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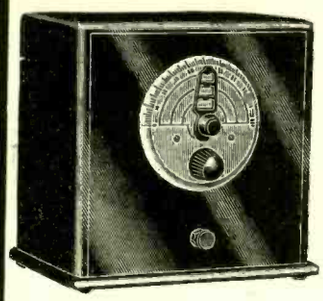

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New Tubes in Super

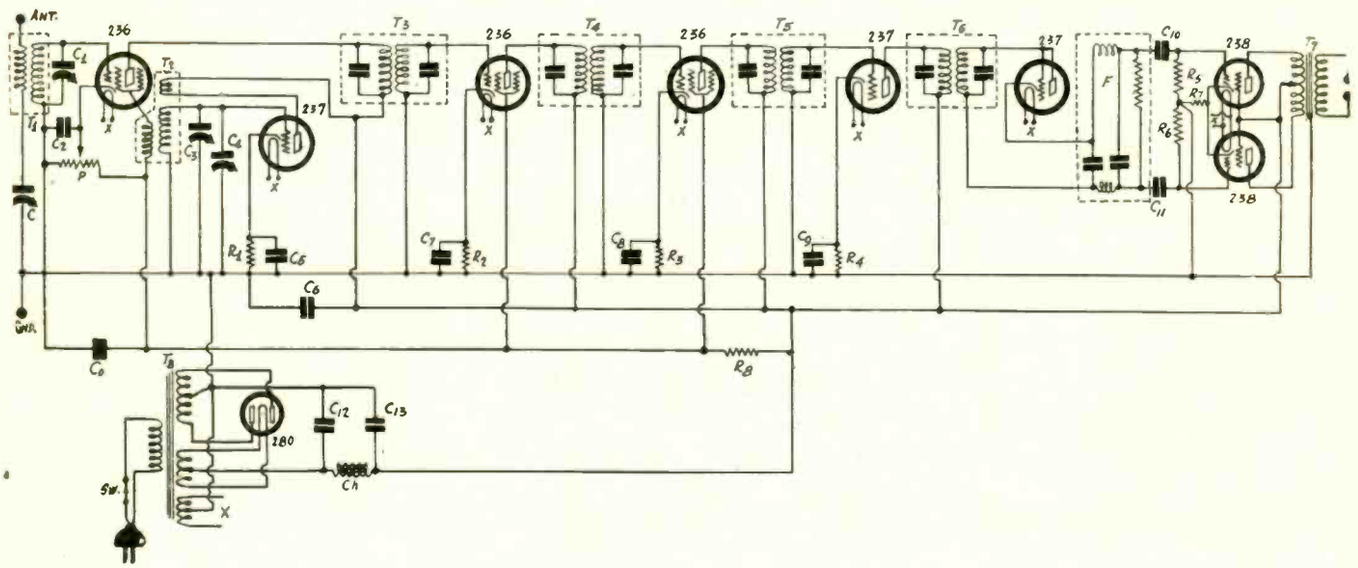

FIG. 1

The circuit of an eight-tube superheterodyne using the automotive type tubes throughout. It is suitable, with slight changes, for AC, DC, and battery operation.

THE so-called automotive tubes, the 236, 237 and 238, are suitable for use both in home receivers and in portable. They can be used on a six volt storage battery directly without any ballast resistors, they can be used on AC if there is a 6.3 volt winding available, or one of a somewhat higher voltage, or they may be used on 110 volt DC lines or on 32 volt storage batteries. When they are used on a 110 volt line the heaters are connected in series, and as many as seventeen tubes may be connected in series if that number is required in a receiver. On a 32 volt battery as many as five tubes may be connected in series. If more than five tubes are used in the circuit the heaters should be connected in series parallel. Since all the tubes in the automotive series take both the same voltage and the same current there are no complications in making the connections.

