue—EIGHTH YEAR

Seven Full Pages on Pentode!

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T-E-M-P-L-E F-A-R-R-A-N-D

Temple AC Dynamic Model 10, in a beautiful cabinet. The speaker chassis is one of the finest made. There are an output transformer and dry rectifier built in. The cabinet has decorated walnut front and back, with carved grille ornament. An AC switch is accessible underneath cabinet. Rear is removable for adjustment of resistor knob to match the impedance of your receiver's output tube. Connect plugged AC cable to 110 volts AC, 50 to 60 cycles, and connect tipped cords to speaker post of receiver. This remarkable speaker **Cat. TEM-10 at only** .....

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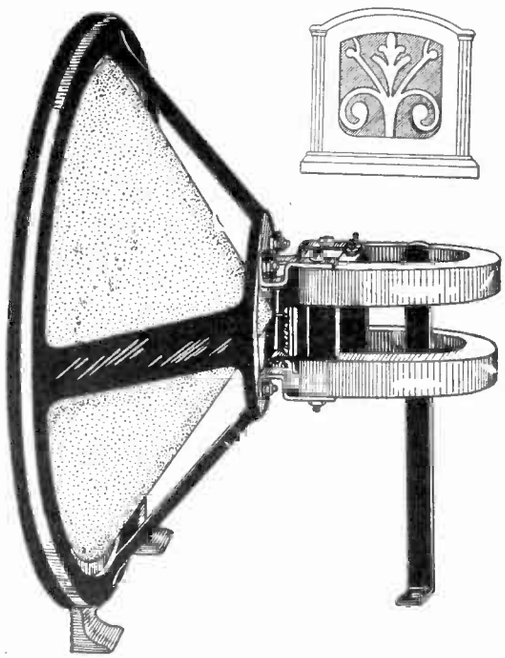


Farrand Inductor Chassis, consisting of the unit, cone, spider, bracket, assembled, but not in a cabinet.

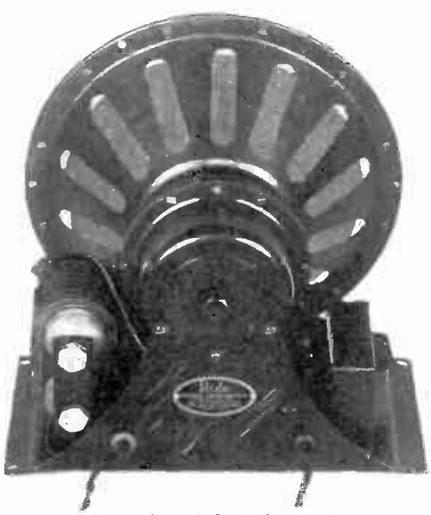
Model 6-G, 10" extreme diameter of cone front rim **$8.00**

Model 10-G, 12" extreme diameter of cone front rim **$10.00**

Model 10-G-PP for connection to push-pull, requiring no output device, because unit is constructed as a center tapped output impedance. Center tap is yellow and goes to B+. Tipped cords go direct to plates. Outside diameter 12" **$11.00**

Brookfield cabinet, No. 10 or No. 6 for those speakers, ... **$6.50**

R-O-L-A



Rear view of the Rola chassis

Rola Model D-10 dynamic chassis, less cabinet, for 110 volts 50-60 cycles AC. Dry rectifier and output transformer built in. The fine workmanship of this chassis is shown in the illustrations of the front and rear views. Extreme diameter of rim 9 inches but baffles with cutouts down to 7 inches may be used.

This is the biggest dynamic chassis bargain we have ever offered and enables you at low price to obtain one of the best chasses made. Tone is most excellent.

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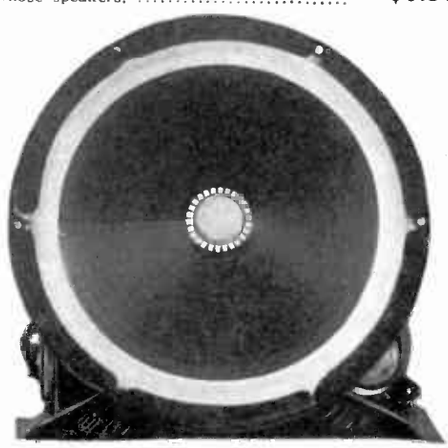

Front view of the Rola chassis. Holes are provided for attachment to your own baffle. The rim is protected by a lining of felt. The voice coil (center) is firmly mounted.

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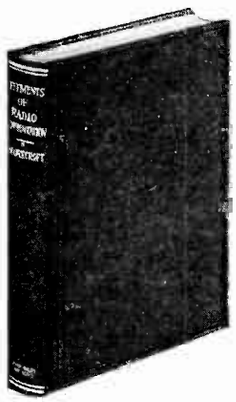

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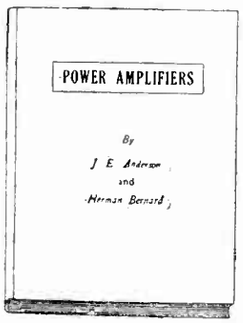

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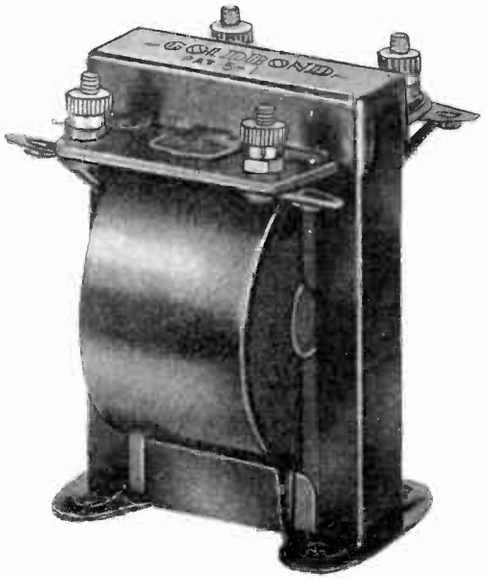
High Impedance Audio Transformers



A single stretch of copper wire without soldered connections of in-between joints is used on each winding of both transformers. The "Gold Bond" model is illustrated.

Order Cat. GB-1-3 for 1-to-3 ratio
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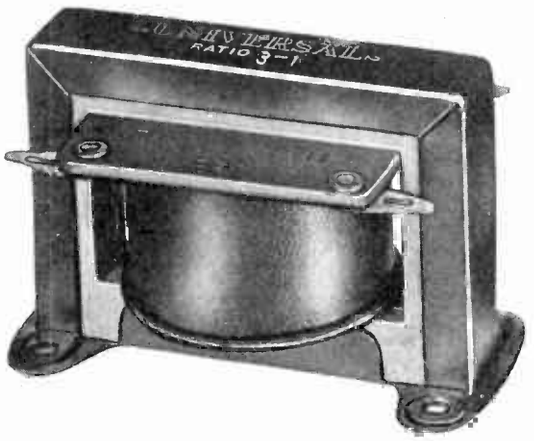
Audio frequency coupling transformers with high impedance primaries and secondaries are made in two models and two ratios of each model. At left is the "Gold Bond" shielded type, at right the "Universal" unshielded type for subpanel mounting, overall height 2¼". The ratios are 1-to-3 and 1-to-5, primary to secondary.

The shielded "Gold Bond" model has 4,000 turns on the primary, so the 1-to-3 model has 12,000 secondary turns and the 1-to-5 model 20,000 secondary turns. Extreme compactness and neatness prevail.

The "Universal" model for subpanel mounting has 3,200 primary turns.

Laminations in both are of best silicon steel in a strong steel frame. The coils in both are vacuum impregnated and therefore moisture-proof.



Excellent reproduction of tonal values as supplied by the detector or first audio tube is assured by use of either of the transformers. The "Universal" model illustrated above, is excellent for replacement purposes. Even on this model high plate voltages may be used, with consequent high plate currents, due to the relatively large diameter of wire used.

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The line input must be 50-60 cycles, 105 to 120 volts. There is a voltage adjuster built in. The magnetic speaker has a matched impedance for the output of the receiver, and is itself housed in a real walnut cabinet with marqueterie inlay.

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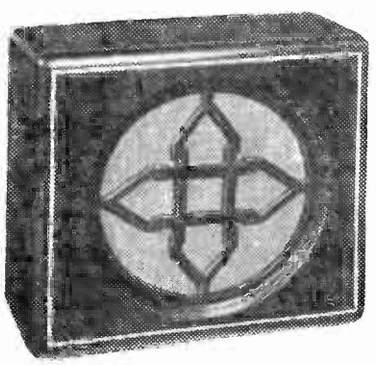

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EIGHTH YEAR

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The Pentode

Six Full Pages Discussing the Five-Element Tube

By J. E. Anderson

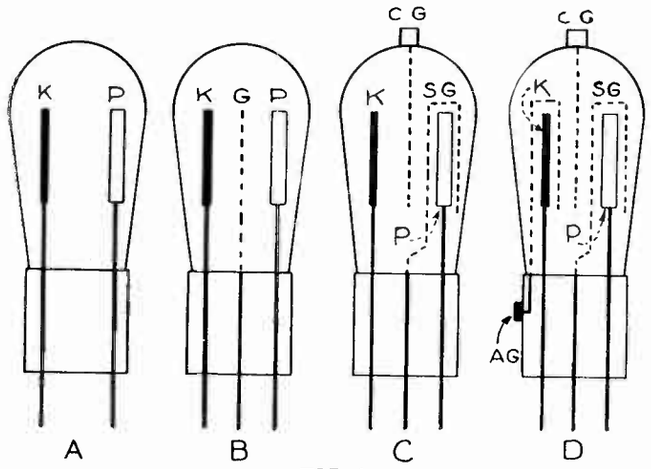

FIG. 1
THESE FOUR SKETCHES ILLUSTRATE THE PRINCIPLES OF THE FOUR MAJOR TYPES OF TUBES USED IN RADIO RECEIVERS. (A), DIODE OR THE FLEMING OSCILLATION VALVE; (B), THE ORDINARY TRIODE OR THREE-ELEMENT TUBE OF DE FOREST; (C), THE SCREEN GRID TUBE; (D), THE PENTODE OF FIVE-ELEMENT TUBE.

THE recently announced pentode tube now shares the spotlight of interest with the Loftin-White amplifier and all fans ask for information on both developments. We shall devote this article to the pentode.

In order to explain the operation of the pentode we shall first review briefly the development of the vacuum tube with respect to the number of elements.

The first application of the vacuum tube to radio was Dr. J. A. Fleming's oscillation valve. This was a diode, or two-element valve. It had only a cathode and a plate, the cathode being in the form of a heated filament. In this article we shall make no distinction between this form of cathode and the indirectly heated type which is now popularly known exclusively as the cathode.

When a metal is heated to a certain temperature depending on the metal and the condition of the surface of that metal, electrons are liberated from the heated surface. They are more than liberated, they are shot out of the surface like tiny projectiles. The distance these electrons are shot out depends on the number of gas molecules in the immediate vicinity of the heated surface. If the space around the cathode is evacuated of all gases the electrons shoot out to some appreciable distance. However, if the cathode is alone in the evacuated space all the electrons fall back into the cathode just as projectiles shot upward from the earth fall back.

The hotter the cathode the more electrons are projected and the farther they journey before they fall back. However, there is a limit because as electrons leave the cathode this is left positively charged and an attraction is established between the electrons and the cathode. It is this attraction which makes the electrons fall back. Moreover, those electrons which have been shot out repel all others which have not been shot out as far or not at all. The free electrons in the space are called the space charge, a term which we shall have occasion to use frequently. It is important to understand the repelling effect of the free electrons on other electrons closer to the cathode since many of the more complex tubes exist because of this effect, and many of the properties of all tubes depend on the space charge.

Adding the Plate

Now let us put another metal member in the evacuated space around or near the cathode, as is shown in A of Fig. 1. The cathode K is hot and projects electrons toward the plate. If the plate is free, that is, not connected to anything, a small number of the electrons having the higher velocities will reach the plate, but it will soon become so much negative due to the accumulation of electrons that no more will be able to reach the plate. The charge on the plate will also repel electrons.

Suppose now that the plate and the cathode be connected metallically outside, or inside, the tube. The electrons reaching the plate will now be able to escape by way of the wire connection and return to the cathode. The plate will not charge up negatively. Hence the electrons shot out from the cathode will have no other obstacles to overcome but the space charge, or the electrons in transit to the plate in the evacuated space. An electric current will therefore continue to flow in the connecting wire as long as the cathode is hot. This flow of current is the Edison effect, which is the basis of the Fleming valve.

When there is only a wire between the two elements the current will be small, being limited largely by the space charge. If it were not for the space charge the current would be limited by the electron emitting power of the cathode, that is, by temperature and chemical nature of the emitting surface. A different situation arises when we connect a battery between the cathode and the plate instead of simply a wire, and arrange the battery so that the positive terminal is connected to the plate. The plate will now be positive with respect to the cathode and will attract electrons, giving them greater velocity. As soon as an electron reaches the plate it will become neutralized by the positive charge thereon, and there will be no accumulation of negative charge on the plate. A current will be established through the battery. The practical limit, for low voltages between the plate and the cathode, will be determined by the space charge. For high voltages between the elements, the current will be limited by the electron-emitting ability of the cathode.

The Fleming diode is now used in radio only as a rectifier in B battery eliminators, and the 281 half-wave rectifier is a well-known example. Of course the tube has grown in size and it has been refined.

In 1907 a third element, the grid, was added to the vacuum tube by Dr. Lee De Forest, the third element being placed between the cathode and the plate as shown in B of Fig. 1. This change made the tube an amplifier and made broadcasting and radio telephony possible and practical.

Effect of the Grid

If the grid be given a negative charge with respect to the cathode, the grid will repel the electrons coming from the cathode. It will partly or completely overcome the attraction which the positive plate has for the electrons. The space charge between the cathode and the grid will be intensified and that between the grid and the plate will be reduced. Should an

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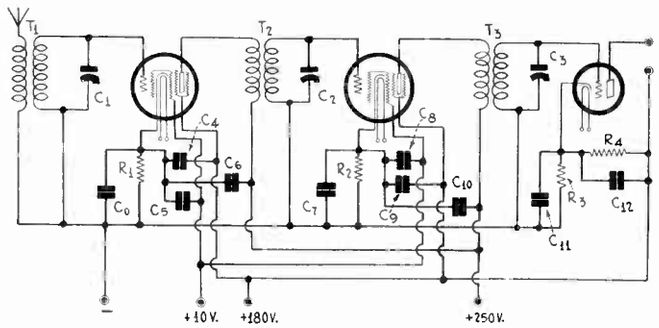


FIG. 2
A THREE-TUBE RADIO FREQUENCY AMPLIFIER INCORPORATING TWO PENTODES AND ONE THREE-ELEMENT TUBE FOR DETECTION.

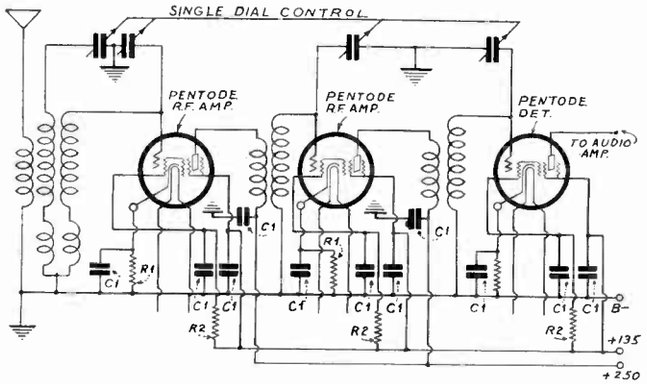


FIG. 3
A THREE-TUBE CIRCUIT INCORPORATING THREE PENTODES. THIS CIRCUIT WAS RECOMMENDED BY THE MAKERS OF THE NEW TUBE.

electron have a sufficient velocity to get through the grid it will be hurried along to the positive plate both by the attraction of the plate and the repulsion of the negative grid.

As long as the grid is negative with respect to the cathode it will not attract any electrons for itself and it will reduce the number going to the plate. Hence there will be no grid current and very little plate current.

Making Grid Positive

If the grid be made positive with respect to the cathode, it will aid the plate in pulling the electrons from the vicinity of the cathode. Between the cathode and the grid the space charge will be reduced, but there will not be much change in the space charge between the grid and the plate. The grid and the plate will now compete for the electrons, but due to the fact that the grid has given most of them a high velocity a relatively large number shoot by the grid and go to the plate. Hence when the grid is positive the plate current is very large. Another reason for the greater plate current is the reduced space charge between the grid and the cathode. The effective resistance in the tube is reduced.

When the grid is positive the number of electrons caught by it may be large and hence the grid current may be large. A positive grid, when not used as control grid, is called a space charge grid because its function is to reduce the space charge. But the grid cannot be used for controlling the plate current at the same time because the grid current would materially decrease the selectivity of the tuned circuit ahead or the amplification in the audio amplifier.

The Screen Grid Added

In C of Fig. 1 is illustrated a four-element or screen grid tube. The fourth element in this tube takes the form of a grid surrounding the plate. The function of the screen is twofold. Its first function is to reduce the electric capacity between the plate and the control grid. The second is to increase the amplifying property of the tube.

In the figure referred to the control grid is marked CG and is brought out at the top of the glass envelope. It takes the place of G in B of Fig. 1. The screen grid is marked SG and is brought out in the base of the tube where the control grid is brought out in the triode.

The reason for the desirability of reducing the electric capacity between the grid and the plate is that this capacity results in a reaction between the plate and the grid which limits the use of the tube. The nature and degree of this reaction depend on the type of load impedance that is used in the plate circuit. For a pure resistance load the reaction is such as to reduce the amplification and for an inductive load it is such as to increase it, frequently to such a degree that the tube oscillates. When the grid potential changes in a certain direction there is a change in the plate current of the tube and there is a corresponding change in the voltage drop in the load impedance in the plate circuit. This drop changes the effective voltage on the plate. And this change in the effective voltage on the plate either increases or decreases the change in the grid potential which brought about the changes in the plate circuit. If there were no electric capacity between the control grid and the plate there would be no reaction of any kind.

The fourth element, the screen grid reduces the capacity to a very small fraction of what it would be without it and hence it reduces the reaction proportionately. The residual capacity is so small that it is only at the very highest frequencies used that the reaction is large enough to warrant consideration.

Acceleration of Electrons

The increase in the amplifying property of the tube as a result of the screen grid results from the fact that the positive charge on the screen gives the electrons a greater velocity. In the first place it reduces the space charge between the cathode and the screen grid. But the screen grid, being positive, attracts a large number of electrons to itself, and the higher its positive potential the larger the number it attracts. If the potential is nearly as high as that on the plate it robs the plate of nearly all electrons and there will be practically no plate current. If the potential on the screen is higher than that on the plate, the plate current will be zero. Indeed, there may be a reverse movement of electrons from the plate to the screen. If the screen grid tube is to function properly the screen voltage must always be considerably less than the voltage on the plate, regardless of the voltage drop that may occur in the load impedance in the plate circuit.

It is by virtue of the higher potential on the plate that more electrons are attracted to the plate than to the screen, although the screen has the first chance to take them. Since the screen is positive it will continue to attract the electrons even after they have passed through the meshes of the screen. Only those electrons that have the higher velocities will be able to get to the plate. The screen helps to increase the plate current only by increasing the velocity before the electrons get to the screen.

Space Charge Connection

When the screen grid tube first came out it was stated that it could be used in two different ways, as a screen grid tube and as a space charge tube. The difference between these two is simply in the reversal of the functions of the two grids. When the space charge connection is used the screen is used as control grid and the other, the cap, is used for the purpose of accelerating the electrons. When this connection is used the capacity between the plate and the control grid is relatively high. Indeed, it is higher than in most three-element tubes. Consequently this use of the tube is not suitable for high frequencies at which the reaction is considerable.

The advantage of the space charge connection is that the plate resistance is decreased so that it is practical to utilize most of the theoretic amplifying property of the tube. It is the space charge grid that contributes most to the lowering of the plate impedance, and this it does by reducing the space charge between the cathode and the space charge grid, or by increasing the velocity of the electrons.

Definition of Space Charge

It will be recalled that we defined a space charge grid as a positive grid not used for controlling the variations in the electron stream. In this case the grid next to the cathode is used for this purpose while the grid next to the plate is used to control the electrons. Perhaps it is necessary to modify the definition of a space charge grid a little to exclude the screen grid when this is positive and used for screening the plate. We should say that a space charge grid is a positive grid used neither for controlling the electrons nor for screening the plate.

American Pentode

ube's Fifth Element As to Plate Load

Actually, however, the screen grid serves the double function of screening the plate and accelerating the electrons.

The Pentode Tube

The disadvantage of the four-element screen grid tube is that its plate impedance is so high that it is practically impossible to make use of the high theoretical amplification of the tube. The AC screen grid tube has an amplification factor under certain operating conditions of 420. It is rarely that the actual voltage amplification exceeds 100.

When the tube is used as a space charge tube the possible amplification in practical circuits is of the order of 60. But this is only for low frequencies. The high capacity between the control grid and the plate lowers the amplification at high frequencies, unless the load is inductive, when oscillation may result from the reaction.

What is needed is a tube which retains the advantages of the screen around the plate and at the same time partakes of the advantages of the space charge tube. That is, we need a screen grid tube with an extra grid to act as space charge grid. Such a tube is called a pentode because it has five elements, namely, a cathode, a space charge grid near the cathode, a control grid, a screen grid surrounding the plate, and finally a plate. Such a tube is illustrated diagramatically in D of Fig. 1. In this figure K is the cathode, P the plate, CG the control grid, SG the screen grid, and AG the space charge grid, or accelerating grid.

The space charge is mostly concentrated near the cathode because many electrons are emitted at low velocities and consequently cannot get far from the cathode. The concentration also helps to prevent even some of the electrons of higher velocity from getting through. To get a physical picture of the space charge one might think of a dense fog surrounding the cathode, a fog which gets less and less dense as the distance from the cathode increases. It is difficult for other electrons to penetrate this fog because of the repelling forces of the electrons already in the space.

Action of Space Charge Grid

The space charge grid is introduced near the cathode and is made positive with respect to it in order to break up the cloud of electrons or to reduce its density. With the positive electrode near the cathode the electrons are attracted away from the cathode, given a high velocity, and some of them are sent on to the screen grid and the plate. Since the space charge grid gets the first chance at the electrons it usually takes most of them for itself, but the proportion of the total intercepted by this element depends on the relative values of the positive voltages on the three positive elements. The higher the voltage on any electrode the larger the number of electrons will that electrode attract.

The chief advantage of the pentode is that its mutual conductance is greater than that of the four-element tube, and this increased conductance is the result of the reduction in the space charge near the cathode. The mutual conductance is a measure of the change in the current in the plate circuit produced by a given change in the control grid voltage. It is usually expressed in micromhos and when so expressed the number means the change in the plate current in microamperes produced by a change of one volt in the control grid voltage. The mutual conductance of a tube is the best figure of merit of that tube as an amplifier and oscillator. The higher it is the better the tube.

Pentode Features

A feature of the pentode is that the mutual conductance varies widely with the voltages applied to the different elements. Not only does this figure of merit vary with the voltages but also the amplification factor and the internal plate resistance. Just how these factors change for certain selected voltages is shown in the accompanying table, which shows the average characteristics of CeCo pentode.

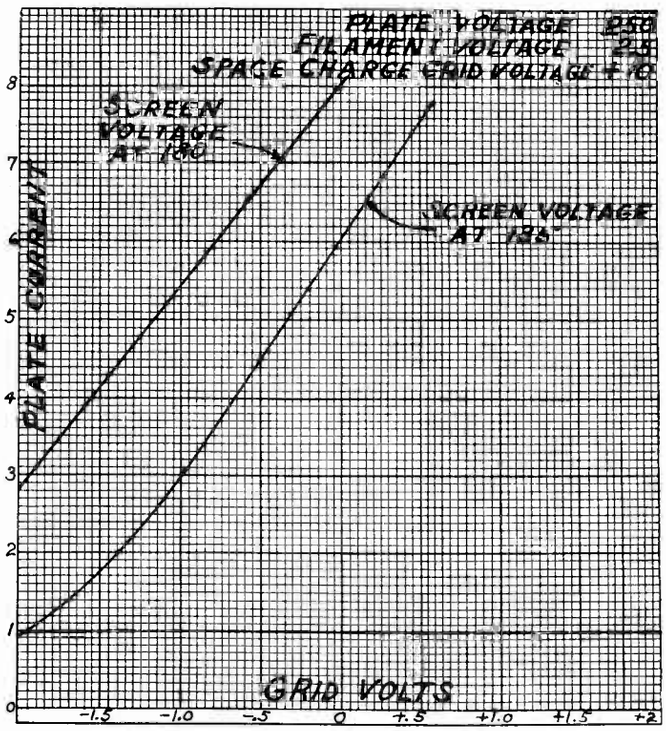


FIG. 4

CURVES SHOWING THE RELATIONSHIP BETWEEN THE GRID VOLTAGE AND THE PLATE CURRENT OF A PENTODE UNDER THE CONDITIONS STATED.

Average Characteristics of Ceco AC Pentode

	(1)	(2)	(3)	(4)
Heater volts	2.5	2.5	2.5	2.5
Heater amperes	1.75	1.75	1.75	1.75
Control grid volts	—1.5	—1.5	—1.5	—1.5
Space charge grid volts	10	20	10	20
Screen grid volts	180	180	135	135
Plate volts	250	250	250	250
Amplification factor	575	540	740	750
Plate resistance, ohms	285,000	100,000	380,000	300,000
Mutual conductance, micromhos	2,000	3,000	1,930	2,500
Plate current milliamperes	4.1	6.0	1.7	2.6
Screen current milliamperes	0.8	0.9	0.5	0.2
Space charge current milliamperes	3.0	10.0	5.0	12.0

From this table we note that the heater characteristics of this tube are the same as those of the AC screen grid tubes. The recommended control grid bias is also the same as that of the screen grid tube, namely 1.5 volts negative. The remaining characteristics are quite different.

We note that there are four different combinations of voltages. When the space charge grid voltage is plus 10, the screen voltage 180, and the plate voltage is 250 volts, the amplification factor is 575, the plate resistance is 285,000 ohms, the mutual conductance 2,000 micromhos, and the plate, screen grid and space charge grid currents are 4.1, 0.8, and 3.0 milliamperes, respectively.

By increasing the space charge grid voltage to 20 volts the characteristics are changed as shown in column (2). The amplification factor has decreased a little, the plate resistance has decreased considerably, the mutual conductance has increased 50 per cent and the various currents have increased, particularly the space charge grid current, which has gone from 3 to 10 milliamperes. This combination seems to be the most desirable of the four in the table.

Further Comparison

By comparing the characteristics in columns (1) and (3) the effect of changing the screen grid voltage from 180 to 135 volts may be seen. The most notable features are the high amplification factor and the low currents in all the elements. By comparing columns (2) and (4) the effect of changing the screen grid voltage from 180 to 135 volts with 20 volts on the space charge grid. The change is of the same order as that effected when the space charge voltage was kept at 10 volts, but combination (4) is not quite so favorable as that in (2).

Although the voltage amplification is about 50 per cent higher in combinations (3) and (4) than in combination (2) it is quite likely that a greater actual voltage amplification can be obtained with combination (2) because the internal plate resistance and the mutual conductance are most favorable in (2).

For comparison of this tube with the AC screen grid tube we give the average characteristics of this tube for the usual recommended voltages. When the plate voltage is 180 volts, the screen grid voltage 75 volts, and the control grid bias is minus 1.5 volts, the amplification factor of this tube is 420, the internal plate resistance 400,000 ohms and the mutual conductance is

Voltages and Tuning

Tube Should Be Operated at Less Than Maxi

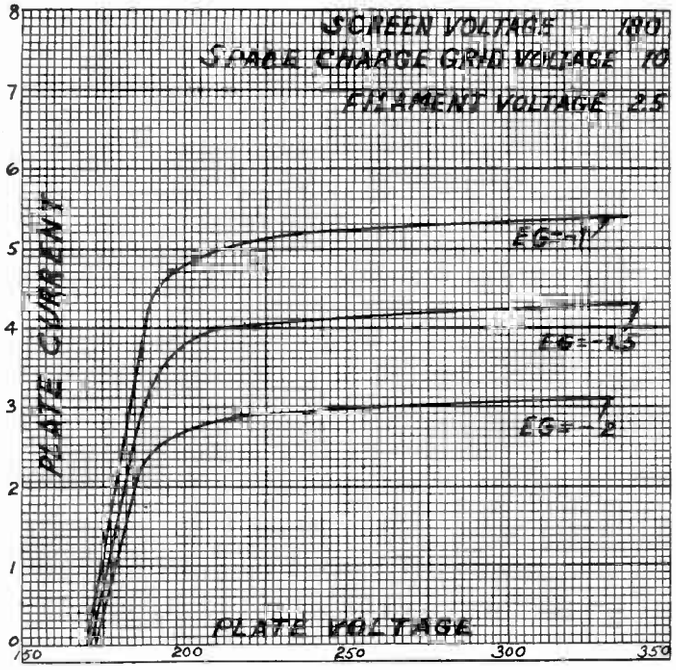


FIG. 5
THIS CURVE SHOWS THE RELATIONSHIP BETWEEN THE SPACE CHARGE GRID VOLTAGE AND THE SPACE CHARGE GRID CURRENT OF THE NEW PENTODE FOR THE OPERATING CONDITIONS STATED.

1,050 micromhos. Since the amplification factor is less and the internal plate resistance is higher for this tube than for the pentode it follows that the voltage amplification will be much less.

The pentode tube here calls for a plate voltage of 250 volts and the four-element tube a plate voltage of 180 volts. In both cases this means the actual plate voltage and not the voltage applied at the low potential end of the plate load. When the applied voltages are 250 and 180 the characteristics and the load has considerable impedance value, as it should have for high amplification, the characteristics may be quite different.

Circuit of Pentode

In Fig. 2 is a three tube radio frequency amplifier and detector in which the first two tubes are of the pentode type. As will be noted there is not much change in this circuit from one incorporating screen grid tubes in the radio frequency stages. The difference lies mainly in the addition of another positive element and in the changes in the voltages and constants.

The control grid bias on the pentode is to be 1.5 volts, and it is obtained from a drop in a resistance as is customary in AC circuits. R1 biases the first tube and R2 the second. The question is what the value of either of these resistances should be. To determine it we have to know the current flowing, and that is the sum of the plate, screen grid and space charge grid currents. Since the voltages are 250, 180 and 10, respectively, we find from the first column in the table of characteristics that the total current is 7.9 milliamperes. Hence we get 1.5/.0079, or 190 ohms. That should be the value of each bias resistor. If the circuit is so arranged that the same bias resistor is used for both tubes, which can be done by simply connecting the cathodes together, the bias resistor should only be 95 ohms. Both these values fall within the range of rheostats which are available.

Since there are now four elements besides the cathode there is need for four by-pass condensers. All the by-pass condensers associated with the pentodes operate at radio frequencies in this circuit and therefore they need not be of large capacity. Condensers Co, C4, C5, C6, C7, C8, C9, and C10 need not be larger than .01 mfd. although larger capacities are preferable, particularly those across the low bias resistances.

Detector Adjustments

The detector tube is of the 227 type and therefore the plate voltage is only 180 volts. So-called power detection is used and the bias is provided by resistance R3. The current that will flow through this resistance will depend on the type of load used on the detector. Since the plate current will be small for all loads it is desirable to augment the current through the bias resistor by another conductive path R4. Suitable values for resistances R3 and R4 when the load is a transformer are 1,800 and 20,000 ohms.

The detector operates at audio frequencies and therefore the by-pass condensers across resistances R3 and R4 must be proportioned accordingly. C12, being connected across a high resistance need not be higher than one or two microfarads, while C11, being connected across a much smaller resistance, should not be smaller than 4 mfd.

The tuning condensers C1, C2, C3 may be either .00035 or .0005 mfd. units according to the desires of those building the circuit. The larger condenser is preferable because it covers the broadcast band better.

The coupling transformers T1, T2 and T3 should be suitable for the condensers selected and also for the impedance of the plate circuits of the tubes. Coils wound for ordinary screen grid tubes will do but those wound for three-element tubes will not because the plate impedance of the pentode is too high for these coils. A coil wound for an ordinary screen grid tube will work better with the pentode because the pentode has a somewhat lower impedance. Coils wound for four-element tubes never did match well because it was not practical to make the primaries of coils of high enough impedance.

The circuit in Fig. 2 can be used ahead of any good audio amplifier but the particular type of detector suggested works better when it is followed by a transformer. So a transformer coupled amplifier with push-pull in the final stage is recommended. However, the circuit works very well with a Loftin-White type of non-reactive amplifier.

Sharp Tuning Important

The amplification in the RF circuit will be very high and for that reason it is important that the selectivity be high. The three tuned circuits will provide ample selectivity provided that the tuning condensers are separately tuned or that they track very well if they are ganged. It is possible with well-constructed condensers to adjust the zero setting capacities and the inductances in all the circuits to have the same values.

It will be noted that the current taken by a pentode is considerably greater than that taken by a screen grid tube. It also requires a higher plate voltage. However, the voltage recommended is the same as that recommended for a 245 so that it is not necessary to get a new B supply unit when installing pentodes in old sets designed for 245 type tubes. Also, since the pentode amplifies more than the screen grid tube it is possible to get the same sensitivity with fewer tubes. It follows that the current requirements for the receiver as a whole will not be much different, unless the same number of pentodes as screen grid tubes are used. The two tube circuit in Fig. 2 takes about 22 milliamperes, including the current through R4. This is much less, for example, than a circuit, having four screen grid tube in addition to the detector.

Any B supply unit maintaining an output voltage of 300 volts can be used with the circuit in Fig. 2 when followed by the transformer coupled amplifier suggested. A few changes, however, are necessary. First, it is necessary to provide a suitable voltage for the space charge grid. No standard B supply unit has a provision for 10 volts positive. There are several methods for obtaining this low positive voltage. One is to connect a voltage divider across the lowest voltage section in the regular voltage divider in the supply, for example, across the 45 volt section. Or if there is a 22.5 volt section it may be connected across that. This shunt divider may have a value of 10,000 ohms or approximately that value. The tap for the space charge grid should be placed so that there will be 10 volts between it and the ground. If the resistance is 10,000 ohms and the voltage across it is 45 volts, there should be 2,222 ohms below the tap.

Providing Suitable Voltages

Another way is to connect a potentiometer across the lowest voltage section and then connect the space charge grids to the slider. In this way any voltage within the limits of the potentiometer may be obtained for the space charge grids simply by moving the slider.

Incidentally, this also provides a volume control, which has not been provided in Fig. 2. Whether or not this will prove to be a satisfactory volume control remains to be determined. The tube is new and this point has not been tested fully.

For screen grid tubes it is standard practice to control the volume by controlling the screen grid voltage. This method is equally applicable to the pentode since the screen performs the same function.

Pointers on Pentode

mum Performance Possibility to Conserve Life

Voltages of 135 and 180 volts are provided on nearly all B supply units. Not so a voltage of 250, even when 245 tubes are used in the power stage. While the 245 tube takes a plate voltage of 250 volts it requires a bias of 50 volts, making a total of 300 volts, so that the voltage between B minus and the top of the voltage divider is actually 300 volts. Therefore, it is necessary to provide a tap on the voltage divider 50 volts down from the highest voltage tap. If there is no tap already, one can be provided by connecting a tapped resistance across the high voltage end and the tap next below and adjusting the new tap so that the voltage between it and B minus is 250 volts. There are resistors with sliding taps available which can be used.

Another Pentode Circuit

In Fig. 3 is a pentode circuit similar to that in Fig. 2, one suggested by the manufacturers of the new tube. In this circuit the by-pass condensers C1 associated with the first two tubes should have a capacity of .1 mfd. or more. The two grid bias resistors R1 serving these two tubes should be 200 ohms each.

It will be noted that the screens and the space charge grids are connected to 135 volts but that in each space charge grid lead is a resistance R2. The value of any R2 should be such that the voltage drop in it will be 125 volts when the current is 5 milliamperes. That is, each R2 should be 25,000 ohms.

The detector in this circuit is also a pentode, and it operates on the grid bias principle. We have to determine R3 so that the tube will operate efficiently as a bias detector when the plate voltage is 250, the screen voltage 135 and the space charge voltage is 10 volts. Referring to the lower curve in Fig. 4, we note that there is considerable curvature when the bias is two volts or more. At 2 volts the plate current is 0.9 milliampere. Assuming that the screen and the space charge grid currents are the same as when the bias is 1.5 negative, we get a total current of 6.4 milliamperes through R3. This is to cause a drop of 2 volts. Therefore R3 should be 312 ohms. This resistance is not critical and a somewhat higher value could be used. The three condensers C1 associated with the detector should not be smaller than 2 mfd. since the tube is primarily working at audio frequencies.

It will be observed that there are four tuned circuits in Fig. 3, the first two preceding the first tube. No special tuners are required between the tubes although the primaries of the transformers should be wound as for ordinary screen grid tubes.

Characteristic Curves

In Fig. 4 are shown grid voltage, plate current curves of the pentode for two different screen voltages and a space charge grid voltage of 10 volts. The lower of these curves shows that for signal voltages of amplitude of less than one-half volt a greater amplification can be obtained when the bias is only one-half volt than when it is 1.5 volts. When the operating conditions are as in the upper curve there is not much difference in the amplification for bias values between zero and 2 volts negative. When the signal voltage has an amplitude of one volt or more the operating conditions should be as indicated by the upper curve, and the bias may be 1.5 volts or somewhat more.

Fig. 5 gives the relationship between the space charge grid voltage and the space charge grid current when the control grid voltage is zero, the plate voltage 250 and the screen voltage 135 volts. This curve is mainly useful when we wish to estimate the total current that will flow in the cathode or when we wish to determine the value of a grid bias resistor to give a specified bias. Unfortunately this is only for zero bias. To be generally useful a family of such curves should be taken at different bias values.

Fig. 6 gives three curves between the plate voltage and the plate current for a screen grid voltage of 180 and a space charge grid voltage of 10 volts and for three different control grid voltages. Curves of this type are the most useful, especially when the tube is used in a resistance coupled amplifier, because they not only give the plate current under the given conditions but they also enable the calculation of the voltage amplification that may be expected. It will be observed that these curves are practically identical with the corresponding curves for four element tubes and that the screen voltage used is a limiting factor in the amplification that may be expected for given load conditions. If the load impedance is high enough to make the tube give up a considerable fraction of its theoretical amplification the amplitude of the possible signal input is greatly narrowed, and this limitation is the greater the higher the screen voltage.

In a resistance coupled amplifier the coupling resistance must be limited to a comparatively low value or else the applied plate voltage must be increased to such a value that the net effective voltage on the plate is considerably in excess of the

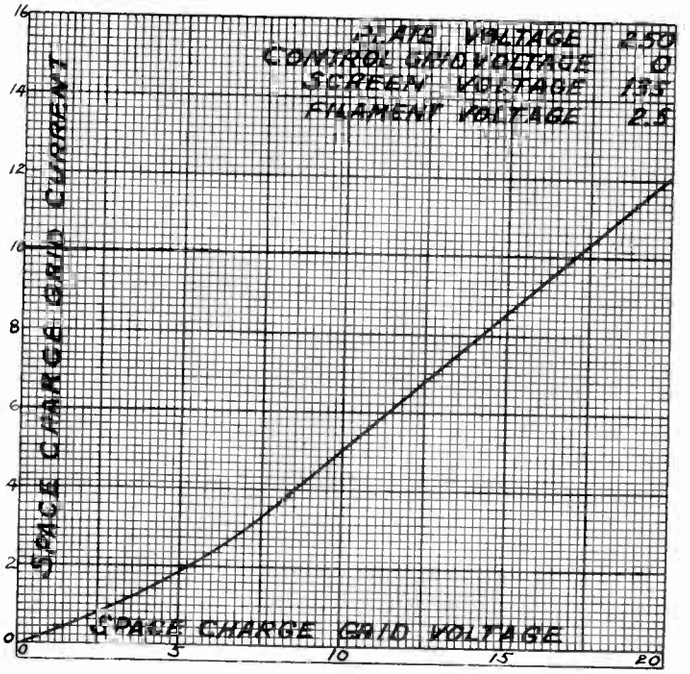


FIG. 6
THESE CURVES SHOW HOW THE PLATE CURRENT IN THE PENTODE VARIES WITH THE PLATE VOLTAGE FOR THE OPERATING CONDITIONS STATED.

screen grid voltage. If this is not practical, which it rarely is, the only alternative is to reduce the screen grid voltage. This is true for the pentode as well as for the four-element tube, because both are screen grid tubes.

Additional Curves

Curves showing the relationship between the control grid voltage and the voltage drop in load resistances will be given for the pentode in the near future, and these curves will show some of the limitations of the tube as related to the voltage applied to the elements. The apparent advantage of the pentode over the four-element tube is that its plate resistance is lower and hence that it is possible to utilize a larger proportion of its amplification factor under practical operating conditions.

The effect of lowering the screen grid voltage on the curves as given in Fig. 6 is to move the "cut-off" on the curves toward the left. In the figure the "cut-off" occurs when the plate voltage is approximately 175 volts, which is nearly equal to the screen grid voltage in the case. If the screen voltage is reduced to 135 volt the cut-off will be shifted to that value of plate voltage. There will be more latitude for the signal voltage.

The curves clearly show the effect of increasing the control grid bias. The greater the bias the smaller the plate current. This suggests another way of bringing the tube into operating condition in case the plate load resistance is too high, and that is to increase the bias around which the signal voltage fluctuates. But doing this reduces the amplification of the tube and also increases the wave form distortion in that it transforms the tube to a detector.

Pentode In Non-Reactive Amplifier

In Fig. 7 is a non-reactive amplifier of the Loftin-White type with a pentode tube in the first stage. It differs in no respect from similar circuits we have published previously except that the space charge grid has been connected to the voltage divider at a suitable point. Let us examine the circuit with a view of finding the values of the various resistors.

When the bias on the 245 is 50 volts the current in the plate circuit will be 32 milliamperes, assuming an average tube. The plate voltage must be 250 volts. This is the drop in R5 and R6. Let us assume that the total resistance of these is 25,000 ohms so that the current through them will be 10 milliamperes. The current diverted through R7 will be so small that we may neglect it at this point.

Let us assign a space charge voltage of 10 volts and a bias on the pentode of 1.5 volts. In order to get a space charge grid voltage of 10 volts the drop in R2 must be 11.5 volts. Now the resistance in R2 will be less than 42 milliamperes because the currents to the two positive grids cannot be neglected. We have to make a reasonable guess here as to what the current

A High Plate Voltage

Is Recommended for the Pentode as Amplifier or Detector

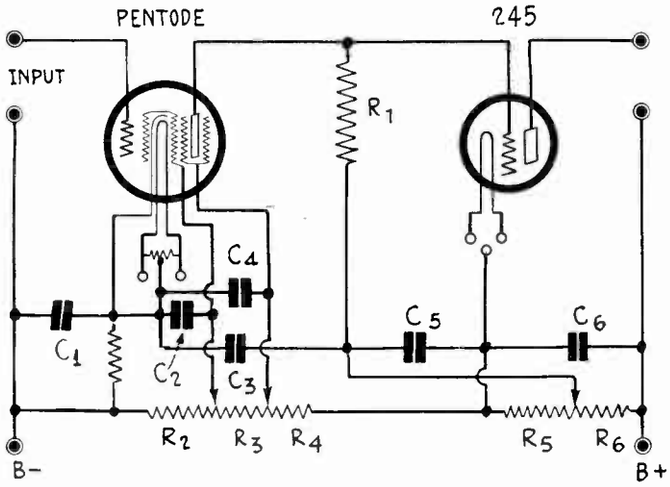


FIG. 7

THIS TWO-TUBE CIRCUIT IS THE REGULAR LOFTIN-WHITE NON-REACTIVE AMPLIFIER ADAPTED TO THE USE OF A PENTODE IN THE FIRST STAGE. THE ADJUSTMENT OF THIS CIRCUIT IS DONE IN THE SAME WAY AS THAT OF THE SIMILAR CIRCUIT USING THE ORDINARY SCREEN GRID TUBE.

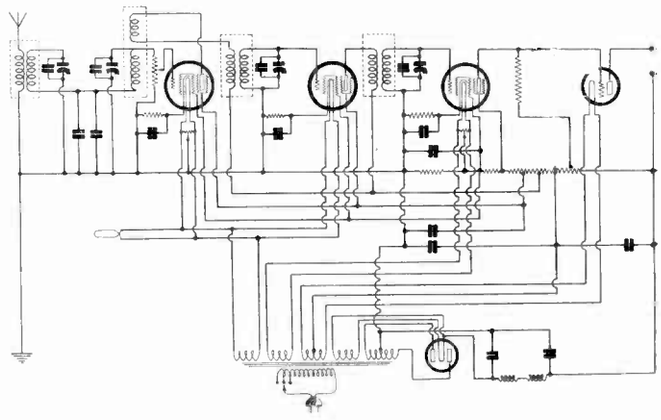


FIG. 8

A RECEIVING CIRCUIT INCORPORATING THREE PENTODE TUBES AND ONE 245 POWER TUBE.

will be after all the voltages have been adjusted. We cannot assume that the two grid currents will be the same when the plate current is negligible as when it is of considerable value. So let the guess be that the current in R2 is 40 milliamperes. This would make R2 equal to 287.5 ohms. Let us call it 300 ohms for short since its exact value is not of great importance

Bases of Selections

Since we deducted 2 milliamperes from the current in R2 we must assume that the current in R1 is 2 milliamperes in order to be consistent, for all the current diverted by the various elements of the pentode must return to B minus through R1. We want a drop of 1.5 volts in this resistance and, therefore, we have to make its value 750 ohms. This may not give exactly the correct bias, but it can be made correct by adjusting the screen voltage on the tube.