The eight-tube superheterodyne shown in Fig. 1 has been wired primarily for alternating current, all the tubes getting their heater current from a special winding X on the power transformer T8. If the voltage of this winding is 6.3 volts no ballast need be used but if the voltage is 7.5 volts a ballast resistance of 0.5 ohm may be used but no harm will result even if no ballast is used because the tubes have been designed to operate over a comparatively wide range of heater voltages.

DC Power Supply

If the heater current is to be taken from a storage battery in a car, the heaters are connected in parallel just as if the current is obtained from a 6.3 volt transformer winding and are then connected across the terminals of the battery. If the heater current is to be taken from a 32 volt battery four tubes are connected in series and the two series thus formed out of the eight tubes are connected in parallel. The series terminal voltage will be 25.2 volts and the current will be 0.6 amperes. If the battery voltage is taken as 32 volts we have to drop the difference of 6.8 volts, and since the current is 0.6 ampere we will need a resistance of 11.3 ohms. In as much as the terminal voltage may be more than 6.3 volts it is permissible to use a 10 ohm rheostat, or a fixed resistance of 10 ohms.

Now if the circuit is to be operated on a 110 volt DC line, all

(*Continued on next page*)

LIST OF PARTS

Coils

T1—One RF transformer as described
T2—One oscillator coupler as described
T3, T4, T5, T6—Four Supertone intermediate frequency (175 kc) transformers
T7—One push-pull output transformer
T8—One power transformer (for AC supply only)
F—One filter as described
Ch—One 30 henry choke

Condensers

Co, C6—Two 2 mfd. by-pass condensers
C1, C3, C—One triple tuning condenser, .00046 mfd.
C2, C5, C7, C8, C9—Five 0.1 mfd. by-pass condensers
C4—One 100 mmfd. trimmer condenser with knob
C10, C11—Two .02 mfd. or larger stopping condensers
C12, C13—Two 8 mfd. electrolytic condensers

Resistors

R1, R4—Two 2,000-ohm grid bias resistors
R2, R3—Two 400 or 500 ohm bias resistors
R5, R6—Two one megohm grid leaks
R7—One 600 to 650 ohm grid bias resistor
R8—One 10,000 ohm resistor
P—One 30,000 ohm potentiometer

Other Parts

Eight UY sockets
One UX socket, if 280 rectifier is used
Sw—One line switch
One dial
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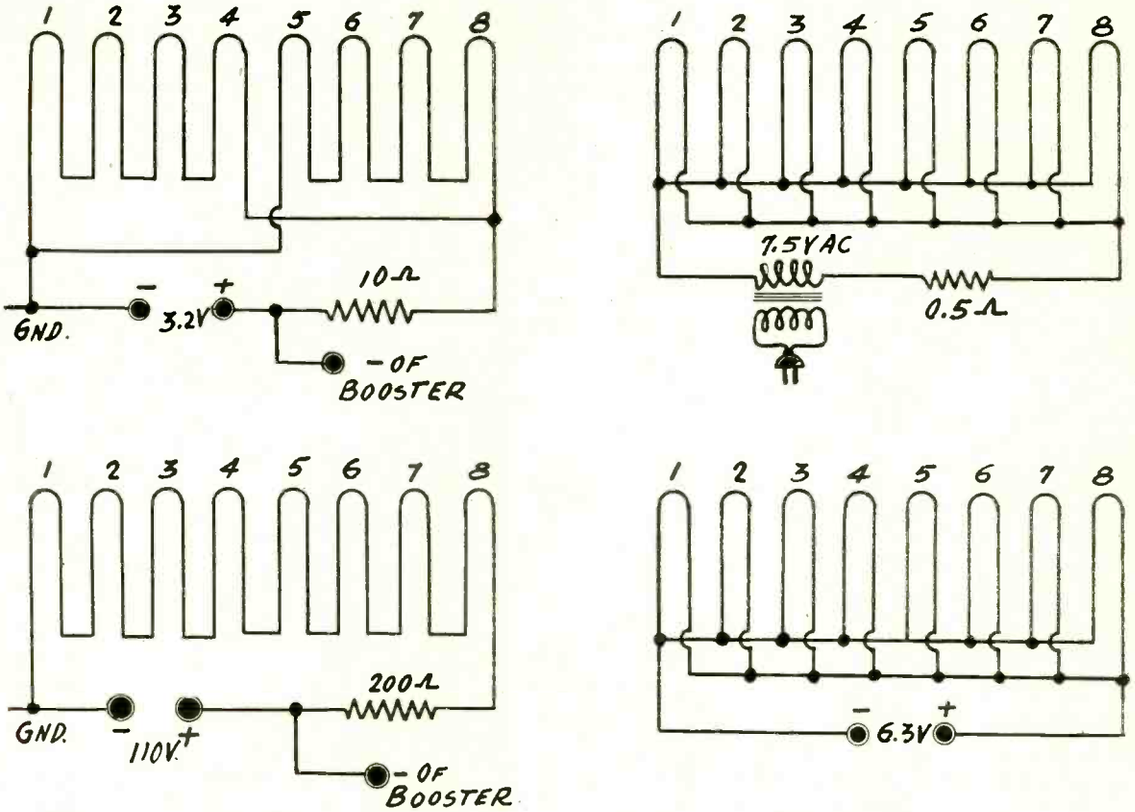