The selection of R7 can be made arbitrarily subject to the condition that it should not be unreasonably large. Let us make it one-half megohm. If the plate current is 0.1 milliampere the drop in this resistor will be 50 volts, just right for the bias on the power tube. Therefore, the return of R7 will be to the center of the filament if the tube, or to the left end of R5. If the current is greater than 0.1 milliampere the drop will be greater and the return will have to be made as shown, R5 being chosen suitably. If the current is less than 0.1 milliamperes the bias will not be enough and the return will have to be made somewhere on R4.

Adjusting the Screen Voltage

The current through R7, and hence the bias on the power tube, can be changed by changing the screen voltage, that is, by returning the screen to different points between R3 and R4. The right point can only be found experimentally and, therefore, R3R4 should be a potentiometer with the screen going to the slider.

We want a rather high voltage on the plate of the pentode. The recommended value is 250 volts, but since we have resistance coupling the applied voltage should preferably be much higher. But let us assume that the total voltage drop in R2, R3 and R4 is 261.5 volts. Since the drop in R2 is 11.5 volts the drop in R3R4 will be 250 volts. The current in these resistors will be 42 milliamperes, according to our previous findings. Hence R3R4 should be very nearly 6,000 ohms, a value that may be selected with assurance.

Simultaneous Variation

The proper adjustment of the circuit must be effected by the simultaneous variation of the return of the screen to R3R4 and the return of the plate to R5R6, and for that reason two potentiometers should be used. If a milliameter be connected in the plate circuit of the power tube the adjustment is greatly facilitated because when the meter shows 32 milliamperes the bias on the tube is correct. Then if the signal is clear at the same time the adjustment of the first tube is also correct. Since there are two interdependent things to be adjusted there must be two variables by means of which to adjust these things. The bias on the first tube and the space charge grid voltage can be adjusted as previously explained and left fixed during the final adjustment.

Not a Critical Circuit

The total voltage required for the circuit in Fig. 7 is 511.5 volts. This does not mean, of course, that lower or higher voltages will not work. The circuit is not at all critical as to voltage requirements. It is only the combination of voltages which is critical. However, the higher the voltage on the plate of the pentode the better the circuit is likely to work. If the voltage is too low it will not work well at all.

If the adjustment of the circuit and the values of the various resistors are made on the assumption on a given available high voltage the adjustment will not be far wrong if the voltage is increased or decreased because the changes will be proportional. If the voltage is too low on the pentode there will be a great deal of distortion and that condition will be apparent.

By-Pass Condensers Important

There are six by-pass condensers in the circuit, all of which are important and necessary. The capacity of any one depends on the resistance across which it is connected. The lower the resistance the higher the capacity must be. So important are some of the condensers that the circuit will not function unless they are used, or it will function so poorly that there is no advantage whatsoever in using non-reactive coupling. The minimum value for any one should be 2 mfd. and those condensers connected across low resistance should preferably be many times that size. Particularly C1, C2, and C5 should be large.

The bias on the first tube was selected so that the tube functions as an amplifier. If it is desired to make it a detector it is only necessary to increase the value of R1 until good detection results. Incidentally, it is not advisable to use the first tube in this circuit as detector.

More Information Soon

As soon as more curves are available on the pentode tube it will be possible to give more definite designs of amplifiers incorporating this tube than were given above. More circuits will be published utilizing this tube both in radio and audio frequency amplifiers as well as in the detector stage. While the conventional curves included in this article supply considerable information on the tube they are of little aid in designing audio frequency amplifiers in which resistance is used for coupling, and since amplifiers of this type are now of greatest interest the curves to be given in the near future will be those specially applicable to resistance coupled circuits.

ASK THE PENTODE EDITOR!

If you have any questions about the pentode, address Pentode Editor, RADIO WORLD, 145 West 45th Street, New York, N. Y. Tabulate questions so answers may be written beside them.

By Dr. Lee De Forest:

What I Think of the Pentode and Its Prospects

Reprinted from The New York "Times"

THE pentode or five-element tube has come to the fore again, not so much materially as verbally. Radio improvements in the past six months have been neither radical nor spectacular. Perhaps it is with a view to creating a demand for something new in the radio line that certain tube manufacturers have taken the pentode out of the obscurity in which it has lain, dusted off the name-plate and are now putting it before the public. Some may call it a new tube. But such is not the case.

As far back as 1915 I developed several pentodes. In fact, in that year I applied for patents on several features of the tube. My interest in a multi-element tube goes back several years prior to that time. The patents were granted in 1916, 1917 and 1918. In those early days of hand-blown tubes, each lead of the pentode, except the filament, came out separately at the top of the tube, permitting of a great deal of experimentation. At that time in the history of radio the pentode might have come into popular demand.

Demand Was for Triode

But, chiefly because the three-element tube had been so much further developed, having been invented almost ten years before, and placed in the hands of the American Telephone and Telegraph Company, the commercial demands were for the three-element device.

In the years following 1918, with the lifting of the broadcasting bans at the conclusion of the war, I turned my attention to the many other radio problems that sprang up like mushrooms. Recently the screen-grid, or four-element tube, came into existence, a great improvement on the former three-element tube. This may have served as an impetus to the revival of the pentode. If the screen-grid could so improve on the three-element tube, why should not the pentode likewise improve upon the screen-grid?

Unfortunately this logic will not completely fit the case in hand. My own early experiments with the pentode, while not devoid of good results, nevertheless failed to warrant the overthrow of the three-element tube in its favor. Of course, it must be remembered that in those early days many principles of the vacuum tube, now common property, were unknown.

More Lore On Subject Now

The discovery of the many possibilities of the split grid, used to such advantage in the three-element and screen-grid tubes, may apply equally well to the pentode. The present-day research in the pentode makes use of the tremendous fund of information gained since my early work in all branches of the vacuum tube.

The use of the pentode is at present confined largely to Europe, and especially England, where the battery-operated portable receiver is in great vogue. Moreover, the English broadcasting industry, being carried on the basis that the receiver of the entertainment should pay for it, works to the advantage of the pentode in that country. The tax which is levied on all radio receivers is based upon the number of tubes the set contains. Since the pentode obtains remarkable results using only one stage of amplification, thereby doing away with at least one other tube, its popularity is apparent as the great reducer of radio taxes.

I have on my desk in the office a six-element tube manufactured in Germany, an exceedingly delicate piece of workmanship and a beauty to behold. The pentode is neither new nor is it the last stage of multi-element tubes.

Primary Use

Designed as it is with the usual cathode and plate, between which are three grids, the pentode is meant primarily for use in the last audio stage in place of the usual 245 and 250 tubes.

The use of the pentode eliminates one stage of radio frequency amplification. As perfected abroad, the sensitivity of the pentode is greater than that of our triode, resulting in higher amplification per stage. Due to the greater per stage amplification, it is possible to eliminate one stage of audio amplification working directly from the detector into a single power stage without danger of overloading either the detector or the radio frequency amplifier tubes.

Doubts Great Forward Step

The greatest advantage of the pentode lies in its use for battery-operated sets, where, with a limited plate voltage, greater undistorted output may be obtained than with the triode. This is also true in the case of those localities which supply 110-volt direct current for the operation of receivers.

From the foregoing it might seem as though the pentode was destined to be the great forward step in radio for 1930. But I seriously doubt that it will so prove, at least in the United States. The pentode has many serious disadvantages. In the first place, the pentode gives no new results. Its advantage lies not in better results but rather in the same results obtained with fewer tubes. And though it might please the imagination to think so, it does not necessarily follow from the above statement that if the same thing can be accomplished with fewer tubes better results may be accomplished with the same number of tubes. Nor is it clear that the cost of the complete receiver using pentodes would be less than the present sets using more triodes.

We have spoken of the elimination of one stage of radio frequency amplification, permitted by the use of the pentode, and the subsequent economy in the number of tubes. But such a reduction in amplification stages means also a reduction in the number of tuned circuits.

Selectivity Important

American broadcasting being what it is, with stations large and small crowded on top of and immediately adjacent to a dozen other stations, the high degree of selectivity required in order to pick out one station from the rest would be greatly lowered by the reduction in tuned circuits.

As yet we have not considered the tube itself. Cutting down the number of tubes does not mean the cutting of tube costs. Due to the complexity of the pentode, and the extremely high vacuum which it demands, the pentode cannot as yet be manufactured with any degree of uniformity in quality and performance.

And whereas non-uniformity of triodes causes only a slight loss of quality in the operation of the receiver, a similar discrepancy in pentodes would cause the set to behave very poorly. Furthermore, let but one element burn out in the costly pentode and the entire tube must be thrown away, an uncalled for waste. It might be compared to an automobile so fabricated that when one tire is worn out the entire car would have to be thrown away. This is also true of the triode, but, being a less expensive tube, the waste is less.

New Problems Appear

Nor is it at all likely that the pentode will vie with the triode in popularity for use on the common volt AC current generally used. For this work, still other problems present themselves.

At present the common practice is to use two 245 tubes in push-pull circuit, in order to reduce the AC hum and improve the tone quality. The greater complexity of the pentode circuits and the cost of the tubes make the practicability of using pentodes in push-pull an open question.

Neither would it be advisable to use a single pentode for the same results now obtained by two triodes in push-pull.

Casts No Aspersions

I do not mean, by enumerating these problems and disadvantages of the pentode, to cast aspersions on the work of those who are trying to perfect the tube. The pentode has its uses. The increasing vogue for portable sets and for battery operated sets for the farmer may bring about a demand for the pentode. The revival for which I earnestly hope in the fields of amateur radio may create a demand for one-tube amateur transmitters.

But the widespread acceptance of the pentode for regulation receivers is most unlikely. If it does take place it will be. I believe, purely a temporary move on the part of set and tube manufacturers, for the purpose of instigating greater sales by use of a novel incentive to get the latest.

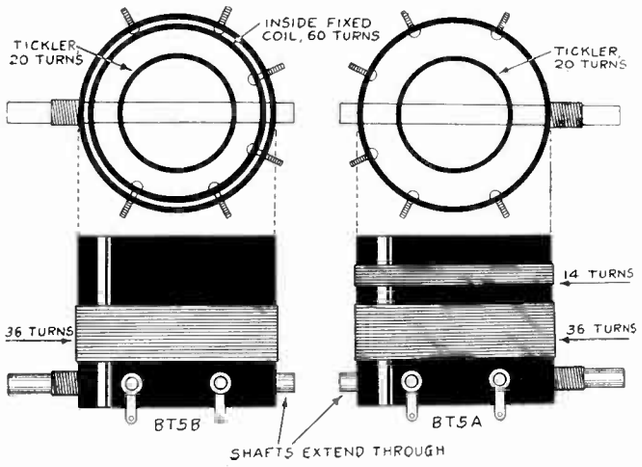
Doubts Much Improvement

From the standpoint of an engineer, I doubt that the use of the pentode in regulation receivers will improve the reproduction quality. Development along the line of the pentode is not without its value. Great use will be made of the vast storehouse of information to which such experimentation will lead. And the day will come when some phases of radio will be greatly benefited by the use of the pentode. I doubt if a phase will be the wired home broadcast receiver. And I am sure that the day is not listed on this year's calendar.

How Many Stages of T

Performance of One, Two and Three Steps of Ampli

By M. J.



COILS FOR A TWO-TUBE CIRCUIT

For a two-tube design special coils may be used with a screen grid RF amplifier to enable large amplification. On a 2½" diameter a 14-turn primary and a 36-turn split secondary, continued on a tickler of 20 or more turns, may be used. The other coupler, for interstage, could have three forms. The outside form would be 2½", with 36 turns, the moving coil 20 turns or more, but of the same number as the other dynamic coil, while a 2¼" diameter inside would have 60 turns. These data are for .0005 mfd. condensers. The condenser and coil objects are united by a link, and the same motion turns both. The tuned interstage winding goes in the screen grid plate circuit, the 60-turn winding, untuned, in the detector grid circuit.

WHAT a receiver can do depends on so many factors that you cannot point even to a specific diagram and predict the performance, since the diagram does not tell you, for instance, how many turns of wire are on the primaries of the radio frequency transformers, if shielding is used, whether the shields are copper, aluminum or tin, or anything about a thousand and two other details that may be important. But it is certainly rational to assume proper values have been assigned to a circuit, and on the basis of that assumption, inquire into the performance, even independent of an actual working test, although there is no fitting substitute for a demonstration. Theory is a plan, performance is a structure.

Let us consider tuners only, that is, radio frequency amplifiers with detectors, independent of audio frequency amplification.

The one-tube design is interesting only to beginners, and to schoolboys particularly, for the fun of working something of one's own making. To be useful it has to be regenerative, and usually a rotary coil connected in the plate circuit of the tube, and capable of inductive coupling to the secondary, is used. The selectivity is not sufficient for modern needs. The sensitivity is too low, also. Besides, the set radiates, and this inflicts punishment on other listeners-in, although by careful manipulation of the movable coil, or tickler, radiation can be avoided. Can be, but isn't, describes the situation nicely and fairly.

Two-Tube Circuit

We come now to the two-tube design, consisting of a stage of tuned radio frequency amplification and a detector. For battery operation the detector will be of the grid leak-condenser type, which is more sensitive, but for AC operation, although the same rule of sensitivity usually prevails, it is customary to have negative bias detection. There is no absolute requirement that a negative grid be maintained in a two-tube design, even for AC, but a good reason for using it on AC is that the RF amplification is usually high enough to justify the lesser sensitivity, and we can enjoy increased selectivity. The negative bias type of detection increases the input impedance, and this helps selectivity, as the higher the impedance the farther is the removal from a short circuit.

Naturally, there will not be too much selectivity in the two-tube circuit, but even without controlled regeneration the selectivity may be high enough for moderate needs. For battery operation it is customary in the two-tube design to have the detector regenerative, and even in AC models this method is sometimes employed.

While a two-tube circuit is modest in the number of tubes, it is also modest in performance. In other days we were accustomed to bring in considerable distance not only on two tubes but indeed on only one, but that was before you had to cut through powerful locals that were prohibitively close in frequency to the desired distant station.

The sensitivity will be high enough in a two-tube design to enable one to get a fair measure of distance, if three-element tubes are used with regenerative detector, either AC or battery-operated. If a screen grid tube is used as radio frequency amplifier, especially if the plate circuit is tuned, the sensitivity, without a regenerative detector, may be about the same as in other two-tube designs using regeneration. But the selectivity will be smaller unless coils are used which are specially designed to overcome this difficulty.

Tubes and Controls

Sometimes a screen grid tube is used as detector, and if so the plate load on the detector must be a high impedance to audio frequencies, preferably a resistor. Negative bias detection is favored for the screen grid tube, as this tube shows scarcely any greater sensitivity when the leak-condenser method is introduced, and the selectivity is then lowered.

The number of controls assumes some importance in a two-tube design. It should be accepted as a certainty that if each circuit is independently tuned there will be greater sensitivity and greater selectivity. No matter what efforts are made to overcome this situation quite likely they will not fully succeed, since at least some small loss must be tolerated if gang condenser operation is installed. Despite this, the single tuning arrangement is preferable to many, both for convenience and appearance, especially as it lends itself most readily to the introduction of the attractive drum dials.

When a three-tube tuner is used one gets into the class of receivers that may be classed as highly sensitive and excellently selective. On smaller undertakings no shielding is required, indeed, it institutes a loss that the circuit can not well afford, but where there are two stages of tuned radio frequency amplification, and of course, where there are more stages, shielding is necessary. It is possible to mount the coils at critical angles to avoid the use of shielding, but the slightest jar would upset this neutralization and render the circuit unmanageable.

Gainful Losses By Shielding

On the subject of shielding, it is well to repeat that the shields introduce losses. Take a single stage as an independent circuit. If you put a shield on the coil the effective inductance decreases, the self-capacity increases, the resistance increases, and the signal level decreases. The losses are due to energy absorption by eddy currents.

This is the case with a single circuit, and it is obvious that such a circuit could not support any such loss. Neither would two stages justify shielding, unless possibly on short-wave receivers.

But when we use two stages of high-gain radio frequency amplification, as with screen grid tubes, or perhaps the pentodes now being introduced to the American public, we need the losses caused by shields to make the circuit stable, for it would be uncontrollably oscillatory at least on the higher broadcast frequencies, without the shields, and usually would be unreceptive all over the dial.

Shields Like Brakes

The need for shielding is on the same plane as the need for a brake on an automobile. If the radio frequency amplifier is regarded as going at high speed all the time, and is likened to an automobile going down a steep hill, with much "interference" all around the motor car, represented by other vehicles and by pedestrians, then we soon realize the importance of riding downhill with the brake on. By no other method would the car be controllable. In the receiver, the shield being the brake, the high-speed vehicle of the air becomes stable. If there are losses they are gainful losses, just as the power expended on braking the automobile is gainful.

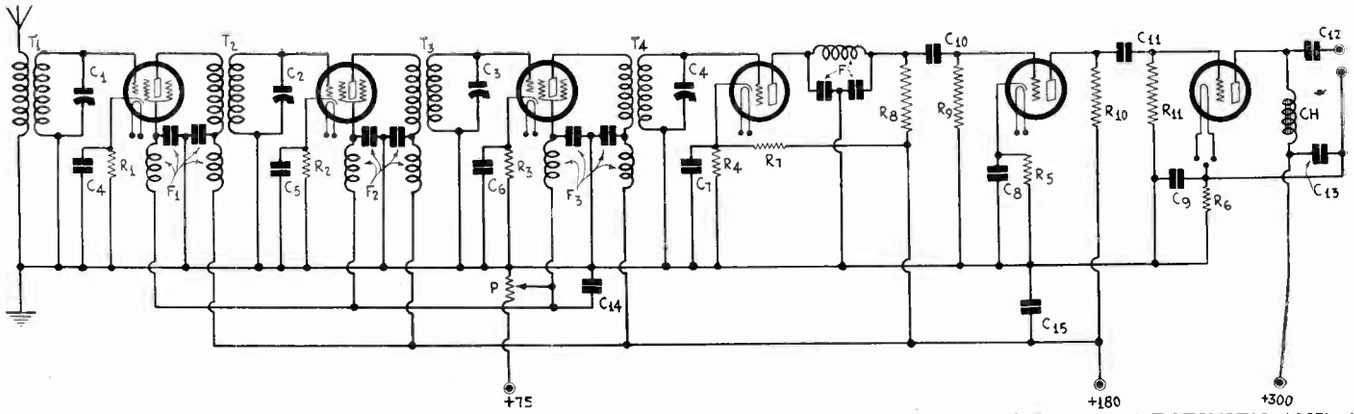
Thus by increasing the tubes or the gain per stage we elevate the amplification on the one hand but destroy it on the other, with shields. The benefit arises from the preponderance of the construction over the destruction, but it is obvious that the gain is not directly proportional to the number of tubes, for finally if we use one tube too many we tend to deaden the receiver.

Especially when considering receivers that establish high gain in two or more stages of RF ahead of a detector is it necessary to make the distinction between performance of AC tubes and

RF Shall You Choose?

fication Analyzed—Fourth Untuned Circuit Discussed

W. Boyd



AT PRESENT FOUR TUNED CIRCUITS ARE MOST POPULAR AS PROVIDING ADEQUATE SELECTIVITY AND A HIGH DEGREE OF SENSITIVITY. NOTE THE EXCEPTIONALLY CAREFUL RF FILTRATION IN ABOVE DESIGN.

battery-type tubes. Screen grid tubes being almost the unanimous choice, it should be remembered that the AC and battery types of these valves, while similar, are by no means identical, as is confirmed in performance tests.

224 of Higher Gain Than 222

The AC screen grid tube, 224, is considerably more effective as an amplifier than the battery type screen grid tube, 224. In multi-stage designs the effect, while the same relatively, is greater absolutely, because of cumulativeness, or the compounding of the gain. If a circuit, with tube included, gives a gain of 18, and another a gain of 16, you might say offhand there was not much difference, but in two stages the comparison would be 256 as against 324, and you might consider that a substantial difference. The 224 as against the 22 is about 3-to-2 stage.

Gain by computation, based on tube characteristics, to furnish what may be termed a prediction of performance, is often misleading.

The arithmetic may express a hope, rather than state a fact. It is true, for instance, that higher gain is obtained from a properly-constituted screen grid circuit than from one using three-element tubes, but the performance had better be measured, rather than estimated or predicted, because the extraction from the screen grid tube of even nearly the gain of which it is theoretically capable has not yet been accomplished. About the best that has been done is to tune the plate circuit, and overcome any over-capacity effects by special coil design, so that the plate circuit has a high impedance due to resonance. If the single tuned circuit were absolutely selective the impedance at resonance would be greater than any number that could be ascribed, that is, it would be an infinite impedance. But the circuit is not absolutely selective, only relatively so, and has a finite impedance. Suppose this is 200,000 ohms, perhaps an incredibly high assumption. With a screen grid tube's plate impedance of 800,000 ohms, how close do we come to having a relatively high load impedance? The plate impedance is four times as great as the load impedance under the most favorable condition, of a tuned plate circuit, and on the basis of an almost rashly high assumption of the impedance at resonance.

So we realize that we are not working the screen grid tube at anything near its maximum possible gain, and we know from experience that if the maximum capabilities were capitalized, we would have to invent some method of stabilizing so keenly sensitive a circuit.

Some Sidelights On Pentode

That is one reason why the pentode is being put forward as a radio frequency amplifier: the fifth element is intended to reduce the plate impedance so that a practical load may be placed on it to obtain great amplification. The problems of selectivity, because of a possibly reduced number of tuned circuits due to fewer tubes used, and of squealing, due to higher gain, have yet to be solved practically for these tubes, at least by persons who have not yet tried to work them to the hilt.

Experimenters in general have had no experience whatever with these tubes, as the valves have existed only in the British market, and even the British tubes were somewhat different geometrically and used principally as audio amplifiers. Therefore reports of results from these tubes are awaited by the American experimenters, who, if they hear glad tidings, no doubt will want to include the tubes in circuits they build from now on.

With two stages of high-gain radio frequency amplification it is always safest to use negative bias detection. This goes by the name of grid bias detection when the bias is relatively low and the plate voltage likewise, but is called power detection when the bias and plate voltages are high. The reason for the word "power" is that the detector under those conditions becomes capable of handling large amounts of power (principally voltage), as much as 10 volts of radio frequency input to the detector being withstood in many such circuits without detector overloading. High gain almost requires this. Extra-high gain certainly does require it, for an overloaded detector produces distortion which the audio amplifier is incapable of correcting. That is why volume controls are usually ahead of the detector, so that the amplitude fed to the detector may be lowered to the within the safety zone.

A leak-condenser detector overloads easily, but still may be welcome for that extra sensitivity, since the correction may be applied through a properly-placed volume control.