FIG. 2
Four methods of connecting the filaments or heaters in the circuit in Fig. 1. Upper left, series connection for 110 volt DC supply. Upper right, parallel connection for battery heating. Lower left, series parallel for use on a 32 volt battery. Lower right, parallel connection for use on a 7.5 volt transformer winding.

(*Continued from preceding page*)

the heaters must be connected in series. The series terminal voltage will now be 50.4 volts and the current will be 0.3 amperes. If we take the line voltage as 110 volts we have to drop the excess of 59.6 volts. Since the current is 0.3 ampere the required ballast resistance is 198.5 ohms. Since the line voltage is likely to be in excess of 110 volts we should allow for this, but also since the voltage per tube may be higher than 6.3 volts we are safe if we use 200 ohms. Suppose the line voltage is 118 volts. The resistance in series with the 118 volts is 368 ohms. This will make the current 0.321 ampere, which is only about 6 per cent. higher than normal, and this is well within the limits of allowed variation.

Operation With Dry Cells

It is even possible to operate the circuit with dry cells, although this is not recommended because the weight of the necessary cells will be considerable. In order to get the necessary voltage there will have to be four cells in series, and in order to get the necessary current without overloading the cells we have to have 10 cells in parallel, assuming that we have No. 6 cells. Obviously, the weight will be very great and therefore dry cell operation should only be used in an emergency.

The B supply suggested in the drawing is a regular B battery eliminator with a 280 rectifier tube. That is the best source when AC is used on the heaters. If a 32 volt storage battery is used to heat the tubes the entire 32 volts can be used as part of the B supply. It is only necessary to connect the negative of the battery to ground. A booster battery is necessary for 32 volts are not even enough for the screens. The voltage of the booster battery should either be 90 or 112.5 volts.

If the circuit is operated on a 110 volt DC line the entire 110 volts can be used on the plates. The negative of the heater which is nearest the negative end of the series should be connected to the ground. Note that when this is done there should be no ground connection to the set for the circuit will be grounded through the line and another connection might result in a short circuit. A booster battery is hardly necessary in this case although a 45 volt booster may be used if desired. In this case the 200 ohm ballast should be placed on the positive side of the heater series and the booster, if used, should be connected with its negative to the positive side of the 110 volt line.

Plate Current Requirements

If the B supply is all dry cell batteries, three 45-volt heavy duty blocks will be needed.