Other Than Screen Grid Tubes

While the discussion has leaned toward screen grid tubes, it must not be assumed that other types of tubes are not desirable. A few of the popular commercial receivers use 227 or 226 tubes as radio frequency amplifiers, with results commensurate with those obtained from screen grid receivers, although there may be an extra radio frequency tube in these non-screen grid models. The Neutrodyne, using 227 tubes, is an example of an excellent receiver, and its sensitivity, tube for tube, often excels that of a screen grid receiver, since in a receiver, circuit design and quality of parts and workmanship really count more than the type of tubes used.

Some manufacturers who did not take all the pains they should, but did select a screen grid design because the high-amplification tubes were popular in circuits, came to grief because they put out receivers made not only of poor parts but with a many unnecessary and vitiating parts included. There should be no prejudice against a receiver that does not use screen grid or pentode radio frequency amplifiers, since what should be the determining factor is the performance, and the type of tubes does not dictate the performance.

When more than two stages of tuned radio frequency amplification are used a lower gain per stage is tolerated, and usually has to be, to make the circuit controllable. The principal reason for using the third stage is to attempt to attain the same level of performance that would be possible if two stages of TRF were used, and each stage were independantly tuned. Therefore the third stage may be regarded as a loss-recouper on account of single control.

The three-stage TRF circuit uses a four-gang condenser, since the detector input also is tuned.

Three tuned stages of radio frequency are all that it is practo use with substantial gain per stage, as the problem of neutralization, by shielding or other means, becomes almost unsurmountable thereafter. If a fourth stage of RF is used it is untuned, and often is found in the first stage, as antenna input.

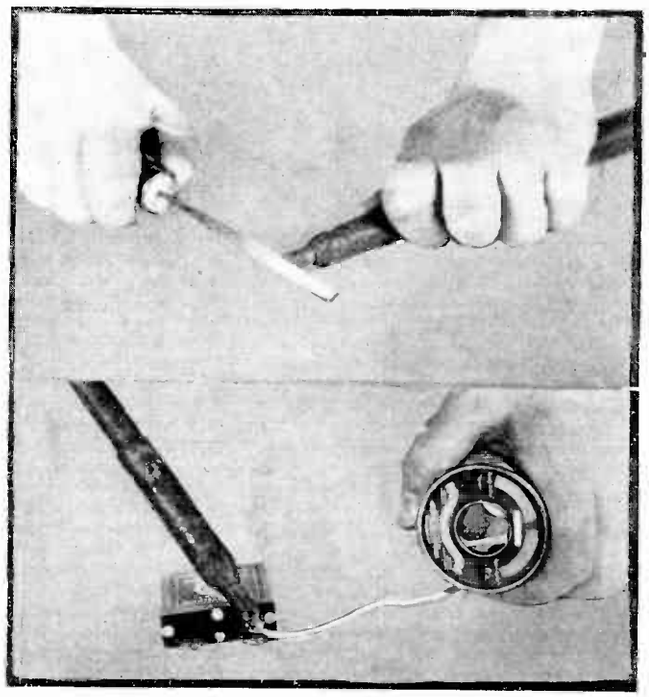
If the selectivity is high enough with four tuned circuits there is no object in adding a fifth tuned circuit, as the four-tuned-circuit gain certainly should bring the receiver's pickup almost to the noise level, where strays and atmospherics become so greatly magnified as to be reproduced at easily heard volume levels, whereupon the ultra-sensitivity passes the stage of an asset and becomes an annoying liability.

Profit by Soldering

Be Careful in Making Joints and Thus Avoid Trouble

By Herbert E. Hayden

Photographs by the Author



KEEP THE IRON TIP CLEAN. FILE IT BEFORE USING. IF YOU RESORT TO SELF-FLUXING SOLDER, MELT THE SOLDER AT THE JOINT, NOT AWAY FROM THE JOINT WHICH WOULD REQUIRE AN EQUILIBRISTIC CARRY-OVER.

NOBODY knows how many radio troubles arise from poorly soldered joints, but everybody knows that the number must be large. In fact, frankness compels all of us to admit that many a "bug" in a receiver of our own making turned out, after investigations that were baffling for quite a while, to be due to loose contacts, mostly poorly soldered joints, or joints not soldered but rosined.

These rosin joints are goat-getters. You have blamed many a good circuit for poor performance only to make it perk properly when the soldering carelessness was remedied. I have done this, I admit, and nobody need be too inquisitive about the number of times!

The first thing I think of in connection with soldering is the iron. Now, I would not have a no-good iron around my laboratory, and yet I visit the laboratories of my friends and I often find them working with a dollar soldering iron. There are two chief objections against this, and I mention them only for their interest, since I have no irons to sell, only to buy.

(1)—The wattage rating should be sufficiently high so that the tip will get hot enough to give instantaneous service when solder is applied to the tip. Otherwise the solder has to be applied up nearer the heater element, although on the casing of the iron, and this was not intended at any time to be a receptacle for solder. Besides the iron quickly acquires a most disreputable appearance, and with such a sight before one's eyes there is little inducement to keep the iron neat and clean. Also, the iron is defective for the intended purpose if the solder has to be heated so near the element to make the solder flow.

(2)—The tip must be kept clean. It will be found that an oxide forms on the tip, and that lack of attention to this condition will result eventually in pits forming in the tip. This corrosion gives the solder an uneven hold on the iron, so that the molten metal will run out unexpectedly, and sometimes strike places, even sensitive ones, on which it was never intended to rest. The iron should be filed before using, and then should have molten solder all around the tip, with no uncovered metal showing on the tip.

When any joint is to be made the first precaution to take is that there exists a natural and clean union. Flux serves the purpose of cleaning the joint, removing the impurities or foreign substances that might prevent the solder from sticking. Sometimes this flux is run through the core of strip solder, but I prefer to use separate flux, and not the so-called self-fluxing type. I use rosin, but I would not like to have the flux all over the iron tip when I am working the iron, because then if I desire to use solder by the carry-over method I know the solder will scoot off the tip. The self-fluxing solder makes the carry-over method precarious.

Most radio workers, I believe, prefer to melt some solder on the iron, and carry the molten bead on the tip over to the intended joint. But if you do use flux-core solder it is preferable to do all the melting right at the joint.

At the joint itself do not rely on the solder overcoming any distension or springiness. Make sure that the wire that is to go to a lug is physically secured to that lug before you use the solder to make the joint permanent. If you are in too much of a hurry to do this, at least see to it that the wire rests on the lug without any tendency to spring off, before you apply solder.

Never take two separated items and hold them together by force, as the only ready way to make a joint possible, and then solder, waiting for the cooled solder to keep the divers parts in place. This is not the kind of a joint calculated to live long or to render unfailing service, because it induces cold solder joints, due to movement of items when the solder is hardening. Any joint you make should be as good as you can make it.

Seek and Ye Shall Find Suitable Aerial

Photographs by Herbert E. Hayden

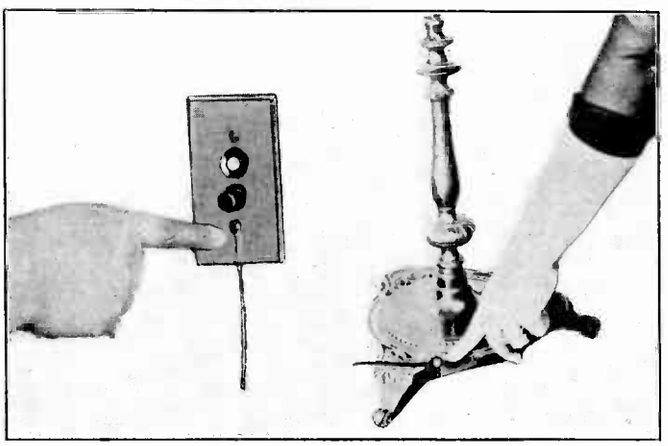
IT is not necessarily true that you must erect an outdoor aerial on lofty poles to obtain satisfactory input to your receiver. Often the outdoor aerial may be dispensed with, and this is in general a convenience, and not always a sacrifice of pickup, either. Besides, on windy nights you need not fear. Your improvised aerial will not blow down. That is, not if it is the holding-screw of the outlet plate or switch plate of your electric line, or if it is the metal stand of a floor lamp.

Suppose you desire to look about the home to ascertain what incidental aerial provisions exist. You will choose the radiator first, let us say. If you live high enough up in the air, as many moderns do, you may use the radiator as aerial and omit ground connection to the receiver.

If you want to use both aerial and ground "from the inside," you may choose the radiator as ground and the plate of the electric switch in your wall as aerial. This switch connects to the conduit and if it picks up either side of the AC line it will be the grounded side, and since your radiator or cold water pipe is grounded you can not pick up the "hot" side of the electric wiring.

In Summer the copper screen on the window serves as a fair aerial. Look around, experiment, and you'll be surprised to find that bedsprings all alone are not the world's champion incidental indoor aerials.

Sometimes you will profit by combining two aerial sources and using a good ground besides.



THE WALL PLATE OF AN ELECTRIC LINE SWITCH HAS FASTENING SCREWS THAT GIVE YOU ACCESS TO A GOOD AERIAL. THE METAL STAND OF A FLOOR LAMP WILL SUPPLY SOME PICKUP, TOO.

A Quick Testing Jig

Large Quantities of Power Transformers Speedily Checked Up

By John B. Brothers

IN many instances it becomes necessary to test a large number of identical units. For example, a factory turns out a large number of power transformer units for radio receivers, each transformer containing several terminals and windings. Each winding must be tested and every terminal must be tested for circuit perfection. To test each winding and each terminal separately would require a large number of operations and the time taken by the test operators would add considerably to the cost of the unit. In the interest of economy the testing must be reduced to the simplest routine and to the least possible number of operations.

Suppose it were necessary to take each unit and connect the terminals in the manner they will be connected in the receiver. A skilled operator could probably do this in 15 minutes. When the connections have been made the same worker, or some other worker specially skilled, would make the tests on all the windings and leads. Probably this would require 15 minutes more. At this rate relatively few transformer units could be tested in the course of a day, and the cost of the transformers would be greater the fewer the units that could be tested.

TESTING JIG

In such cases it is customary to build a testing jig by means of which all the connections can be made in a single operation requiring less than a minute. The same jig automatically connects the various leads to suitable meters or lamps which indicate the condition of the unit under test. A glance around the indicators suffices to determine whether or not the unit is in good condition. The entire testing job is done in about one minute and about 30 times as many of the units could be tested by one operator in the course of a day as if the same operator had to make all the connections separately. The jig can be operated by a person who is not specially skilled since the work requires only the operation of a lever and looking at some indicators.

As an illustration of the use of a jig in testing a power transformer unit we show the diagram in Fig. 1. The numbered circles in this drawing correspond to terminals of the transformer, with their relative positions approximately correct.

The first three terminals are in the primary of the transformer and are for voltages of 105, 115, and 125 volts, AC effective. One of these is the extreme terminal and the other two are only taps. Terminal (4) is the other extreme of the primary winding and, of course, is common for the other three terminals.

In view of the fact that a serious short circuit may arise in the transformer, it is safest to put a couple of one-ampere fuses in the supply line where indicated. The terminals marked AC Supply are for connection to the line and is not a part of the transformer under test any more than the fuses.

In order to test the three first terminals for continuity, it is necessary to connect each one in turn in the circuit and to note the effect. A three-point switch is provided for the purpose. This is the only part of the tester which is not handled in the single operation.

LAMP INDICATORS

There are two 2.5 volt windings on the transformer that are not center tapped, those indicated by terminals (13, 14) and (15, 16). To test these completely it is only necessary to connect indicators across them. For accurate reading of the voltages the indicators should be AC voltmeters, but for a simple continuity test it is sufficient to connect a 2.5 volt pilot lamp across each, as indicated in the drawing.

If the other 2.5 volt winding were not center-tapped this also could be tested in the same way, but the center-tap requires a more complex arrangement. The indicator across the total winding would test the entire winding, but not the center tap. A lamp across each half would do the same except when one side was defective, when the center-tap lead would be tested.

We now have the choice of testing the two halves separately, one at a time, thus adding an operation, or making the circuit still more complex to avoid the added operation. We have chosen the more complex arrangement in the drawing. A 245 tube is connected across the terminals (10, 12). If the tube lights up the filament is continuous, and if it lights up normally the voltage is right. We use this tube as a rectifier by connecting the grid and the plate together, although it is not necessary to use the grid at all. The plate is connected through a 10,000-ohm resistance to the terminal (7), which is one side of the rectifier filament. The center-tap (11) of the winding (10, 12) is connected through a 0-50 milliammeter to terminal (8), which is the center-tap of the high-volting winding (5, 6).

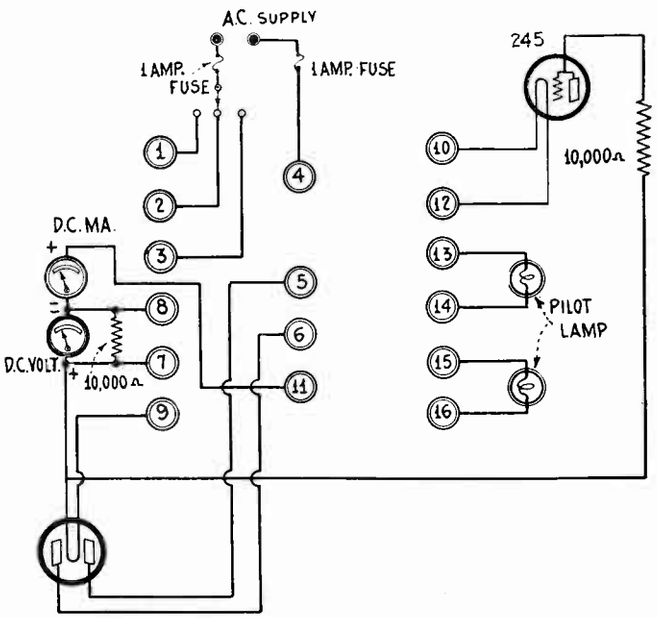


FIG. 1

AN ARRANGEMENT FOR TESTING A LARGE NUMBER OF POWER TRANSFORMERS IN WHICH THE TERMINALS ARE BROUGHT TO LUGS. A SPECIALLY CONSTRUCTED HARNESS MAKES ALL THE CONNECTIONS IN ONE OPERATION.

If the milliammeter shows a current the center-tap (11) is continuous.

HIGH VOLTAGE TEST

The high-voltage winding is tested indirectly by measuring the voltage across (8) and (7). The 10,000-ohm resistor in parallel with the meter is simply to prevent an excessive voltage. It should be noted that as far as continuity is concerned it would be sufficient to use the milliammeter since this also tests the high-voltage winding.

The test of the high-voltage winding is not complete, even if both meters are used. One side may be open and still the circuit would give indications on the two meters. But the center lead and one of the others is tested. To tell whether both the extreme high-voltage leads are intact it is necessary to judge the readings. The current and the voltage indicated when both extremes are intact will be about twice as great as when one side is defective. There can be no ambiguity after a few units have been tested, for presumably most of the transformers are correct.

The test for continuity of the five-volt winding is that the regular rectifier tube light up.

CONTACT HARNESS

When all the terminals of the transformer are brought to lugs or binding posts it is possible to construct a contact-making harness which makes all the necessary connections in one operation, just as plugging into a tube socket makes all the connections to the tube elements. Leads from this harness run to the various meters, indicators and tubes as illustrated in Fig. 1.

When the transformer does not contain terminal posts but is provided with leads, the testing is not so simple. It is then necessary to connect each lead as required by the circuit, one lead at a time. The testing jig is then not a great time-saver. When the transformer to be tested is of this kind it may be advantageous to test each winding with a voltmeter.

One way of doing this quickly is to connect two flexible leads to a low-voltage voltmeter and provide the free ends of these leads with sharp points which can be held conveniently in the hands. These leads can be connected across all the low-voltage windings, including the half windings in case there is a center tap, in a very short time. If the terminals of the transformer are insulated the sharp points will pierce the insulation very easily.

Resolved, That Distant R

AFFIRMATIVE

By Herman Bernard

THE radio receiver is solely an instrument of enjoyment. It may furnish entertainment, information, instruction, and all these constructive enjoyment.

As long as people live—and I assume even thereafter—they will have differences of opinion, a sign of mental health and vigor. Just as a college boy may consider a talk on the tariff boresome, and a jazz orchestra positively entrancing, so his father, a manufacturer, may spurn the jazz and delight in catching each word of the tariff talk. It so happens that the subject of distant reception is no different than a multitude of other topics, in that distance is enchanting to some, but of no interest to others.

Strong Fascination of Distance

I do not assume that a person who owns a good receiver and listens exclusively to local programs, with never a thought of even trying to tune in a far-away voice, is abnormal. But I do say that teeming thousands—aye, millions—delight in the distant program, and there is ample justification, although it is my private opinion that the fact alone is its own full justification. The distance-hunters may be in the minority, let us say, the imaginative minority, but their case is a strong one, and bears analysis.

If all those who at present take no interest in listening to distant programs would own a receiver that could tune in really distant stations, say, 2,000 miles away, with creditable loud-speaker volume, while the locals are on, operation of that receiver as a weapon of distance-hunting would add a new thrill to their lives.

The main reason why a person lacks interest in distance is that his receiver will not bring in the far-distant stations. Hence he resigns himself to his fate, a thoroughly human trait, and builds up an actual distaste for distance, that was formerly merely a lack of interest. It is like dreams of great wealth. How quickly they fade as soon as we become convinced that the goal is utterly beyond the making!

Must Step Far Out

I stress the point of *far* distance. It is not enough for a receiver in New York City to be able to tune in Chicago stations when metropolitan locals are on the air. What is heard from Chicago is little different from what is heard from New York City. The real test is to tune in a program and be thrilled by its difference. It is like travelling to strange ports, seeing strange sights and hearing strange voices. These attractions of travel are well known to those who have moved about this sphere more than a little, and distance receiving is next best thing to a personal visit to the point from which the broadcast is sent.

The people of the United States are not of one manner, one type of speech, one personality or one habit of thought, thank goodness, and the fetching variety of the population, when it strikes home, enables one to get a better grasp of the anti-cosmopolitanism of our population, and to become familiar with the diverse phases. It should be attractive to every American to learn this much at least about those who live in his own country.

We may look upon the reception of far-distant stations, therefore, as educational, as a means of broadening one's knowledge of American speech habits, and indeed as an introspection into the segmented culture of the forty-eight States.

It can not be denied that there is an inherent charm in the Southern manner of speech, and that a trickling sensation of delight accompanies its reception on a cold, wintry night in a New York City apartment, at a time when roses may be blooming at the point of origin. It may be true, indeed, that an orchestra is playing "If I Had a Talking Picture of You," and you may have made quiet reservations to avoid tuning in that song whenever possible, but there is still the announcer to attract you, and the Southland is marked for the originality and charm of its announcers.

What people are thinking about and how they are behaving themselves in California should be of interest to a New Englander, too, and with a very sensitive receiver he can frequently pick up the West Coast, bringing in stations from California to Washington. And that same receiver will bring in Texas and intervening points, as well as reach easily into Canada, where a different mode of program presentation exists.

The English and the French

If contrasts in manner of program treatment are interesting to listeners, and I can't understand why they should not be, Canada is a likely area from which to draw for one's demonstrations. You may tune in an announcer who has an English accent, which happens frequently enough, or if you are listening to another part of the Dominion you may hear the announcement in French, only to learn in a few moments, alas, that the fluent Frenchman is really of British origin, by his speech in Brighton English.

You will ascertain a great deal of data concerning the doings, habits and thoughts of remote localities by listening to programs that originate there, for talkers at these stations will take pains to inform you.

Particularly interesting to listen to are the small distant stations, where a degree of informality reigns that is not tolerated in the great studios of the populous centers of this Continent. I may as well admit that some of these entertainments are the more entertaining because the less formal, and remind one of amateur night as it reigned in playhouses throughout the country a quarter of a century ago. The best we get along that line from almost any of the stations in the high-power class is an imitation of amateur night, but I would like to know when an imitation begins to be more real than the original!

Some of the statements you hear, from small, distant stations, are as funny as any standardized humor can ever be. Here is what I heard one night:

"Ladies and gentlemen, our kind listeners, may we now inform you that this musical program, presenting the Gishwish Orchestra, is, of course, offered to you for its entertaining value, but it must be admitted that it is paid for by the Gonkwon Tea Company, which uses this means of obtaining your attention, so as to accelerate the sales of its worth-while wares, Combonk Ceylon Package Tea and Undyke Loose Ceylon Tea, and we trust that we have not trespassed upon your credulity."

Now, you can not tune in anything as rich as that on any chain programs over a Coast-to-Coast network.

It must not be supposed that the United States and Canada alone offer an open road to the ultra-sensitive receiver. There are stations in Central America and South America that can be received, also in Cuba, and these are particularly interesting to any who have a knowledge of Spanish. And yet if one knows only the English language, certainly he can understand the universal language of music, and to hear native music played by native talent on their native soil is refreshing.

Where Aloofness Turns To Fervor

As good a confirmation as is possible of the assertions that far-distant reception is undeniably attractive is that you can win any one's attention with the invitation to come to your house to "hear Cuba."

"Oh, I don't care two cents about hearing Cuba," may be the worded reply, but the acted reply will be the presence of the disavower under your roof at the appointed time. The only precaution necessary is that you must be able to make good your boast. If you boast conservatively you should be able to make good.

In the homes today throughout this land conversation goes on merrily while the stations are being received. But if you will say to New Yorkers in their home town, "Listen, this is San Francisco," you will be astonished how long the whole company will listen in silent attention. Silence for as much as two minutes has been recorded. Of course this duration could not be possible in Venice or Paris.

There are times indeed when one can not find an acceptable program on the local air. Those certainly are good times to go after distance. You can not be so jaded as to be unable to pick up anything that interests you, with sixty to seventy stations at your command.

To have a receiver sensitive enough to perform well on distance it is often necessary to build the receiver yourself, for few commercial receivers are as sensitive as that. That accounts to a great extent for the widespread disinterest in distance, as already stated. The dissemination of factory-made receivers among the population has put into the hands of almost the entirety of listeners receivers of only moderate sensitivity. A man familiar with the performance of factory-made receivers told me that there were only four that could be called super-sensitive.

Effect On Sidebands By Super-Selectivity

Any one sufficiently desirous of getting real distance can own a receiver that will deliver it to him, and deliver it consistently, although the range is subject to the familiar limitations of moisture, heat, light and barometric pressure.

To bring in stations 2,000 miles off, or more, requires selectivity of a high order. The question will be raised whether there is sideband-cutting. Locals will come in with very good quality, because the relative selectivity is less as the signal input is greater, but as to out-of-town stations there will be sideband cutting and it is all right that there should be, as we are not concerned particularly with the finest quality of hissing sounds and other upper frequencies of the modulation, on distant reception, but with bringing in the station. That done, all is done, and what a kick there is in it!

Merely medium distance offers little attraction, I agree. I think the mistake most persons make who profess no interest in distance is that they mistake reception of stations a few hundred miles away as bona-fide distance. When I say distance I mean more than a thousand miles. An exception would exist as to inhabitants of the United States who live, say, a few hundred miles from the northern or southern border, for to tune in stations from the other side of the line is as good as reaching out a couple of thousand miles within

eception *Is* Worth While

NEGATIVE

By Charles Norton Salmon

THE novelty wore off radio reception in 1923 and if there is any appeal that radio has in 1930 it is quality. On every hand we find confirmation of this fact. Audio channels have been developed so that they can cope with rigorous quality standards of excellence. Detector circuits are so arranged that fine quality is possible even at a strong input to the detector. Even the radio frequency selectors are specially made, so that they shall not discriminate too much, nor be permitted to discriminate too little. The programs obtainable from local stations and stations not quite local but within easy enough reach to be considered as such, give us the highest quality of performance.

I would like to ask one question right now: if by tuning in distant stations all you can get is not as good quality, why not enjoy the quality that has come about only after much exhaustive work in laboratories and broadcasting stations?

Ultra-Selectivity Called Ruinous

Suppose you have a receiver that is capable of getting stations on the other side of the Continent. What have you, in the way of a receiver? Is it an instrument capable of delivering even on local reception the quality that is put into the program by the station? No, you will have a receiver that does very little toward reproduction or indeed reception of frequencies in the modulation higher than a bare 3,500 cycles, and I submit this is not nearly enough—not by at least 1,500 cycles.

There is no reason for having a receiver that is gaited to receive over great distances programs admittedly inferior to ones obtainable "at home," and which receiver at the same time can be relied on most assuredly to spoil the quality of the local programs.

Even the local stations bring in programs from different parts of the country often enough, should any one be inquisitive as to how a native Californian handles his r's, as compared with some urchin of the New York City streets. Chain broadcasting, with parts of a given program originating from scattered points of the country, or at least from two places, are not infrequent. There may not be the same thrill in hearing this distance mainly through the kindly assistance of telephone wires, but the hearing of what is said, sung or played is far better than by space radio over long distances at broadcast wavelengths.

Another Novelty Gone to Smash

Recently the radio public has been treated to foreign reception, even hearing the King of England speaking at the opening of the London Naval Conference. The foreign programs are received here on short waves and relayed on broadcast wavelengths over large chains, so that one need not starve for distance. One can scarcely avoid hearing it. The question whether one particularly enjoys it is another matter. In the instance of the King's speech, the thrill was in the fact that the King was being heard. The fact that the short waves crossed the ocean was of purely incidental interest. This novelty wore off late last year.

On broadcasting wavelengths there is not much incentive for any one to go distance fishing. He will pick up the same two programs on such a plethora of stations that his enthusiasm soon will be dissipated in disgust. What distance stations he does hear will not be as clear as locals by any means, and if the intervening distance is more than a few hundred miles there are the added distractions of static and fading.

If there were twenty-four, or one-quarter as many of the ninety-six channels as used at present, there might be some justification for going beyond the local stations, but I doubt even that.

A Jungle Hue of Heterodynes

At present there is no scientific possibility of receiving anything but bad quality from stations far away. Not only the sideband attenuation rises to torment you, but an almost incredible jungle hue of heterodynes is an inevitable accompaniment. Then when a signal from far away is tuned in it is an almost unrecognizable squeak from the bill of some unfamiliar call letters. You will find your DX hound with ear stuck into the flare of the speaker, and joyously announcing to any and all who may be present that they heard station DXOK very plainly, whereas they did not hear it all on all, only a wobbling twitter that had no meaning.

All this delightful distance reception you read about you never hear yourself. You need imagination indeed to hear it, much more imagination indeed to enjoy it and it is extremely doubtful if anything short of sheer nonsense is involved in this conglomerate fanaticism.

I do not know where a receiver can be purchased that will bring in stations rather frequently over a range of even 1,000 miles, nor could I build one myself that would be sure to give such performance, no matter how wretchedly, with any regularity whatever.

Getting Something Worth While

When I tune in a delightful local station, enjoying, as I frequently do, some choice feature of either of the two large chains, I know I am getting out of radio about all there is in it. The best voices, the best bands and symphonic orchestras, the finest modulation, the most expert monitoring, all these gush at me, and if I am fool enough to turn aside from this for the uncertainties and perplexities of strange toots, whistles and gurgles from some distant town, I myself am to blame. I will not choose awkward amateurism in preference to skilled performance. I prefer to choose the best, even if that choice is the easier, rather than waste my energies trying to make the worst audible. It is fortunate that distant reception comes in weakly. If it were loud enough for all to hear, it would be intolerable.

It may be observed that I lean toward the most important stations. They furnish the most important programs. If you were the personnel director of a large corporation, whom would you prefer for general manager, somebody of the utmost importance, whose record is well known and whose performance under all conditions is utterly reliable, or some unknown sadly tainted with uncertainty and indecision? In choosing your program you should use as good judgment as in making any other serious choice. You spend so many of your hours listening in that it is really important to your personal welfare and happiness, as well as to the satisfaction of your family, that you choose wisely.

It may seem one-sidedness to choose this way, since it is certainly no crime to tune in some distant station once in a while, but I ask, what is the use? What do you hear? What fun do you get? Once, twice, you hear the station, always weakly. Then what is there left? The only possible attraction, that of novelty, has gone. You will eat apples and oranges every day, but not pomegranates.

Extremely distant reception is nearly always a broad claim made for commercial purposes, but backed up by no guarantee. The attainment is so difficult, and is made, if ever, at such a draining expense of quality, that the result can not be rated judiciously as real performance. I find that these yarns about covering great distances on broadcast frequencies under conditions of the ether as they exist in the United States to-day, are largely imaginative or fantastic, and melt into the hazy horizon of their origin on the first scrutinizing impulse.

If there were anything valuable in the reception of distant stations the situation would become important enough to engage the attention of the Federal Radio Commission and the manufacturers of receivers.

It Could Be Made Easy, If Worth While

The Commission realizes that distance reception, once a popular sport, is now without any lure, while set manufacturers simply do not make hyper-sensitive receivers, which would be costly you may rest assured, because a man would get next to nothing worth while for his money. Instead he would have a receiver that was a serious offender in that it robbed the programs of their loftiest asset, tone quality, the really entrancing attribute of modern receivers.

All these things are true on the broadcast band of wavelengths, but not as to short waves. Any one who is a DX fan and who is concentrating on the broadcast spectrum is wasting his time. The field of operations for him are short waves. More and more is being accomplished in distance reception on short waves each day, and every enthusiast should join the fast-growing army of short-wave zealots. Then he can feel he has a good opportunity of reaching into the far distances, across the ocean, across a pair of oceans, for that matter. He will have his troubles, to be sure. Fading and atmospherics will be there to annoy him now and again. But he can bring in distance to his heart's content, domestic distance, foreign distance, almost anything this side of the moon.

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one's own country to get that "something different" which entices everyone.

My cure for distance opponents is to treat them to some real distance, brought in loud enough to be heard plainly twenty feet from the reproducer, filling the room with enjoyment without the necessity of any strain of neck or ear.

If you will get beyond the semi-distant range you will not find the chain broadcasting such a problem. It is true that with a sensitive receiver you may tune throughout the scale of the dial and pick up the same program from a dozen stations, as to one chain, and sixteen stations as to another program on a second chain, but the receiver may be responsive to as many as sixty or seventy stations, and you may pass up the stations, no matter how far off, that subject you to ditto reception. One fact that helps, however, no matter what the program, is that if the station is far, far away and you bring it in loud, all is well with your receiver on the sensitivity and selectivity score, and all you need do is to tune about for some more acceptable program.

It is not intended, either by Providence or me, that anybody should devote his life to tuning in far-distant stations. I do not advocate the avoidance of local reception. I favor strong concentration on locals, but not to the exclusion of hunting for distance, nor for the reason distance is not a superlative and substantial attraction.

POLITICS RULES WAVE GRANTS, CALDWELL IDEA

The transfer of WGBS, New York City, from 1180 kc. to 600 kc., whereby WMCA and WNYC, both on 570 kc, are only 30 kc. removed, was characterized by Orestes H. Caldwell, former Federal Radio Commissioner, as an "ominous and disquieting" action.

"The Commission has taken the first step backward toward the very conditions of such 30 kc. spacings and consequent bedlam which so nearly wrecked radio in 1926," he told the Massachusetts Institute of Technology Club in New York City.

WMCA and WGBS are privately owned commercial stations, while WNYC is owned and operated by the City of New York. The WNYC transmitter is in the Municipal Building, while that of WMCA is in Hoboken, N. J., and that of WGBS in Astoria, L. I. The studios of all three stations are in New York City and the stations are in the city quota.

WMCA quickly protested to the Commission against the assignment to WGBS, and repeated its request for an exclusive local wave on full time. WNYC soon followed with a similar protest and request. The time sharing on 570 kc has been obnoxious to both. There have been several open quarrels between these two stations, but not lately. Now they are united in their attitudes toward WGBS, since they had been told that their own time-sharing was necessitated by the 50 kc minimum separation between locals, and then WGBS got a "berth" only 30 kc away.

Wants Politics Barred

Mr. Caldwell did not mention call letters in his talk, but his reference was plain enough. He asked that engineering considerations alone should govern assignments and politics should be ruled out. Political pressure was making itself felt on the Commission, he added.

"One of the ominous and disquieting events which points this new trend," said Mr. Caldwell, "is the assignment of a New York City station to a channel only 30 kilocycles away from two other local New York stations in spite of the consensus of all radio experience that a spacing of 50 to 100 kilocycles is desirable between stations in the same community.

"Moreover the assignment mentioned put the New York station on the same channel with a popular Baltimore station only 160 miles away although such separation should not be less than 1,200 miles away for good service.

Cross-talk Results

"The result of this grievous assignment is to produce cross-talk locally between the two New York stations so close on the dial, while in both New York and Baltimore the channel affected is beset by a howling heterodyne outside of the immediate precincts of the stations themselves.

"By its regrettable order the Commission has thus taken the first step backward toward the very condition of such 30-cycle spacings and consequent bedlam which so nearly wrecked radio in 1926 following the law's breakdown. One such permit is bound to lead to other demands for similar assignments, backed by added political pressure, now that the entering wedge is driven.

"The Commission has committed a serious mistake in yielding to politics and outraging the first principles of radio. The damage it has done can be repaired only by an immediate restoration of sound operating conditions at every point on the dial. Restoration made, the Commission should next proceed to make broadcast conditions better, not worse.

"It will cost the radio industry millions of dollars in future sales and the public an immeasurable loss of priceless facilities if the radio structure is allowed to crumble under insidious but cumulative unsound modifications. Political meddling must not be permitted to let broadcasting slip back again toward the deplorable bedlam of 1926."

WGBS Calls Its Wave Justified

WGBS, owned by the General Broadcasting Company, was formerly owned by the Gimbel Brothers department store in New York City. Dailey Paskman, who was director of the station in the store, is at the head of the succeeding organization. The studios are in the Hotel Lincoln.

Mr. Paskman said that in the reallocation of November 11th, 1928, WGBS received a low wavelength, and not a very favorable one, whereupon steps were taken in an attempt to procure an improved position. The Federal Radio Commission has had the request for a better assignment under consideration for more than a year, he added.

WGBS, Mr. Paskman contends, has been on the air longer than several other metropolitan broadcasters, and following the assignment of a low wavelength in the allocation, had the promise that a better assignment would be made when the facilities were available.

NEW YORK CITY FILES PROTEST

Albert Goldman, Commissioner of Plant and Structures of the City of New York, and as such in charge of WNYC, protested to the Federal Radio Commission that WNYC was denied full time by the Commission, and the action was upheld in court, on the ground that to grant the petition would mean the elimination of WMCA, but now WGBS is put on a wave not previously used in New York, so the alleged impossiblity did not and does not exist.

"It now develops that it was neither impossible nor impracticable to grant the city's application," Mr. Goldman wrote in his protest. "There was another frequency to which WMCA could have been shifted and the Commission's finding regarding the complete elimination of WMCA was wholly unauthorized and not based upon the facts.

"As it appears to be not only possible but practicable to create this additional regional channel without creating interference, such channel should be assigned to WMCA and not to another station operating on a frequency of 1,180 kilocycles far removed from the 600 kilocycle channel.

"Since WMCA has now applied to you for the 600-kilocycle channel the equities of the situation require that its application be granted and that the city station should be restored to its original unlimited time of operation.'

The station that operated on 1,180 kc. was WGBS, now on 600 kc.

RCA TO BE SUED AS A "TRUST" IF LAW JUSTIFIES

Washington

The Department of Justice, through John Lord O'Brian, assistant to the Attorney General, notified the Senate, by a letter to Senator Couzens, of Michigan, that the investigation of the Radio Corporation of America and affiliated companies under the anti-trust laws, because of patent pooling, is being continued, but that the legal problem is one of the most complicated.

The letter was addressed to Senator Couzens as chairman of the Senate Committee on Interstate Commerce, which is holding hearings on the Couzens bill to establish a department of communications. The letter followed an inquiry by Senator Couzens as to the status of the the case.

Mr. O'Brian wrote:

"As you are no doubt aware, all of the proceedings taken by the Radio Corporation and its affiliated corporations have been guided by the advice of some of the best known lawyers and patent experts in the country.

One of Most Complicated Cases

"As shown by the briefs filed before the Federal Trade Commission and their (the RCA counsel's) recent statements, it is their claim that every act complained of is protected by legal monopoly granted by the United States Patent Office and they still own or control about 3,500 patents.

"In this important aspect the case presents a conflict between the anti-trust laws enacted to prevent monopoly and the type of monopoly created by the government through the issue of patents. It is not an exaggeration to say that the case is one of the most complicated ever examined by this department.

"In addition to the patent features, other legal questions are presented by the types of contract and corporate forms employed by the parties as well as by their business practice.

Sifting Problem

"Until the legal questions presented by conflicting representations on the more important claims can be solved it will be impossible for the department to reach a conclusive opinion as to whether the parties have in fact exceeded their legal rights and have in fact transgressed the anti-trust laws. The work on the case is being done by two of the ablest men of this division, under my personal direction.

"From the progress already made it seems probable that the department will be able to define its attitude within another three or four weeks' additional time. Nothing more can be done to expedite its consideration than is being done.

"I can assure you, however, that the case is receiving preferred attention, and that if as a result of the present intensive study the conclusion is reached that any legal proceedings are justified, such proceedings will be promptly instituted."

WRVA SEEKS MORE POWER

Washington

Larus & Bros. Co., Inc., of Richmond, Va., has requested authority of the Federal Radio Commission to increase its broadcasting power of WRVA to the maximum of 50,000 watts. The station has been using 5,000 watts on the cleared channel of 1,110 kilocycles.

THIEF OF TIME ON AIR, CHARGE AGAINST MAN

Washington

The Federal authorities in St. Louis, Mo., have arrested George W. Fellowes upon a warrant issued under the provisions of the national radio act, charging operation of a broadcasting station without license and interference with interstate commerce, it has been stated by the Department of Justice. The statement of the department follows:

Information has been received at the Department of Justice of a case brought under the penal provisions of the national radio act, involving one George W. Fellowes, at St. Louis, Mo. Fellowes was arrested on a warrant charging operation of a station without a license and interference with interstate commerce by interfering with the broadcasting of other stations. The radio inspectors of the Department of Commerce made the charge that operation of a broadcasting station by Mr. Fellowes was interfering with programs issued by licensed stations.

Investigation was made by officials of Department of Justice which disclosed that Mr. Fellowes would, by means of his apparatus, re-broadcast over his station a program being broadcast from one of the other stations. In this way it was alleged that he was "stealing a program."

Through arrangements perfected with a licensed station, the operations of Mr. Fellowes were disclosed and a search warrant was issued and some of the apparatus in connection with his station, employed in ascertaining the wave length, was seized

The facts in connection with the case are shortly to be presented to the Federal grand jury in St. Louis. The offenses enumerated in the radio act are felonies, with a maximum punishment of five years or fine of $5,000, or both.

2,000 Applications For Radio Patents

Washington

Applications for patent protection are pouring into the Patent Office at the rate of 85,000 a year, and the examining force is faced with 113,000 applications on which action must be taken. Every effort is being made to catch up with the flood of applications. Many applications have been pending for several months and there are some that have been pending for as long as three years. The long time required to dispose of some of the applications is due to arguments among inventors, their counsel and the patent officials as to what features of the applications are patentable.

There are no fewer than 2,000 applications on radio inventions alone, covering new developments in this line in the United States. This fact is indicative of the rapid progress being made in radio.

DeForest an Editor Of New 'Electrons'

Lee DeForest has been appointed consulting editor of the new publication, "Electronics," to be issued by McGraw-Hill. The new publication will deal with applications of vacuum tubes to entertainment, educational and industrial purposes, as well as to technology. The first issue will be the April number

RCA Asks U. S. To Drop Tube Case

Washington

The Radio Corporation of America has requested the Federal Trade Commission to withdraw its complaint against the Radio Corporation which charges that certain patent licenses granted by the Radio Corporation of America to manufacturers of radio receiving sets violated certain sections of the Clayton Act and the Federal Trade Commission Act. It was charged that the license agreement required licensees using RCA patents initially to equip their sets with RCA tubes instead of tubes made by other manufacturers. The request follows:

"The Radio Corporation of America moves that the case be dismissed, such dismissal to be without prejudice to the right of the Federal Trade Commission to proceed against the respondent at any time in the future, for any cause, or in the alternative that the cause be put upon the suspense docket until further notice."

The Commission has taken no action on the petition and no time has been set for a hearing.

'SCHOOL OF AIR' TEST IS BEGUN

Washington.

The United States Office of Education is encouraging the educational broadcasting experiment of "The American School of the Air," which opened the first of a series of programs under the auspices of the Grigsby-Grunow Company in co-operation with the Columbia Broadcasting System, the Commissioner of Education, William John Cooper, stated.

As a member of the advisory council of the School of the Air, of which the Secretary of the Interior, Dr. Ray Lyman Wilbur, and the Assistant Secretary of Commerce, Julius Klein, are members, Dr. Cooper pointed out that this experiment will be watched to ascertain the possibilities of radio in education.

Dr. William C. Bagley, professor of education, Teachers' College, Columbia University, heads the advisory faculty of the school, which consists of educators in different branches of learning.

The American School of the Air will broadcast programs twice a week for 15 weeks. The program is to broadcast every Tuesday and Thursday at 2:30, Eastern Standard Time, and continue one-half hour. The Tuesday broadcast will deal with American history and that on Thursday will deal with literature, civics, art, music, health, nature study, and international good will.

The first program was opened by the chairman of the Federal Radio Commission, Ira E. Robinson. After the formal opening Columbus was the topic of discussion.

It has been estimated that this experiment reached more than 6,000,000 school children through approximately 150,000 receiving sets.

Dr. Cooper called attention to previous statements by the Secretary of the Interior and himself that the Office of Education will aid any broadcaster who is planning educational programs.

OPERATORS WORK 2 HOURS DAILY

Rudolph L. Duncan, president of RCA Institutes, said that the usual ship operator works little more than two solid hours per day, with the remaining 22 hours more or less for himself. He may be on watch for eight hours at a stretch, but listening in for calls does not prevent him from engaging in useful study, Duncan added.

JOB ASPIRANTS FOUND LACKING IN KNOWLEDGE

By RUDOLPH L. DUNCAN

It's about time that the myth of easy radio men be exploded. The idea that mere radio knowledge immediately qualifies one for a position of wealth and affluence is just as foolish as expecting the graduate of the law, engineering, medical or journalistic school to attain fame and fortune overnight. Education is only the first, albeit very necessary step; hard work, constant application, and a specialized training, constitute the second and decisive step.

Radio and allied industries are more anxious than ever before to obtain qualified radio trained men. But it is well to note that they are looking for men with qualifications other than ability to handle soldering iron and pliers, or again the ability to handle a simple home-made radio set.

No Longer an Experiment

Radio today is no longer an experiment: it is a serious industry. With business running into hundreds of millions; with millions of sets to be produced each year; with hundreds of millions of capital and hundreds of thousands of workers, radio no longer can tolerate the handy man of pioneers memories.

Recenntly I had an opportunity of looking over the calibre of men applying for radio positions of trust. It is appalling to note how few men really know radio.

Operators Deficient, Too

Even radio operators who have been at sea for years, with many hours of leisure time each day in which to study, show a woeful lack of modern radio knowledge. Many cannot answer simple questions readily answered by our young students. Rather than bemoan the lack of good positions, many of our so-called radio men would do well to take stock of their radio knowledge.

Trade is Likened By an Executive As Kicking, Biting Herd

Washington

The radio industry has a bad reputation in the estimation of F. B. MacKinnon, of Chicago, president of the United States Independent Telephone Association.

Appearing before the Senate Interstate Commerce Committee, opposing the Couzens bill for a communications department, and favoring retention of authority over telephones in the Interstate Commerce Commission, he spoke the following:

"The association desires to say that its members prefer to remain hitched up with the railroad organizations than to be driven into the same corral with the kic - ing and biting herd that is known as the radio industry, which is involved in a patent battle and which has not yet arrived at a point where any sort of reputation can be applied.

"The association asks that until the radio industry becomes stabilized the telephone industry, which has been stabilized for years, be not hampered and confused by such a relationship as is proposed."

I. T. & T. TO PAY $100,000,000 FOR RCA UNIT

Washington.

Agreement by the International Telephone and Telegraph Company to pay to the Radio Corporation of America approximately $100,000,000 in stock for its radio communications unit was reached after protracted negotiations, during which the banking firm of J. P. Morgan & Company acted as agents for the I. T. & T., it was shown in correspondence involved in the transaction made available by the Senate Committee on Interstate Commerce.

Sufficient Information

After an executive session, the chairman of the committee, Senator Couzens (Rep.), of Michigan, said the committee felt it had sufficient information about the proposal, and consequently would not subpoena additional witnesses or documents concerning it. The committee, he declared, at this time does not wish to recall Col. Sosthenes Behn, president of the I. T. & T.

The chairman said that the committee has about completed the drafting of the legislation for establishing a department of communications.

Accord Reached

The correspondence, subpoenaed by the committee, from Col Behn, showed that the accord was reached after more than a month's negotiation in Paris, and that Col. Behn expressed an unwillingness to meet the figure set by Owen D. Young, chairman of the board of the R. C. A. at that time, and David Sarnoff, then R. C. A. executive vice-president.

Finally, in March, 1929, Col. Behn, who was in New York, cabled the Morgan representatives in Paris that the I. T. & T., subject to certain conditions, would meet the R. C. A. request for 400,000 shares of I. T. & T. stock, then having a market value of about $100,000,000, but a present value of $78,000,000.

Impelled by Behn

The memoranda, says the "United States Daily," were subpoenaed to ascertain the part played by the Morgan firm in the negotiations, since charges had been made before the committee now considering the Couzens bill for a Federal communications commission, that the Morgan firm had "forced" the transaction. Col. Behn, in testimony before the committee, denied this, saying he was the "impelling force."

The intended purchase is predicated on the removal of legal barriers that now prohibit interlocking stock ownership of communications corporations. The administration is believed to look favorably on such legislation.

New Corporations

Zee-Rad Co., Inc., Wilmington, Del., radio accessories—Corp. Trust Co. of America, Wilmington, Del.