Each of the three 236 tubes will take about 3.5 milliamperes plate current and 1.15 milliampere of screen current, making a total for the three tubes of 10.95 milliamperes. Each of the two 237 tubes will take 4.5 milliamperes plate current, making a total of 9 milliamperes, and each of the two 238 tubes will take 8 milliamperes plate current and 2.5 milliamperes screen current, making a total of 21 milliamperes. Hence the tubes in the set will take 40.95 milliamperes plate and screen current. In addition to this there will be 2.75 milliamperes through the 30,000 ohm potentiometer, making a grand total of approximately 43.7 milliamperes. This is a low current for an eight tube receiver. It will be noted that the detector does not take any current at all since only signal voltage is applied to it.

This total current is based on the assumption that the plate voltage on tubes and the screen voltage on the power tubes is 135 volts and that the screen voltage on all the other screen grid tubes is 75 volts. If the voltages are less the current will also be less. The current in the first tube will really be less than that assumed because the operation is that of a grid bias detector with a comparatively high voltage on the control grid.

Grid Bias Voltage

The grid bias on the two 236 intermediate frequency amplifiers should be 1.5 volts. To get this with a grid bias resistor we should have a resistance of 411 ohms. It is permissible to use either 400 or 500 ohms. R2 and R3 in Fig. 1 come under this rating. The bias for the two 237 used under amplifying conditions should have a bias of 9 volts. Hence we need a bias resistance of 2,000 ohms for each of these tubes. R1 and R4 are the two 2,000 ohm resistors.

The bias resistance R7 serves the two power tubes. The

Moullin's Book Notable Treatise

"The Theory and Practice of Radio Frequency Measurements" by E. B. Moullin, M.A., second edition, published by J. B. Lippincott Company, Philadelphia, is a notable book for the advanced radio student. It is a text book suitable for an advanced college course in the measurements of quantities occurring in radio engineering.

It opens with a chapter on the theory of the electromagnetic field. While this is entirely mathematical the subject is treated in such manner as to make it vital and to simplify the understanding of the principles of measurement based on the theory.

Home and DC in an Auto

of Tubes Used in 175 kc Circuit

bias for these tubes should be 13.5 volts. As the total current through these tubes should be 13.5 volts. As the total current through it will be 21 milliamperes the value of R7 should be 643 ohms. If the bias resistor is 600 ohms, the bias will be 12.6 volts, assuming that there is no change in the plate current. Actually the current will go up so that the bias will not decrease as much as indicated.

The potentiometer P serves to give the first detector the correct bias for highest detecting efficiency and also as a volume control. When the slider is all the way to the left, that is, to the negative or ground end, the bias on the tube is zero and the tube is only a fair detector. As the slider is moved toward the right the bias increases, and at the same time the screen voltage decreases. The detecting efficiency increases rapidly until the maximum is reached and then it begins to decrease again. For complete silence the slider has to be moved about half way toward the positive. This divides the 75 volts equally between the screen and the grid.

Experimental Detector

The detector tube operates as a half-wave rectifier and works into a very high impedance comprising a filter and a voltage distributor. The impedance is so high that the amplitude of the audio voltage is nearly as high as the amplitude of the radio frequency voltage impressed on the circuit. This type of detector is used so that resistance coupled push-pull may be used after it. Since the audio voltage across the output will not be very high the tubes following are the 238 pentodes. If the signal across R5 and R6, that is, across the output of the filter, is 27 volts, each pentode will get all the voltage it can stand without overloading.

The value of R5 and R6 are one megohm. The stopping condensers C10 and C11, which prevent the DC component of the rectified current from entering R5 and R6, should be very large. If the circuit is to amplify well as low as ten cycles per second the value o feach should be not less than 0.1 mfd. and they may well be one microfarad each. If the lowest frequency is 50 cycles per second, each condenser need not be greater than 0.02 mfd.