Virginia Radio Co.—Atty. E. A. Carlin, 7 Hanover St., New York.

Crane & Vandernoth, radio—Atty. C. H. Seifert, Hempstead, L. I., N. Y.

Marti Radio Corp., Bloomfield, N. J.—Attys. Peck & Rawson, Bloomfield.

G. V. Radio and Battery Service—Atty. J. C. Zimmerman, 225 West 42nd St., New York, N. Y.

Fenton H. Davenport, Inc., Wilkensburg, Pa., Broadcasting station—Capitol Trust Company of Delaware, Dover, Del.

Couzens Bill Called Invasion

Montpelier, Vermont

The Vermont Public Service Commission passed a resolution opposing the Couzens bill.

The resolution states that the Commission considers the proposed legislation unnecessary and a serious impairment of the rights of the States without any corresponding gain, and a handicap to proper State regulation of the telephone and electric business.

The resolution submits the Commission's views of the proposed legislation to the Vermont delegation in Congress.

Vermont is the thirty-sixth State whose State Commission adopted a resolution opposing the Couzens bill. The attitude of the State Commissions is that Federal action on rates is "interference" and that only State Commissions lower rates, while Federal courts and commissions only raise them.

J. P. MORGAN CO. COURSE UPHELD

Washington.

The firm of J. P. Morgan & Co., the bankers, was absolved by the Senate Commerce Committee of having exerted pressure on the negotiators of the proposed merger between the Radio Corporation of America and the International Telephone and Telegraph Company, according to an announcement. Senator Couzens, chairman of the Senate committee, in commenting on the correspondence tracing the progress of the negotiations, said: "I think the Morgan firm acted very diplomatically."

The correspondence, which was made public by the committee, showed that Colonel Sosthenes Behn, chairman of the board of International Telephone and Telegraph Company, had been the "propelling force" in the negotiations, just as he himself had testified before the committee.

While Thomas W. Lamont and N. D. Jay of the Morgan firm in their negotiations with Owen D. Young and David Sarnoff in Paris had advanced suggestions of their own for "tactical reasons" they had been authorized by cable by Mr. Behn to do so, and were acting for him and under his instructions.

The correspondence showed that Mr. Young and Mr. Sarnoff had never receded from their original demand of 400,000 shares of the International Tel. and Tel. stock in payment for the communications branch of the Radio Corporation of America.

The agreement was subject to government approval, but the negotiators fully expected that it would be approved.

Bellows Has Post With Columbia Chain

Henry A. Bellows, one of the original five radio Commissioners, has been made a vice-president of the Columbia Broadcasting System. He is the second former radio commissioner to become associated with the CBS in this capacity. Sam Pickard was the first.

Mr. Bellows is associated with the Columbia system as advisory counsel. Besides holding this position he is the head of the Northwestern Broadcasting Company, Inc., which operates WCCO.

BROWN CALLED UNFIT AS LEGAL CHIEF OF BOARD

Washington

Senator Wheeler (Dem.), of Montana, at a hearing by the Senate Committee on Interstate Commerce, holding hearings on the Couzens bill, attacked the appointment of Thad. H. Brown, of Ohio, as general counsel of the Federal Radio Commission. He said Mr. Brown was not qualified for the position, not being familiar with the radio law or cases before the courts in which the commission is affected, and even questioned that Mr. Brown ever had handled any big cases in court.

Managed Ohio Campaign for Hoover

Mr. Brown was the Hoover campaign manager for Ohio in the 1928 pre-convention contest. He was counsel to the Federal Power Commission, a $9,000-a-year position to which he was appointed a few months prior to becoming the radio board's counsel at $10,000.

Federal Radio Commissioners were heard by the committee, and they disclosed disagreement among themselves over the appointment of Mr. Brown.

Charles McK. Saltzman, of the Radio Commission, a retired Army officer, testified that President Hoover's secretary, Lawrence Richey, recommended the appointment of Mr. Brown. The appointment was made at a special meeting of the Commission, over the protests of Chairman Ira E. Robinson and Commissioner Eugene O. Sykes.

Under examination by Senator Wheeler, Gen. Saltzman said that when Bethuel M. Webster resigned as general counsel he realized the need for appointment of a successor because of what he considered pressing legal problems before the commission.

"I went over to the White House and told Mr. Richey that there was a vacancy I considered important," said Gen. Saltzman. "I asked him if it would not be possible to get someone from the Attorney General's office for the job.

"I thought we could get a lawyer from the Department of Justice," he continued, "but Mr. Richey suggested that I see Mr. Brown, and I had a talk with him at his office in the Power Commission. He seemed to be acquainted with the cases of the Radio Commission."

Acted in Haste

"But you are not a lawyer, you are an engineer, and realized that Brown had no knowledge of radio law; so why didn't you go to the Department of Justice or Commissioner Sykes, who is in charge of the legal division of the Commission?" asked Senator Wheeler.

"I am sorry now that I didn't," replied Saltzman. He said also that he should have deferred Commission action on Brown's appointment until Commissioner Sykes had had opportunity to investigate his qualifications.

"Now, isn't this the truth of the whole matter," said Senator Wheeler, "that as soon as you knew of this vacancy as counsel you ran right over to the White House and told Mr. Richey about it, and then on his suggestion called a meeting and made the nomination and rushed it through over the protest of the two members of the commission who wanted first to investigate the qualifications of Mr. Brown for the office."

"I think you're mainly right about it," Mr. Saltzman agreed.

WAVE IS WORTH $1,000,000, SAY ARMY EXPERTS

Washington

A wavelength is worth a million dollars.

That is the estimate of Army engineers, as reported by Federal Trade Commissioner Harold A. Lafount, at a hearing before a House committee on $450,000 increased appropriation for the Federal Radio Commission. He added:

"We are handling something like 2,400 of these wave lengths that belong to the world. How many this country is going to use, and how to use them without interfering with other countries is one of our problems."

Much License Work

Gen. Charles McK. Saltzman testified that much of the Commission's work involved the issuance of license to broadcasting stations every 90 days. He said Congress placed this time limitation because it felt that from time to time the Commission would have power in its hands not to renew a license if a station was objectionable.

"Personally," he said, "I have always thought that licensing period was too short. It seems to me those licenses ought to last for more than 90 days, but that was prescribed in the radio act by Congress and we simply are carrying out the law."

Senator Dill said:

"I particularly would like to urge an allowance of money for assistants who can go out into the various sections of the country and investigate for the individual Commissioners existing conditions. No engineer can sit in Washington and decide what ought to be done in any section of the country or in any community about radio. No engineer can study that by looking at the map, or by reading about it; he must go there.

Needs Reliable Men

"It seems to me that the thing that the Commission has needed worst has been men upon whom it could rely to go out as individuals and study individual stations impersonally and come back and report to them so they can act more intelligently."

The appointment of Federal Radio Commissioners on a regional basis was opposed by Representative White (Rep.) of Lewiston, Me. The selections being required from different parts of the country "have had unfortunate effects in regard to the Commission," he said.

Literature Wanted

Thomas H. Renard, 39 Holiday St., Dorchester, Mass.
William C. Bryant, 102 Water St., Williamstown, Mass.
Paul A. Miller, 807 N. Colony Rd., Meriden, Conn.
R. W. Kool, 503 Oak St., DeKalb, Ill.
Ebenezer B. Peebles, 2059 W. Roosevelt Rd., Chicago, Ill.
H. W. Lambert, 16 Westmoreland Ave., Bellemoor, Del.
William F. Davis, 11904 Ablewhite Ave., Cleveland, Ohio.
Joseph Agoglia, 146 — 22nd St., Brooklyn, N. Y.
Frank Gross, 117 Third Ave., Long Island City, N. Y.
Arthur Heeren, 157 E. 72nd St., New York, N. Y.
M. Haskin, 89 Spruce St., Newark, N. J.
Marvin G. Smith, R. F. D. No. 1, Londonderry, Vt.
W. Blackburn, 264 Dunn Ave., Toronto, Ont., Can.
T. T. Kauppiner, 163 Washington St., Gardner, Mass.
Hawaii Music Co., Hilo, Hawaii.
J. E. Hearon, Box 660, Middlesboro, Ky.
R. V. Ortega, Sur. 11, No. 21, Caracas, Venezuela, S. A.

Tells World About U. S. on Short Wave

Chicago

Under the personal direction of Everett Mitchell, chief announcer of WENR, the 50,000 watt Chicago station and W9XF, the 5,000 watt short wave transmitter, is to present a series of weekly programs which will "tell the world" the advantage of living in the United States.

The presentations will be musical travelogues under the general title, "Know Your United States."

Over the air Mr. Mitchell has asked the Chambers of Commerce and tourist associations of each state to send him literature and he has already received hundreds of pamphlets and pages of descriptive matter.

Between musical selections, which in themselves will be directly connected with the various States, Mitchell will tell the audience of the various points of interest and the advantages of the locality he is describing. He will attempt particularly to include places that are not widely advertised and generally known.

SYMPHONY GETS AIR SCHEDULE

The Columbia Broadcasting System will radiate Philharmonic-Symphony Society concerts next season from Carnegie Hall and the Metropolitan Opera House, New York City, as well as from the Brooklyn Academy of Music, on a coast-to-coast chain. WABC will be the key station. W2XE, of New York, the companion short-wave transmitter, and W3XAU, of Philadelphia, also on a short wave, will attempt to enliven the programs around the world.

Conductors who will direct such concerts will include Willem Mengelberg, Arturo Toscanini, Sir Thomas Beecham and Bernardino Molineri.

A joint statement by the Philharmonic-Symphony Society and William S. Paley, president of the Columbia system, set forth:

"It is the desire to give the public the best thing available in orchestration. The constantly increasing cost of symphony orchestras has made it impossible for such organizations to tour the country as formerly, and for many music lovers the only possibility of hearing a symphony orchestra is by means of radio presentations. Both of the organizations responsible for these broadcasts feel it their duty and privilege to give to the listeners of the United States and Europe the same opportunity, as far as possible, to hear the great masterpieces of music adequately presented."

Station Seeks Wave Now Used by KWKH

Washington

Joseph H. Uhalt, of New Orleans, operating WDSU, has filed an application with the Federal Radio Commission to displace KWKH, at Shreveport, La., operated by W. K. Henderson, and to increase its power form 1,000 to 5,000 watts with full time operation. WDSU is now using the 1,250 channel and KWKH the 850 kc channel.

KWKH is the station accused of permitting profanity to be broadcast in its attack on chain store systems. Complaints were filed with the Radio Commission seeking to have the station silenced. Mr. Henderson, the owner, has since promised to refrain from using objectionable language.

RCA ASKS WRIT FOR UNIVERSAL ON 2 PATENTS

Wilmington, Del.

An injunction suit was started by the Radio Corporation of America and the American Telephone and Telegraph Company against Universal Wireless Communications Company, Inc., charging infringement of two regenerative patents, known as the feedback patent and the oscillating audion patent.

The defendant has licenses to operate broadcasting stations and a short wave communication system, the communication work being laid out on an extremely large scale, with branches in 110 cities in the United States, although only a few stations are in actual operation yet.

The plaintiffs contend that the defendant can not operate without using these two patents, and actually did use them, wherefore an injunction is the only quick remedy to prevent the repeated invasion of the patent rights.

De Forest Company Co-Defendant

Besides the Universal corporation the De Forest Radio Company is made defendant, because it refused to join as a party plaintiff. The two patents in question were obtained by Dr. Lee De Forest, inventor of the three-element vacuum tube, who assigned his rights to the Western Electric Company which in turn made an assignment of these rights to American Telephone and Telegraph Company. The RCA and the telephone company patents in this field have been pooled.

Argument on the application for an injunction was made before Judge Morris in Federal Court, on the ground the plaintiffs had no adequate remedy at law.

Besides charges of patent violation, the plaintiffs assert that the defendant has not complied with the requirements of the Federal Radio Commission, which set definite dates for the opening of the stations when it granted wavelengths. Although the time limit has expired, only two stations have been erected, it is charged, one of these being in Northern New Jersey, the other in Chicago.

Out to Do a Real Job

The Universal corporation contends that it is not violating any patent rights, but is itself the owner of patents that are used in its work. The company is strongly financed and has recently added several experts to its engineering staff with the intention of instituting the largest domestic service in history.

A competitor for wavelengths assigned to it by the Commission was the RCA, which, through its communications unit was seeking to establish service in the domestic field. At present RCA Communications, Inc., is engaged in foreign traffic, although it has laid tentative plans for domestic service.

The RCA communications unit has concluded negotiations with the International Telephone and Telegraph for the sale of its rights and other assets in communications for stock in the I. T. & T. worth $100,000,000, market value at the time of the agreement. But this is predicated on the removal by Congress of restrictions that now prohibit the inter-ownership of stock by communications companies.

55 CITIES PLAN POLICE RADIO; ROOM LACKING

Washington.

The likelihood of more than 55 cities of the country, with populations of 20,000 and over, applying for authority to operate police radio services to aid in catching criminals, requires a definite determination of policy by the Federal Radio Commission to "save the situation from a chaotic condition," Lieut. Kenneth Cox, of the Chicago police department, informed the Federal Radio Commission.

Appearing before the Commission with a committee of police representatives of several cities, Lieut. Cox said the Commission should make provisions for an adequate number of frequencies in the mobile continental short wave band for such police services, and also require the installation of modern equipment and place a definite limitation of power with a view of keeping interference at a minimum.

Advantages Proved

He said the advantages of police radio already have been proved, but that the use of makeshift equipment and the "doubling up" of stations of the same channel by cities in close proximity was leading to a condition that will warrant correction, because of the impending large numbers of applications.

There are now approximately 25 cities which either have licenses or construction permits for the installation of crime detection services, Lieut. Cox pointed out. These services consist of the transmission, by voice, of crime information, to police cruising cars, which speed to the scene. In the cities in which the services are operating, he declared, criminals have been caught in 30 seconds after the signal, and that an average of 60 seconds only is required for the car to reach the scene.

Didn't Expect 55 To Apply

The Chairman of the Commission, Ira E. Robinson, said the Commission already has decided that police radio is in the public interest, but that it had not anticipated that 55 cities ultimately will require the service.

He said he could understand why large cities could utilize to advantage short-wave radio broadcasting, but that it did not seem to him that smaller ones would be justified in maintaining such services. He suggested that code transmission might be feasible, since less space in the ether would be utilized, but the police representatives declared this would be impracticable, since it would be difficult to train large groups of patrolmen to use code.

The Acting Chief Engineer of the Commission, Capt. Guy Hill, pointed out that the main problem was that of insufficient frequencies.

"We are going to be just as congested in police frequencies as we are in the broadcast band," he said.

"Most of the cities are handicapped in the crime services by equipment which consists of just associated parts, and consequently there are frequency fluctuations," said Lieut. Cox. "Most of them are amateur layouts."

Chicago To Use Three Transmitters

Lieut. Cox explained that in Chicago three transmitters of 500 watts each will be employed with modern crystal-controlled equipment. He said the Commission should limit power to a maximum of 500 watts and that in cities covering large geographical areas more than one transmitter should be employed rather than permit a set to go beyond 500 watts and cause interference with other services in neighboring cities operating on the same frequency.

Col. Joseph Gerk, chief of police of St. Louis, declared the element of time was the essence of the whole scheme and for that reason broadcasting transmission, rather than code, must be used in dispatching cars for arrests. In substance, he supported the views as expressed by Lieut. Cox.

Ed. Denstaedt, of the Detroit police department, and Robert L. Batts, supervisor of police radio, of Indianapolis, also testified. They explained, says "The United States Daily," that they are now operating their services experimentally on frequencies other than those allocated for police services, and would like to have a determination by the Commission as to whether these frequencies would be allocated them on a regular basis. This is necessary, they explained, because in the ordering of new equipment, the precise frequency must be known, both for the transmitter and the receiving sets used on the scouting cars.

On behalf of the St. Paul Police Department, Stanley Hubbard, special representative, said it was necessary to assign specific frequencies for the services in order to avert future congestion. He said for example that the 1,712-kilocycle frequency, one of the three now used, is in such close proximity to the broadcast band, which ends at 1,500 kilocycles, that some makes of receiving sets pick up the police orders, and in that manner interfere with the work.

This also was attested to by Mr. Batts, who said that Cleveland's police signals are picked up in Indianapolis, and vice versa.

Lieut. E. K. Jett, short wave engineer of the Commission, said there are only a few frequencies in the mobile band between 1,500 and 3,000 kilocycles available for such services. In all, he declared there are 25, and of these three now are provided for police services. Even the entire 25 would not suffice for 55 such services which Lieut. Cox expects will be requested, he said.

St. Paul Obtains Police Permit

Washington.

Authority to create a crime detection radio service was granted the City of St. Paul, Minn., by the Federal Radio Commission. The Commission's grant was as follows:

"City of St. Paul, Department of Public Safety, St. Paul, Minn., construction permit on 2,416 kc., 500 watts power, to communicate with squad cars and police stations, with the following clause: 'The Commission reserves the right to change frequency herein granted at any time during the life of permit without advance notice or hearing'."

EVEN VETERANS OF STAGE ARE 'MIKE' NOVICES

Entertainers who have spent years on the stage must learn new tricks before they can expect to win the approval of the radio audience, according to Rosalie Stewart, who is in charge of the Radio-Keith-Orpheum programs heard twice each week through the National Broadcasting Company networks.

Miss Stewart's job is to take the stars of vaudeville and the talking pictures and make them into radio entertainers. She finds it a difficult undertaking.

"To expect a vaudeville headliner to leave the footlights and step in front of the microphone and do a good job might be compared to asking a poster artist to produce an etching," she said. "There is as much difference in the technique of vaudeville and of the microphone as between the attention-arresting colors of a poster and the fine details of an etching.

Mass Psychology Useless

"The vaudeville performer appeals to a crowd. His training is to apply mass psychology. The radio audience on the other hand may be numbered in millions but seldom if ever is it a crowd. Instead it is made up of thousands upon thousands of individual audiences numbering from one to five persons. A story that will make a crowd laugh won't always affect a family group the same way. Why? If we knew that we wouldn't have so many problems.

"The vaudeville artist depends on many things to put his material across. Stage settings help. Make-up helps. Facial expressions help. The very spirit of the people beyond the footlights—the people who have paid money to be amused and want to get their money's worth helps.

Radio's Only Demand

"Radio demands but one thing—sound that means something. Thus many acts that fill theatres are of no use whatsoever to radio. Dancers, acrobats, pantomime artists, spectacular novelties, and similar presentations have no place in the studios. We must pick our radio entertainers from the ranks of singers, musicians and people who say funny or interesting things.

"We are attempting to solve the problem and expect to solve it. Our present plan is to select approximately two hundred of the best available acts in vaudeville—acts that use words and music—and study them in order to determine their microphone possibilities. Then we train the people in these acts in microphone technique. Though we may give them new material we must always be careful to preserve the personalities and entertainment characteristics they have built up in the theatre," Miss Stewart said.

Stock Buyer Ducks Kolster Inquisitor

The refusal of George F. Breen of New York State to appear for questioning in the New Jersey Chancery Court investigating the charges that Kolster radio stock was "rigged" has virtually resulted in an impasse, according to Special Master John A. Berhard of the court. Mr. Breen's counsel, Louis Kaufman has notified George Furst of counsel for the Kolster receivers that Mr. Breen denied the jurisdiction of the New Jersey court over a New York resident, and he also asserted in Mr. Breen's behalf that he considered his stock transactions a purely personal matter.

At previous hearings before Mr. Bernard, Rudolph Spreckels, chairman of the board of the Kolster Radio Corporation, had testified that he sold 254,976 shares of Kolster common stock to Mr. Breen in November of 1928, but not through the Stock Exchange. Mr. Bernhard declared that he would use "every legitimate means" to make him appear for questioning, or to have him examined "in whatever jurisdiction he may be found."

GREAT MARKET SEEN FOR SETS IN MOTOR CARS

Cleveland, O.

The National Federation of Radio Associations, in convention here, heard Michael Ert, of Milwaukee, president, extol the sales possibilities of radio receivers for automobile installation. Receivers will become stock equipment in automobiles, he predicted, and in the same way that bumpers and headlights now are. What particularly delighted him was the fact that he superintended the installation of radios on numerous cars and that in every instance the result was highly successful. This freedom from trouble, he explained, refuted assertions some had made that ignition and road noises would hamper the progress of radio installations in automobiles.

"Radios make the long Summer trips all the more enjoyable," he said, "by providing excellent entertainment. It has been proven that no risk whatsoever attaches to the installation of a radio in an automobile, and this fact was well recognized by automobile manufacturers who decided to bring out radio-equipped models.

Radio Market Hampered

"Several automobile makers now include a built-in aerial in the top as standard equipment. Five radio manufacturers already are making receivers especially designed for car installation, and it is certain that this number soon will grow, and that very rapid expansion in this branch of the radio business will follow."

H. B. Richmond, president of the Radio Manufacturers' Association, told about manufacturers' troubles in the present market, and was frank in his statements about the condition of the industry. He looked forward confidently to a resumption of more prosperous operations, and said that reports received by him encourage that expectation.

The subject of interchange of radio patents was discussed at length. The manufacturers desire to confine their efforts to manufacturing and selling, and to avoid the great expense and uncertainty of patent litigation. The reduction of manufacturing and selling costs would be expected to follow any patent pooling, if it is done on the scale that characterized the same movement several years ago in the automobile industry.

Speaker For Every Room

Just as the automobile manufacturers advise persons to have two cars, a fine, new one for major service, and a used car for incidental use or for shopping or other activities when the main car may be in service, so the radio manufacturers are taking to the idea of selling more than one receiver in each home. They, too, have their "used set" problem, as these sets are obtained as trade-ins when a new set is purchased, but the general idea was to get customers to buy two new sets rather than merely a new one and an old one.

Dr. George W. Allison of Chicago said the first thing to do in solving the "trade-in" problem was to recognize that they would be a permanent factor in the business. He said that the auto industry had solved it and the radio men, through cooperation, could do the same.

Another idea brought forward was to encourage the use of a loudspeaker in every room.

WLS and WCBD Lose Appeals

Washington

The Court of Appeals of the District of Columbia refused a rehearing to WLS, Chicago, and WCBD, Zion City, Ill., WLS having requested full time on 870 kc., and WCBD restoration to 870 kc., which frequency it occupied prior to the 1928 reallocation. WLS's equal division of time on 870 kc. with WENR, Chicago, stands. The Federal Radio Commission denied both petitions and the stations' appeal to court failed likewise.

A mandate ordering the Commission to assign one-half broadcasting time on the 870 kc. channel to WENR, operated by the Great Lakes Broadcasting Company, which had used two-sevenths time, was issued by the court. The mandate was in the nature of a certified copy of the decision of the court, rendered January 6, reversing the previous decision of the Commission denying the station increased broadcasting time.

ALTIMETER RUN BY RADIO TUBES

An altimeter that will tell airplane pilots exactly how high they are above the ground immediately beneath them rather than their approximate altitude in reference to the point of departure, is the latest contribution of the vacuum tube to twentieth century living.

George Lewis, radio engineer and vice-president of the Arcturus Radio Tube Company of Newark, N. J., explains how the absolute altimeter, employing radio principles, works.

"The trouble with the old type or barometric altimeter is that it varies with weather conditions, and assuming consistent air pressure (which is rarely encountered over distances greater than 100 miles), it only indicates the altitude above the starting point—always providing the pilot remembered to set the pointer to zero before he took off. Flying blind between New York and Cleveland, he might run into a mountain, with his altimeter registering 3,000 feet.

"Aviation has for many years recognized the need for an absolute altimeter —an altimeter that would show the pilot how high he is above the ground immediately beneath. The perfection of the vacuum tube has made this possible, and the radio altimeter is now emerging from the laboratory as a practical instrument.

"The operation of the radio altimeter depends upon a newly discovered principle that a radio receiver can be slightly tuned by the influence of an outside wave as well as by variation of the usual tuning controls. However, conditions are seldom such that this effect will be noticed on the home broadcast receiver.

"A low-powered transmitter and an oscillating receiver are installed on the plane, and so arranged that a beat note or a squeal is heard when 'phones are plugged in the receiver. The waves from the transmitter are reflected by the ground beneath the plane back to the plane again, and as the altitude varies a phase difference can be noticed. The "phase difference" describes the relationship between the wave returning to the plane and the wave generated in the oscillating receiver. At certain altitudes the reflected wave arrives on the plane at just the right time to be perfectly in phase with the local wave. At other altitures, the two waves are out of phase."

SENATOR ASKS 'EQUALITY' LAW BE RESCINDED

Washington

Repeal of the Davis amendment of the radio law will be proposed by Senator Nye, of North Dakota. The law decrees that there shall be maintained an equal allocation of broadcasting licenses, of bands of frequency or wavelengths, of periods of time for operation, and of station power, to each of the five radio zones, "when and in so far as there are applications therefor," and that a fair and equitable allocations of licenses wavelengths, time of operation and station power be effected to each State, the District of Columbia, the territories and possessions of the United States within each zone, according to population.

Senator Nye would eliminate the provisions of the Davis amendment entirely and substitute therefor a provision that the licensing authority shall distribute facilities to insure an equality of broadcasting service throughout the country, regardless of the population or geographical lines. He stated that the amendment has caused much dissatisfaction among listeners and broadcasters in certain sections of the country.

Wants Engineering Basis

Without the restriction imposed by the amendment, the licensing authority could distribute facilities so as to meet engineering practice and to take advantage of radio opportunities now unused because of the law.

The Senator declared that under the present arrangement the country is divided arbitrarily into five sections having approximately the same population but differing greatly in area. Thus the fifth zone in the West is five times the size of the first zone in New England, yet the large western zone can have no more radio stations than the compact first zone. For that reason there is unequal radio service resulting in "gross injustice" to the listeners in the remote areas.

Wants Real Equality

An equality of radio service, both transmission and reception opportunity, should be provided the different States and communities, Senator Nye declared.

The Senate Committe on Interstate Commerce now has before it the Couzens Bill for the establishment of a Federal Communications Commission, which would take over the present functions of the Federal Radio Commission, and this committee might, the senator stated, consider remedial legislation along the lines he proposes, of its own accord.

20 Kw Permit Asked To Send Television

The power of the DeForest experimental radio telephone station, W2XCD at Passaic, N. J., which has become familiar to many broadcast listeners who tune to the bottom of their dials, is being steadily increased. New equipment is being developed and installed for increased power and coverage. From 50 watts, the transmitter has been increased to 500 watts, and the power is now being further increased to the full 5,000 watts authorized by the license granted by the Federal Radio Commission and 20 kw sought.

RADIO WORLD

The First and Only National Radio Weekly
***Eighth* Year**

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y. Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, business manager and managing editor; J. E. Anderson, technical editor.

The Pentode

A TUBE new to the United States market has just appeared. At once a dispute starts. Will the tube improve reception? Will it be adopted quickly by set manufacturers?

Thus the pentode is made these shores, after a somewhat different version prospered in Great Britain for several years.

The pentode, as now made here by Ceco, has, as its name implies, five elements. These are the usual four of the screen grid tube, besides, as the fifth element, a second screen, this one surrounding the cathode. It looks like the 224, but there is a binding post on the side of the base for connection of the fifth element, which requires a low positive potential.

As produced here, the pentode is intended for radio frequency amplification.

So far as the dispute goes, those exasperated by the introduction of a tube that promises much, at a time when set makers are having the task of their lives trying to sell the models already produced, using familiar tubes, speak theoretically. The Radio Manufacturers' Association, Dr. Lee DeForest, and others who gave the Ceco pentode an indifferent reception, did not state that they had tried the tube. They drew on a theoretical background, well-established in all instances, and on commercial experience. But theory does not completely answer the question. Practice will do it.

On behalf of the tube, it should be observed that the fifth element is intended to perform an important function in substantially reducing the plate resistance, by dissipation of the space charge, or parasitic cloud of electrons that is obstructive to best tube performance.

With new standards of tube performance expected even by the man on the street, the effort to determine whether there is a genuine reason for the pentode at this time is commendable. Admittedly, it is inopportune from a set manufacturer's viewpoint, with an overproduced set-market, and the strongest of these manufacturers suffering from the weakness of the weak, since consumer sales are attracted to receivers' stocks by prices often below the cost of production.

The leading tube manufacturers are set manufacturers or are owned in part by set manufacturers, except Ceco and a few others, so it had to be some one like Ceco that would force the issue at this critical time. From the viewpoint of a tube manufacturer unencumbered by a receiver factory, maybe the pentode will be like a blood transfusion to a suffering patient.

The pentode will be subjected to careful test under actual operating conditions, in receivers, the only way to test it satisfactorily. Even now several leading set manufacturers are making such tests. Private experimenters soon will be answering the question to their own satisfaction.

No prediction is made here. The tube is on the market, the opportunity to make the proper tests is here, so why speculate, theorize or prophesy? Why not determine, and then announce?

Dumping

MANUFACTURERS of receiving sets have not had a pleasant time of it this season. Several were cast into receivership. The result was that sets made by corporations that went into bankruptcy flooded the market, and hurt the sales of remaining manufacturers. It was no fault of the surviving manufacturers, but they suffered nevertheless. Some of them tried to relieve the situation by price reductions, but could not possibly reduce to a price that would cope with the unexpected competition of distress merchandise.

Another method used by some of the remaining set manufacturers, many of whom had to close down their factories at least temporarily, due to sales being less than they had expected, is to discourage the purchase of receivers made by manufacturers that went bankrupt. Such discouragement certainly is well within their rights. But when they sweepingly ascribe inferiority to all the receivers in the distress class, it is time to point out that the success of a set manufacturing corporation is not solely dependent on the quality of the receiver manufactured. Some very excellent receivers were made by corporations whose wares are now swamping the "surplus" market. And not all corporations that did not meet success went bankrupt. Some few simply paid all bills and called quits. And one of these made one of the best receivers.

Quite a few of the receivers now trying to find a respectable home at bankrupt prices are not cheap even at the prices asked. But a person who does not know anything about a radio receiver knows no more about it whether it is part of a "close-out" or the remnant of a referee's auction or the product of a financially sound factory, since there are good and not-so-good receivers in all groups.

Even the bankrupt corporations are deserving of some sympathy, in many instances, and not entitled exclusively to sneers and abuse. Some were simply the victims of over-production in which they and their competitors, including well financed and surviving corporations, participated. Some even did not fall victim to a "stock proposition." That those who failed failed, and those whose business ran far behind expectation still did not fail, is often only another way of stating that some had enough money to weather the storm and others did not.

But by far the worst sufferers were the retail stores. Their innocence or non-participation in the causes may be taken for granted. The fortunes of war might be expected to pass them up, since they were not in the battle. But modern warfare, in actual drives on disputed terrain, or in business, is no respecter of non-combatants. These retail store owners bought the receivers of manufacturers in good faith and paid for them at current discount prices, which were more or less standard. When the crashes came they found themselves at first victimized by price reductions, as not all manufacturers gave the retailers any recognition when prices on previously purchased stocks were reduced, and then, after the actual receiverships, found themselves stocked with set models for which they paid more than the consumer price now asked.

Some dealers decided to carry only one, two or at most three lines of receivers, and to select, first, the best seller, and second, a very high-class receiver that might not sell so fast but which had a steady market, and if any third choice was to be made, a receiver that was second best seller. Not all dealers could gain their point, as some of the franchises they sought were not obtainable, whereupon they made the next best choice, but always sought established lines, with a record behind them.

Some dealers decided to carry only one, ation, and the best-managed and best-financed corporations may yet get the business they rightly deserve, while the owners of retail stores will have a chance to recoup their losses in the manner they prefer, through the so-called "legitimate" channel.

The Patent Monopoly

WHAT to do about the Radio Corporation of America and its associated corporations as the owners of a group of patents that gives them virtual control of the broadcasting, set-manufacturing and communications fields, is a problem to the Attorney General of the United States, no less than it was a problem, in the past, to independent set manufacturers who fought shy of taking out a license.

It will be remembered with what persistence some of them refused to submit to the dictation of the trust, as they called it, and how they vowed a fight to the bitter end. But the end came quickly enough thereafter, and it was not so bitter as they had imagined. The recalcitrants simply agreed to take out a license and pay a royalty of 7½ per cent, with a $100,000 annual minimum. The more sets they produced, the more royalty they paid, and they hoped then, and indeed as they most fervently hope now, that the royalties would be enormous because of the enormity of the required manufacture.

Besides the set manufacturers, whose problem is solved by the licensing that was discriminately and not injudiciously consummated, there are communications companies to whom no such solution has been granted, for the communications field is one that RCA is guarding most jealously. Some of the big set licensees, it is hoped, have showed RCA how to merchandise receivers, but in the actual communications field (as distinguished from the field of frequency assignments and lawsuits on communications) no one has risen to show the RCA much.

There is a great deal at stake in the patent situation. In brief, the situation is this: RCA and its associates obtained their patents in a lawful way, since it is still lawful to obtain even patents by payments of millions of dollars. A patent pool was formed. Now the possession of these basic patents under one control gives what opponents of RCA call a monopoly. And it certainly does. Hence it is urged upon the Attorney General that RCA and its associates be sued for violation of the anti-monopoly law, particularly certain provisions of the Sherman anti-trust law and the Clayton Act. What the Attorney General is trying to ascertain is whether the admitted monopoly that the Federal Government gives to a patent owner in respect to that patent can be so used as to constitute a violation of a Federal anti-monopoly law. Can the Federal Government award a monopoly on the one hand, and on the other hand punish for its possession?

What the Attorney General is taking his time to ascertain, because it is a knotty problem, those fighting RCA knew all about with a speedy fullness that carries little conviction.

A THOUGHT FOR THE WEEK

WHAT'S to become of the millions of radio sets that are old-fashioned and almost useless so far as even fair reception is concerned? One of these days in the near future—perhaps the time is here now—the radio trade will have to make a united attack along the entire front and defeat the enemy of the whole industry. It would pay the trade to endow in perpetuity a Home for Aged and Decrepit Boxes of Junk. In the meantime, dealers will continue to utter groans whenever customers ask the oft-repeated query: "And my old set—how much allowance, mister?"

STATIONS FIGHT IN INDIANA FOR CLEAR CHANNEL

Washington.

A contest between two Indiana broadcasting stations, for the right to a cleared channel with the maximum broadcasting power of 50,000 watts, developed before the Federal Radio Commission, during hearings of the applications of the stations.

WOWO, at Fort Wayne, Ind., now using 10,000 watts power on the 1,160 kilocycle channel, one-half time, sought full time on that frequency with an increase in power to the 50,000 watt maximum. WWVA, at Wheeling, W. Va., occupies the channel for the other half of the time.

Everett Sanders, secretary to former President Coolidge, and Frank D. Scott, of Washington, appeared as counsel for the Fort Wayne station.

WFBM Wants Same Concession

Also applying for the 1,160 kilocycle frequency with the same power was WFBM, operated at Indianapolis, by the Indianapolis Power & Light Co. The station was represented by Thomas F. Littlepage, Washington attorney. It operates at present on the 1,230 kilocycle channel with 1,000 watts.

It was explained, says "The United States Daily," that the 1,160 kilocycle channel, under the Commission's allocation of radio facilities, is assigned to the Fourth or Middle-western Radio Zone as a cleared channel, but that one-half of the time on it was assigned to the Second or East-Central Zone, to WWVA, in return for the 1,020 kilocycle channel, which has been loaned outright to the Fourth Radio Zone, and is used by KYW, at Chicago.

Scott brought out that, under the compilation of the Commission, designating the quota of each State to broadcasting facilities, pursuant to the Davis equalization amendment, Indiana is entitled to .95 of a cleared channel, based on its population. It now has only one-half of a cleared channel, he said.

Can't Get the Habit

C. R. Durbin, sales manager and vice-president of the Main Autom Supply Co., which operates WOWO, said the station subscribed to the chain programs of the Columbia Broadcasting System, and is the only station in the territory offering it. National Broadcasting Co. programs, however, he declared, can be heard from many stations on cleared channels.

Because the station is restricted as to its hours of operation, he declared, it is "impossible" for listeners in the territory to get the "listener habit" and tune in on the station.

Six Stations Apply For Same Channel

Washington.

Three applications of stations located in the second or east-central radio zone for assignment on the cleared channel of 1,020 kilocycles, now loaned to the second or middle western zone for KYW, at Chicago, were designated for hearing by the Federal Radio Commission.

The stations applying for the frequency and located in the second zone are WCAU, Philadelphia; WWJ, Detroit, and WJAS, Pittsburgh. In addition three other stations in the second zone have applied for assignments to this frequency.

Forum

Chance for a Good Hat

REFERRING to the letter of Joseph Henkin, operator of K500, which appeared in the February 1 edition, I note he objects to technical educational matter you publish, to the quantity of your advertising, is of the opinion that the public is not interested in set building, and that the commercial set is better than any thing the amateur can construct.

Mr. Henkin states he is always seeking constructive criticism and inferentially, he hands out the same kind. I would suggest that he advise you how to operate your publication without advertising, and at the same time meet your bills.

Personally, it is the technical stuff that prompts me to buy Radio World regularly.

Speaking about commercial sets as compared with "home brewed" sets, I wish to state I have a home-made set, a Super, three stages screen grid TRF, two intermediate screen grid stages, a 250 power pack and a dynamic with ample baffle. If Mr. Jenkin can produce a commercial set that will equal it in selectivity, sensitivity, and realistic tone, I will then admit he is correct and buy him a Panama hat, taking care to remove all the advertising marks before presenting it to him.

I wonder how profitable K500 would be without advertising.

R. E. Gifford,
Garyville, La.

* * *

Wants Policy Continued

I HAVE been reading "Radio World" for nearly two years and I believe your technical articles are as reliable as any published.

I have built all my own sets and I would not buy any radio publication which failed to cater to set builders and experimenters, and I know plenty of other radio fans who are of the same mind.

Letters have come to you recently from readers who want more news and less advertising.

Well, if they want news, why don't they read the newspapers?

If they prefer stories, any news-stand can furnish them with a great variety. They are not compelled to read the ads, so why complain? Furthermore it is common knowledge that the revenue from advertising would enable any publisher to enlarge his magazine and without raising the price of a copy.

I also hope you do not consider printing matter of interest to the dealer and professional service man only, because I have dropped two of this class of publications within the last few months.

I have consulted other readers, who agree with me in requesting that you give us the latest hookups with full construction details, as you have in the past.

We suggest that in order to please all classes of set builders and experimenters you might print details of the latest sets that require from three to six tubes, and also those which use a greater number.

The educational articles, radio theory and other technical instructions are of intense interest to all those who wish to learn how and why every part of a radio set operates.

We realize that most set owners are content if they know enough to switch their sets on and off, but there are, also, great numbers who wish to gain more knowledge of this wonderful and fascinating discovery, which was perfected after almost numberless experiments and years of research by our greatest scientists.

A periodical equipped with a staff of experts can give us knowledge of the latest inventions and discoveries which can not be accomplished in any other way, therefore the writer hopes you will continue your present policy and not be influenced by those who wish to read stories and news.

Lewis Beuthel,
Fresno, Calif.

ANNOUNCER HAS VITAL JOB NOW IN BROADCASTS

While radio announcers continue to be the subject of jokes and comic sketches and the occasion for letters to the newspapers, the fact remains that without announcers there wouldn't be any programs.

So far, no technique of radio presentation has been evolved that eliminates the announcer, according to program makers of the National Broadcasting Company, and there is little likelihood that such a drastic change in broadcasting methods ever will be made.

The announcer is the peg on which the program is hung, as one program builder phrased it. When a continuity is written, the first speeches to go on paper are the words of the announcer.

The public depends on him, too. He must tell them the names of the selections to be played, what the program is about and the other details impossible to get across in any other way.

The Narrator Revived

In musical programs the announcer takes the place of the program notes offered in concert halls, theatres and opera houses. In the dramatic production the announcer not only fills the place held by the printed program in legitimate theatres, but has revived the old theatre narrator, the person who filled in the gaps between scenes of the play.

In elaborate presentations, the announcer becomes a master of ceremonies.

Sponsors of programs recognize the importance of air personality in an announcer and usually specify the announcer to be assigned to a series of broadcast.

First Recognition

The medal awarded by the American Academy of Arts and Letters for excellence in diction on the radio, won last year by Milton J. Cross of NBC, had its effect on the status of announcing in radio. It signified the first recognition given radio as an allied academic art and served to stimulate announcers everywhere to improve and clarify their speech.

During the past year a school for announcers was established by the NBC and all its staff spokesmen were given lessons in diction and speech several times a week.

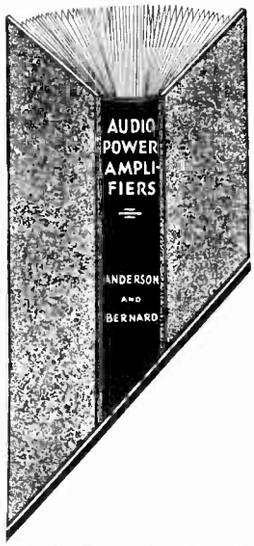
That the job of an announcer is regarded highly by young men is indicated in the tremendous number of applications received by NBC for positions on the staff.

100 Men a Month Apply

More than a hundred men a month—and quite a few women—call to take the tests necessary to qualify as an announcer. Thousands of letters from all parts of the country asking: "How can I become a radio announcer?"

"The radio announcer is definitely established in American life," Graham McNamee said. "I believe he is accorded more respect than ever before and that he regards his work with a decidedly professional aspect."

Cross is making announcing his life work, but he doesn't encourage too many young men to do the same thing.



"Audio Power Amplifiers," 193 pages, 147 Illustrations; Maroon Cloth Bound Cover, Lettering in gold. Price, $3.50.

"AUDIO POWER AMPLIFIERS"

By J. E. ANDERSON and HERMAN BERNARD

The First and Only Book on This Important Subject—Just Out

IN radio receivers, separate audio amplifiers, talking movies, public address systems and the like, the power amplifier stands out as of predominating importance, therefore a full and authentic knowledge of these systems is imperative to every technician. "Audio Power Amplifiers" is the book that presents this subject thoroughly. The authors are

J. E. Anderson, M.A., former instructor in physics, University of Wisconsin, former Western Electric engineer, and for the last three years technical editor of "Radio World."

Herman Bernard, LL.B., managing editor of "Radio World."

They have gathered together the far-flung branches of their chosen subject, treated them judiciously and authoritatively, and produced a volume that will clear up the mysteries that have perplexed many.

What are the essentials to the reproduction of true tone values?
What coupling media should be used? What tubes? How should voltages be adjusted?
These are only four out of 1,400 questions raised and solved in "Audio Power Amplifiers."

The book begins with an elementary exposition of the historical development and circuit constitution of audio amplifiers and sources of powering them. From this simple start it quickly proceeds to a well considered 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.

Rectification theory and practice in all the applied branches, grid bias methods and effects, push-pull principles, power detection, reproduction of recordings and methods of measurements and testing are set forth. And besides there is a chapter on the subject of motorboating, with which one of the authors is probably better familiar than any other textbook author. Then, too, there is a chapter on tubes, with essential curves and a full list of tables of tube data. Every tube that will be used in an audio amplifier —therefore virtually all tubes—is clearly diagnosed, classified and tabulated! These data on tubes should be at every radio engineer's hand.

"Audio Power Amplifiers" is a book for those who know something about radio. It is not for novices—not by a mile. But the engineers of manufacturers of radio receivers, power amplifiers, sound installations in theatres, public address systems and phonograph pickups will welcome this book. Engineers—even chief engineers—of the Bell Telephone Laboratories, Radio Corporation of America, Westinghouse Electric & Mfg. Co., Western Electric, Photophone, Vitaphone and the like needn't be afraid they won't learn something from this little book.

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The book consists of 193 pages in type the size used in printing these words, known as 8 point, and therefore a great deal of text is contained in these 193 pages, and the book is small enough to be carried conveniently in the side pocket of a sack coat. It was purposely printed that way because busy engineers and other experimenters will want to consult this precious volume while riding in conveyances, as well as when in the laboratory, and compactness was therefore desirable.

The edition is strictly limited to 1,000, and the publishers recognize that the field of distribution is necessarily small, hence the price is $3.50. Those to whom such a volume is of any value would not be without it at any price.

The device of presenting no more information or greater number of illustrations, but of using larger type, and thicker and often cheaper paper, to present a bulkier appearance, was purposely avoided. The paper is finest super stock and the size of the page is 5 x 8".

Detailed Exposition of Chapter Contents

Chapter I. General Principles, analyzes the four types of power amplifiers, AC, DC, battery-operated and composite, illustrates them in functional blocks and schematic diagrams, and treats each branch in clear textual exposition. Audio coupling media are illustrated and discussed as to form and performance: transformer, resistance-resistance, impedance-impedance, impedance-resistance, resistance-autotransformer, autotransformer-resistance and non-reactive. Push-pull forms are illustrated, also speaker coupling devices. Simple audio amplifiers are illustrated and analyzed. Methods of connection for best results are stressed.

Chapter II. Circuit Laws, expounds and applies Ohm's laws and their special form known as Kirchhoff's laws. Direction of current flow in tube circuits is revealed in connection with the application of these laws to several circuits, including a DC 110-volt A, B and C supply, and series and parallel filaments in general. Special diagrams are published for Ohm's and Kirchhoff's laws.

Chapter III. Principles of Rectification, expounds the vacuum tube, both filament and gaseous types, electrolytic and contact rectifiers, and explains why and how they work. Full-wave and half-wave rectification are treated, with current flow and voltage derivation analysis. Regulation curves for the 280 tube are given. Voltage division, filtration and stabilization are fully illustrated and dissected.

Chapter IV. Practical Voltage Adjustments, gives the experimental use of the theoretical knowledge previously imparted. Determination of resistance values is carefully revealed.

Chapter V. Methods of Obtaining Grid Bias, enumerates shows and compares them.