The Filter

There are five elements in the filter, two equal chokes, two equal condensers and one resistor. Each choke may be an 800 turn duolateral coil such as are used in the intermediate frequency transformers and each condenser may be 0.00025 mfd. The resistor should be about one megohm. These five elements are inclosed in a shield can similar to the shields used for the intermediate frequency transformers. The two coils should be mounted so that their axes are at right angles to each other so that there is no coupling between them.

Each of the four intermediate frequency transformers T3, T4, T5 and T6, is made of two 100 mmfd. trimmer condensers and two 800 turn duolateral coils and tuned to a frequency of 175 kc. They have been described in detail in previous issues. Each is encased in a shield can two inches high and two and a half inches in diameter.

All the by-pass condensers across grid bias resistors should be 0.1 mfd. or larger. Condensers Co and C6 should not be less than 2 mfd. units, and condensers C12 and C13 in the B supply filter should be eights. If the plate voltage is taken from a battery or source different from a regular rectifier supply, one large condenser of 8 mfd. or so should be connected from B plus to B minus. That is, C13 should be retained.

The Tuner

The tuning condenser consists of three sections each having a capacity of .00046 mfd., nominally rated at .0005 mfd. The first of these sections is put in the antenna circuit to equalize the sensitivity of the receiver. This section is not a tuner but should be looked at as a variable series antenna condenser. At short waves where the transformer T1 is more effective the capacity of the condenser is small and at the long waves the capacity is large so that the impedance of the antenna circuit short waves.

The second section of the triple condenser is connected across the secondary of T1 and serves as the first tuner in the circuit. The third section is across the oscillator coil and determines the frequency. It is the principal tuner.

This suggests that the superheterodyne is single control. It is not that exactly, for there is a trimmer condenser C4 associated with the oscillator. While it is possible to arrange condensers so that a superheterodyne is single control very few amateur builders will take the trouble required to effect a satisfactory adjustment. It is a major operation which too often is unsuccessful. Even when the adjustment is as good as it can be made with a condenser in series with C3 and a trimmer in the position of C4, the tuning is not as exact as when an adjustable trimmer is available from the panel. The oscillator condenser tunes all right because that determines the tuning, but the RF condenser is not in tune. Consequently there is a loss in sensitivity at most of the settings of the control. This trouble can be avoided so easily by means of a trimmer on the panel that it is not worth while to go through all the trouble to achieve mediocre results.

Question of Coils

Just why is the trimmer C4 connected across the oscillator? There is no particular reason. It can also be connected across the RF section of the tuning condenser. But the design of the coils will be different in the two cases. We shall work out the coils on the supposition that the trimmer is in the oscillator circuit and that the variable portion of the two sections is .00046 mfd. The zero setting capacity of the RF condenser should be 71.5 mmfd. This can be obtained from the trimmer usually connected across ganged condensers. The maximum capacity in the tuned circuit will then be 531.5 mmfd. For this an inductance of 157.7 microhenries will be needed.

In the oscillator we need a minimum capacity of about 100 mmfd. This we will get by cutting in a variable condenser of 100 mmfd. and distributed capacity. At 550 kc the trimmer should be wide open and the circuit should tune to 725 kc. We may assume that the capacity in the circuit when the large condenser is at maximum is 500 mmfd. Thus for the oscillator we need an inductance of 96.5 microhenries. With this inductance the oscillator should tune to 1,675 kc when the large condenser is wide open. The capacity needed is 93.5 mmfd. But the large condenser will have a capacity of only about 40 mmfd. when it is wide open. Hence we have to use the 100 mmfd. trimmer to make up the difference.

Winding the Coils

If we wind the RF coil with No. 28 enameled wire on a 1.75 inch diameter, 157.7 microhenries will require 57 turns. That is for the tuned winding. The primary should contain 25 turns of the same wire. This large primary may be used because of the series condenser.

If we use the same size form and the same wire for the oscillator we will get our 96.5 microhenries by winding 41 turns. The tickler winding should have 2/3 as many and the pick-up need not have more than 10 turns. The tickler should be wound on one side of the tuned winding and the pick-up on the other.

These coils should be inclosed in large shields not less than three inches in diameter and they should preferably be of copper. The coil should be centered in its shield in both directions and there should be at least one inch from the top or bottom to the nearest turn of a winding.

Trimmer in RF Tuner

If the trimmer is in the RF tuner the trimmer should be set at maximum when the main condenser is at maximum. Let us assume that the total capacity including distributed is 600 mmfd. when both condensers are at maximum. Then the inductance should be 139.4 microhenries. With this inductance the capacity needed at 1,500 kc is 80.8 mmfd., which may be reached with the trimmer if the main condenser is near minimum.

The maximum capacity in the oscillator circuit may be taken as 500 mmfd. Hence we need not change the coil in the oscillator. The capacity needed at 1,675 kc with this coil we found to be 93.5 mmfd. This is more than the capacity needed in the RF circuit and it is in the wrong direction to be corrected for by the trimmer. Therefore this method is not so good as that of putting the trimmer in the oscillator circuit. Still, it may be used if we make the RF coil a little smaller and the trimmer condenser a little larger. If we use a 125 mmfd. trimmer and a 134 microhenry coil we would need a minimum capacity of 84 mmfd., which is near enough to obtain accurate tuning.

A coil of 134 mirohenries is obtained by winding 50 turns of No. 28 enameled wire on a 1.75 inch diameter without spacing the turns than the wire diameter.—J. E. Anderson.

on Radio Frequency Measurements

The treatment is not elementary by any means but it is satisfactory to one who has a knowledge of the calculus and partial differential equations. But this chapter need not deter anyone from reading the book for there follows ample material that anyone can understand. A knowledge of simple algebra is about all that is needed to read the major portion of the book with understanding.

The second chapter is devoted to circuit formulas, those of various combinations of resistances, condensers, and inductances. There are many filter formulas, since filters are always combinations of these circuit elements.