Chapter VI. Principles of Push-Pull Amplifier, defines the push-pull relationship, with keys to the attainment of desired electrical symmetry.

Chapter VII, Oscillation in Audio Amplifiers, deals with motorboating and oscillation at higher audio frequencies, explaining why it is present, stating remedies and giving expressions for predetermination of regions of instability. The trouble is definitely assigned to the feedback through common impedance of load reactors and B supply, and in some special instances to the load's relationship to the C bias derivation as well. The feedback is shown as negative or positive and the results stated.

Chapter VIII, Characteristics of Tubes, tells how to run curves on tubes, how to build and use a vacuum tube voltmeter, discusses hum in tubes with AC on the filament or heater, and presents families of curves, plate voltage—plate current, for the 240, 220, 201A, 112A, 171A, 227 and 245, with load lines. Also, plate-screen current characteristics of the 224, at five different control grid biases, at plate voltages 0-250. Then Table I gives the Average Characteristics of Amplifier and Detector Tubes 220, 200A, 201A, 112A, 171A, 222, 240, 226, 227, 224, 245, 210 and 250, stating use, filament voltage, current, and resistance, Det. B volts, Amplifier B volts, grid bias for amplification and detector, plate current, plate AC resistance, mutual conductance, mu, maximum undistorted power output, physical size. There is a composite table (II) of characteristics of Rectifier and Voltage Regulator Tubes, and individual tables, giving grid voltage, plate current characteristics over full useful voltage ranges for the 220, 201A, 112A, 171A, 222, 240, 227, 245 and 224.

Chapter IX, Reproduction of Recordings, states coupling methods and shows circuits for best connections.

Chapter X, Power Detection, explains what it is, when it should be used, and how to use it. A rectifying detector, designed by one of the authors, is expounded also.

Chapter XI, Practical Power Amplifier, gives AC circuits and shows the design of a sound reproduction system for theatres. A page is devoted to power amplifier symbols.

Chapter XII, Measurements and Testing, discloses methods of qualitative and quantitative analysis of power amplifier performance. A scale illustrates the audio frequencies in comparison with the ranges of voice and musical instruments. A beat note oscillator is described. Thirteen causes of hum, with remedies, are stated, also the estimation of power required for output and preliminary tubes.

What Is Not As Well As What Is

SOMETIMES it is more important to expose a fallacy than merely to state the fact. A crop of technical weeds has grown into the garden of audio amplification, and the authors have gone to the pains of exposing these.

The book "Audio Power Amplifiers" is free from traditional errors, except in citing them as fallacious conclusions. Each attack on a fallacy is abundantly supported by proof of the REAL facts.

As an example, take the theory that motorboating is due to grid blocking. The authors say: "Many explanations for this oscillatory condition (motorboating) have been made, some of which are wholly untenable. One of these is that the oscillation is due to blocking of the grids of the amplifiers . . . If blocking of the grid were the cause of the phenomenon, the wave form of the oscillation would be very irregular, but an oscillograph shows that it is very nearly of a sinusoidal form."

Then follows an exposition of motorboating, and oscillation at other frequencies, with expressions for predetermining the instability or stability of audio circuits.

You may safely order "Audio Power Amplifiers," either enclosing your remittance or ordering the book mailed C.O.D. Examine it for five days. If you are not completely satisfied with it for any reason, or for no reason, send it back in five days with a letter asking for a refund. A check refunding the purchase price will be sent to you immediately. We can not send the book on approval, without payment before receipt, so please do not ask us to do so.

Send in This Coupon Now!

Hennessy Radio Publications Corporation,
145 West 45th Street, New York, N. Y.
(Just East of Broadway).

☐ Please send at once postpaid ..... copies of "Audio Power Amplifiers," by J. E. Anderson and Herman Bernard, for which please find enclosed $3.50 per copy.

☐ Please send ..... copies C.O.D. I will pay $3.50 plus Post Office charges.

Name .....

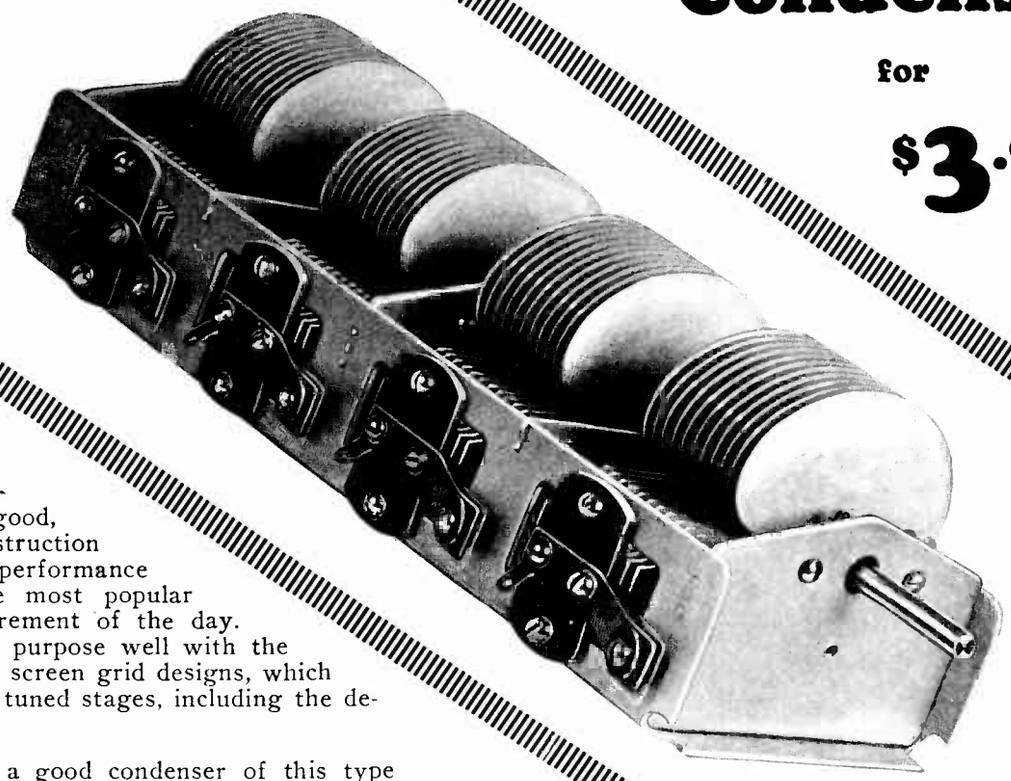
Address .....

City..... **State**.....

A Substantial Four-Gang Condenser

for

$3.95



A FOUR-GANG condenser of good, sturdy construction and reliable performance fits into the most popular tuning requirement of the day. It serves its purpose well with the most popular screen grid designs, which call for four tuned stages, including the detector input.

Ordinarily a good condenser of this type costs, at the best discount you can contrive to get, about twice as much as is charged for the one illustrated **and even then the trimming condensers are not included.** The question then arises, has quality been sacrificed to meet a price? As a reply, read the twenty-six points of advantage. The first consideration was to build quality into the condenser.

The reason for the low price is that the condenser was manufactured in very large quantities and is sold to the consumer with only one handling between factory and him, at a price only 10% above the cost of production.

All claims are backed up by our guaranty—**MONEY BACK IF IN FIVE DAYS AFTER RECEIPT OF CONDENSER YOU ARE NOT COMPLETELY SATISFIED.**

The Capacity is .00035 mfd. for each section. We haven't this condenser in any other capacity. The price is net to all, no matter what quantity. Order one shipped C. O. D.

[Overall length is 11 inches.]

5-DAY MONEY-BACK GUARANTY

GUARANTY RADIO GOODS CO.
143 West 45th St., New York, N. Y.
(Just East of Broadway)

Please ship me within one day of receipt of this order one four-gang tuning condenser, capacity of each section .00035 mfd., with trimmers built in, as advertised, at $3.95. Please send C. O. D.

Name .....

Address .....

City .....

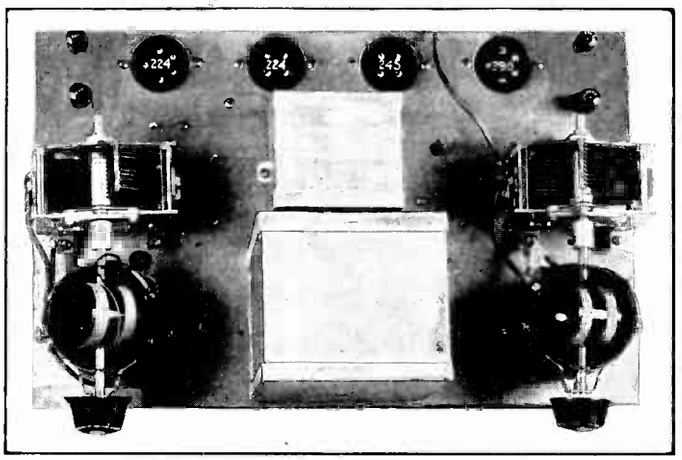
State .....

26 Points of Advantage!

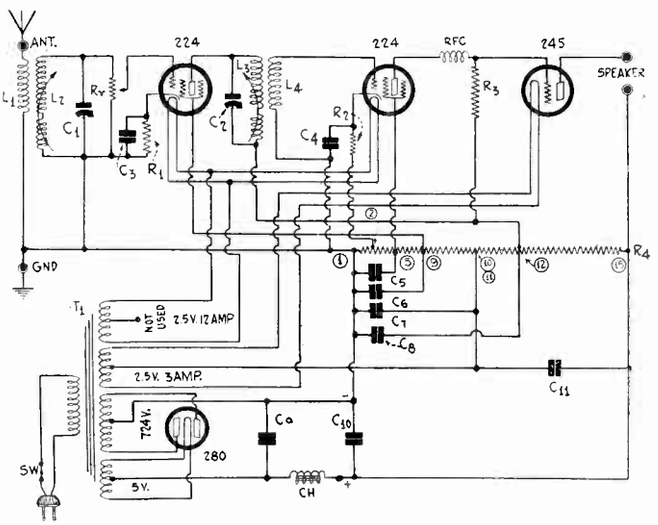
THE desirability and dependability of this condenser are attested by the following roster of features:

(1)—Rigid steel frame.
(2)—Accurate mechanical alignment.
(3)—Single steel shaft.
(4)—Shaft supported at both ends and at the center.
(5)—Accurate spacing of rotor and stator plates.
(6)—Plates made of aluminum of uniform thickness.
(7)—Stator plates shielded from each other and from external conductors.
(8)—Each section provided with a built-in adjustable trimmer condenser.
(9)—Steel spring bearings.
(10)—Adjustable tension on bearings.
(11)—Shaft and rotor plates removable.
(12)—Low minimum capacity in each section.
(13)—Low loss insulation between stator and rotor plates.
(14)—Common rotor connection to steel frame.
(15)—Each rotor attached to common shaft with two set screws.
(16)—Exact equality of all condenser sections at all settings.
(17)—Side and bottom mounting provisions.
(18)—Straight line wavelength shape of plates.
(19)—Brass soldering lug for each condenser stator section.
(20)—Capacity increases with counter clockwise rotation of shaft.
(21)—Capacity of each section, .00035 mfd.
(22)—Plates cannot short.
(23)—Easy turning shaft.
(24)—Will last a lifetime.
(25)—Eleven rotor and eleven stator plates in each section.
(26)—Weight (condenser alone), 3½ lbs.

Non-Reactive Audio with Tuner!



Layout of the NR-4, using a steel chassis, 15" wide x 9½" deep. The volume control (not shown) is at center. For installation dials replace the illustrated knobs.



The NR-4 circuit diagram, with numbers designating voltage divider taps, corresponding to illustration below.

NR-4

The Remarkable Non-Reactive Circuit designed by Herman Bernard, using the newly popular audio channel for AC operation. Speaker operation on four tubes, including rectifier.

L1, L2, C1—One Bernard antenna coil, .00035 mfd. condenser, link, Cat. BT-L-AC.....	$3.00
L3, L4, C2—One Bernard interstage tuner, with .00035 mfd. condenser, link, Cat. BT-R-AC	3.00
C3—One .01 mfd. condenser.....	.35
C4, C5, C6, C7, C8, C9, C12—Seven 1 mfd. condensers, low voltage.....	3.50
C9, C10—Two 1 mfd. filter condensers, 550 v. A.C. r.m.s 1,000 volts D.C.....	2.00
Rv (vol. control)—One Electrad Tonatrol pot. (500,000 ohms)	1.50
R1—One Electrad 800 ohm biasing resistor strip	.20
R2—One .02 meg. (20,000 ohms) resistor with mounting	.55
R3—One Lynch 0.5 meg. metallized resistor with mounting	.50
R4—One Multi-Tap Voltage Divider, with brackets, Cat. MTVD	3.95
T1—One Polo filament-plate supply, (50-60 cycle), Cat. PFPS	7.50
Ch—One single Polo B filter choke, Cat. PSC	2.50
RFC—One shielded radio frequency choke, 50 millihenries	.50
SW—One pendant AC switch with 12 foot cable	1.12
Ant., Gnd., Speaker—Four binding posts.....	.40
One steel chassis 15" wide by 9½" deep, with sockets affixed	3.50
Two dials, 100 to 0.....	1.00
Insulators (four for subpanel, three for front panel)	.22
	$35.29
Tubes: Two 224, one 245, one 280.....	$5.27

Construction Advice.

In building the NR-4, insulate the right-hand condenser from the chassis, as it tunes the SG plate circuit, and ground the chassis, also connecting ground and negative of the B supply. Then, to have both condensers equally elevated, insulate the left-hand one, but connect its frame to subpanel by a lead soldered to a lug fastened to subpanel.

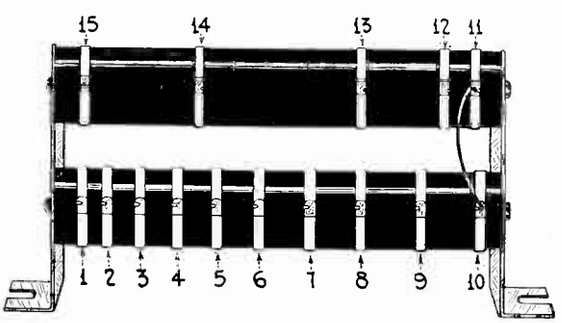
Polo 245 Filament Plate Supply (less chokes) has four windings, all save primary center-tapped (red), is 4½" wide, 5" high, 4" front to back. Weight, 9 lbs. Filament windings, 2.5 v. at 12 amps., 2.5 v. at 3 amps. (for 245 filaments), 5 v. at 2 amps. for 280 rectifier, and 724 v. @ 80 m.a., center-tapped. Order Cat. PFPS @ $7.50.
[For 25 cycles order Cat. PFPS-25 @ $12.00.]
[For 40 cycles order Cat. PFPS-40 @ $10.00.]

Multi-Tap Voltage Divider

For non-reactive audio circuits, instead of using variable resistors you may more conveniently use a voltage divider with numerous taps. Used as in the NR-4 it will not get hot—barely tepid after 10 hours continuous operation—because it will stand 125 milliamperes! The conservative rating, actual use, is 50 watts.

Two rugged, expertly engineered wire-wound, enamelled resistors, mounted in series, one atop the other, with fourteen useful lugs, providing all necessary choice of voltages without the uncertainty of adjustable variable resistance.

The Multi-Tap Voltage Divider has a total resistance value of 13,850 ohms, in the following steps: 3,000, 4,500, 2,000, 800, 700, 600, 550, 500, 450, 400, 200, 100 and 50 ohms. With the zero voltage lug (at lower left) the total number of useful lugs is fourteen. The resistance stated are those between respective lugs and are to be added together to constitute 13,850 ohms total.



Multi-Tap Voltage Divider, showing where to connect the leads for plate and screen voltages in connection with circuit diagram above.

Extreme care has been exercised in the manufacture ot the Multi-Tap Voltage Divider. It is mounted on brackets insulated from the resistance wire.

The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, where the current rating of 125 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. If good ventilation is provided, this rating may be exceeded 15 per cent.

The expertness of design and construction will be recognized by those whose knowledge teaches them to appreciate parts finely made.

When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. Sample voltages are 300, 180, 120, 75, 50, 40, 35, 30, 25, 16, 10, 6 and 3. By making suitable connection of grid returns the lower voltages may be used for negative bias or even for positive voltage on the plates.

Order Cat. MTVD at $3.95.

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We are headquarters for information and advice on non-reactive audio amplifiers and tuners therefor. Write us your questions, or telephone BARclay 8659. Telegraphed inquiries answered same day as received. All orders promptly filled. Five-day money-back guaranty on everything. Square deal is our motto.

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Jaynxon Laboratories,
57 Dey Street, N. Y. City.
Walter J. McCord, Chief Engineer.

Please ship at once C. O. D. tested parts for NR-4 as advertised. I am attaching a list of those parts desired.

☐ All parts are desired, as indicated by cross in square at left of this sentence.

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City ..... State .....

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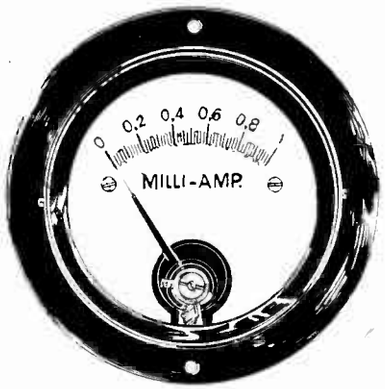

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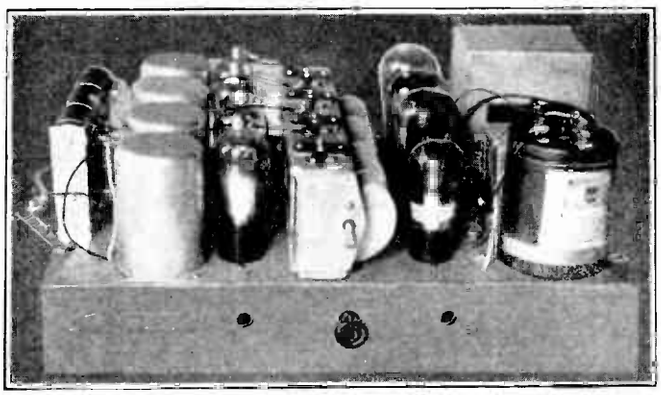

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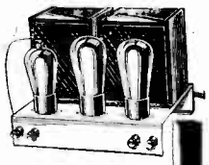

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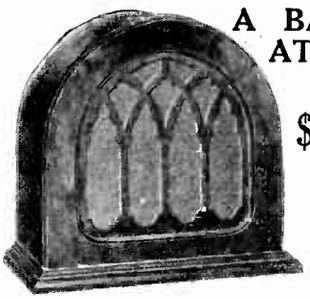

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Your Price

$15.82

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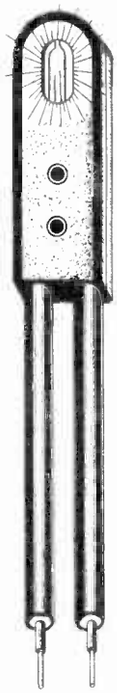
The three-meter assembly, in the crackle-brown finish carrying case, with slip-on cover in place. The handle is genuine leather. The buckled strap holds the cover on.

Illustration above is 2/3 scale.

J-111 Multiplier, upper left, with tip; below it, J-106 Multiplier with tip; plugs, left to right, J-19, conforms UV socket to UX plug; J-20, conforms UX tester socket to UV199 tube; J-24, to test Kellogg and old style Arcturus tubes.



Illumination Tester, Vest Pocket Size, Shows Shorts and Opens Visually, also polarity of DC line. A Neon lamp is built in.

Makes All Necessary Tests in a Jiffy and Simplifies Service Work!

WHEN servicing a radio set, power amplifier, speech amplifier or sound reproduction or recording equipment, the circuits and voltages are almost inaccessible, unless a plug-in tester is used.

The Jiffy 245-X plugs in and does everything you want done. It consists of:

(1)—The encased three-meter assembly, with 4-prong (UX) and 5-prong (UY) sockets built in; changeover switch built in, from 0-20 to 0-100 ma.; ten vari-colored jacks, five of them to receive the vari-colored tipped ends of the plug cable; grid push-button, that when pushed in connects grid direct to the cathode for 224 and 227 tubes, to note change in plate current, and thus shorts the signal input.

(2)—4-prong adapter for 5-prong plug of cable.

(3)—Screen grid cable for testing screen grid tubes.

(4)—Pair of Test Leads for individual use of meters.

(5)—J-106 Multiplier, to make 0-300 DC read 0-600.

(6)—J 111 Multiplier, to make 0-140 AC read 0-560.

(7)—Two jack tips to facilitate connection of multipliers to jacks in tester

(8), (9), (10)—Three adapters so UV199 and Kellogg tubes may be tested.

(11)—Illumination Tester.

The illumination tester will disclose continuities and opens and also the polarity of DC house mains. It is as handy as a pencil and fits in your vest pocket. It works on voltages from 100 to 400. There are two electrodes in a Neon lamp in the top of the instrument. On AC both electrodes light. On DC only one lights, and that one is negative of the line, the light being on the same side as the lead. Hence the illuminator shows whether tested source is AC or DC, and if DC, which side is negative.

Even the output of the speaker cord will show a light.

Also, the device will test which fuses are blown in fused house lines, AC or DC. Besides it tests ignition of spark plugs of automobiles, boats and airplanes, also faulty or weak spark plugs.

Just flash on the illumination tester momentarily. It will last about 4,000 flashes.

THE new Jiffy Tester, J-245-X, is a complete servicing outfit. It consists of a three-meter assembly in a metal case, with slip-on cover and a cable plug. There are ten adapters. It is vital to have the complete outfit so you can meet any emergency.

With this outfit you plug the cable into a vacated socket of a receiver, putting the removed tube in the tester, and using the receiver's power for making these tests: plate current, up to 100 milliamperes; plate voltage up to 300 volts; filament or heater voltage (AC or DC), up to 10 volts.

Each meter may be used independently. One of the adapters—a pair of test leads, one red, the other black, with tip jack terminals—serves this purpose. Multiplier J-106 extends the range of the DC voltmeter to 600 volts, but this reading must be obtained independently, as must readings on the 0-60 scale of the DC voltmeter. Independent reading of the AC voltmeter for line of voltage is necessary; also to use 0-140 scale while Multiplier J-111 extends the AC scale to 560 volts for reading power transformer secondaries.

The other adapters permit the testing of special receiver tubes, so that tests may be made, in all, of 22 different tubes: 201A, 200A, UX199, UV199, 120, 240, 171, 171A, 112, 112A, 245, 224, 222, 228, 280, 281, 227, 226, 210, 250, Kellogg tubes and old style Arcturus tubes.

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☐ Please send me on 5-day money-back guaranty your J-245-X Jiffy Tester, complete, with all 10 adapters, and with Illuminated Tester FREE with each order. Also send instruction sheet, tube data sheet and rectifier tube testing information.

☐ Enclosed please find $15.82 remittance. Ship at your expense. [Canadian must be P.O. or Express M.O.]

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