Plugless All-Waver

By Herman Bernard

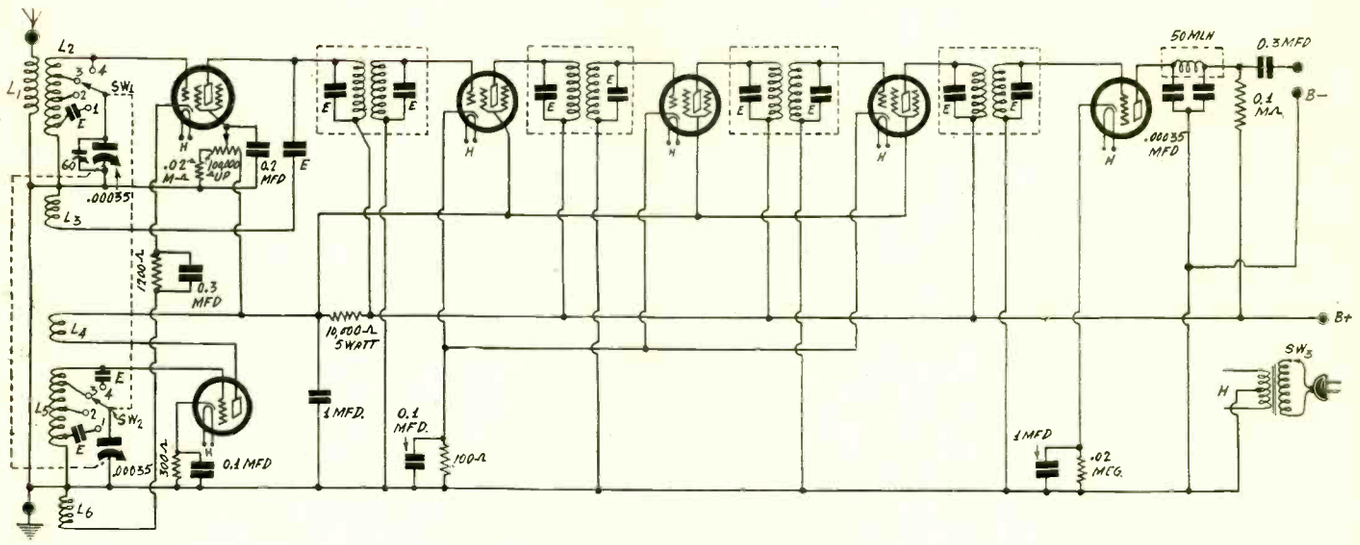

FIG. 1

WHERE there are two tuned circuits in a mixer, with an established intermediate frequency, as in Fig 1, inductance switches may be used so that no plug-in coils would be necessary, yet a wave band from 600 to about 15 meters can be covered. The two tuned circuits are the oscillator grid and modulator grid circuits, and they are united to a desirably small extent by some inducive coupling. How this may be done is shown in the coil construction diagram, Fig. 2. The respective grid windings are at the extremes, and the plate winding of the oscillator in the center, since the coupling between the plate of the oscillator and the grid of the modulator is much less that way, than if the two grid windings were close together. No pickup coil (L6) then is necessary. If used it would consist of 4 twins.

For all-wave reception an intermediate frequency around 450 kc is satisfactory. A much higher frequency, for instance one higher than the highest broadcast frequency, would be troublesome, since for tuning in the broadcast band at its low frequency end the difference in frequency between the oscillator and the modulator would be too great a multiple of the original carrier frequency, and tandem tuning would become a major engineering problem.

Case of a Lower Intermediate

If the intermediate frequency were much lower than 450 kc, then the frequency difference between modulator and oscillator would be too small, and the two circuits would tend to become united, that is, function as one, with consequent reduction in selectivity and possible stoppage of oscillation, even though some constructors have had good luck at an intermediate frequency around 250 kc.

The two switches may be actuated by one shaft, so that only one knob need be turned to change the frequency band. Preferably the shaft should be of the insulated type. If it is not, then the switch must be insulated from the chassis front, if a metal chassis is used.

Assuming the use of a .00035 mfd. double condenser, and a coil wound on a 1¾ inch diameter bakelite form, say 3½ inches axial length, the grid windings with No. 18 enamel wire, the plate winding with No. 24 single or double silk covered wire, the number of turns would be as diagrammed in Fig. 2. The seperation between the oscillator grid winding and the adjoining plate winding is ¼ inch, while that between the oscillator plate winding and the modulator grid winding is ¾ inch. L6 would be needed only for far separated coils or separately shielded coils.

The coil is so tapped that a four-pole single throw switch is used for each grid winding, and, as explained, may be a compound switch, constituting eight-pole double throw. Movement of the switch arm connects the stators of the variable condensers respectively direct to grid (tap 4), to a tap 15 turns removed from the grid connection (tap 3), to a tap 23 turns removed from the grid connection (tap 2), and to a tap 27 turns removed from the grid connection (tap 1). Since the turns total 31, to bring in the highest frequencies there are 4 turns in the tuned circuit, with the tuned part and the rest acting as the secondary of a step-up ratio auto-transformer.

System Works Well

The inductance switching method works very well indeed. The difference in frequency between modulator and oscillator is of a substantial order only in respect to the broadcast band, and a series condenser of .0001 mfd. (a Hammarlund equalizer) will take this up nicely. The fixed condensers at the other end of the two coils are optional, and also are equalizers.

The object now is merely to present the coil data with considerable frequency overlapping and show how the system of omitting plug-in coils by the inductance switch method is worked. With .00035 mfd. the same band could be covered with three taps, using less overlap.

The intermediate transformers consist of 200-turn honeycomb coils, with .0001 mfd. (100 mmfd.) trimmers across them, contained in an aluminum shield.

If desired, the mixer coil may be shielded likewise, but in that instances the shield should be copper, at least 3 inches in diameter, and at least 4 inches long.

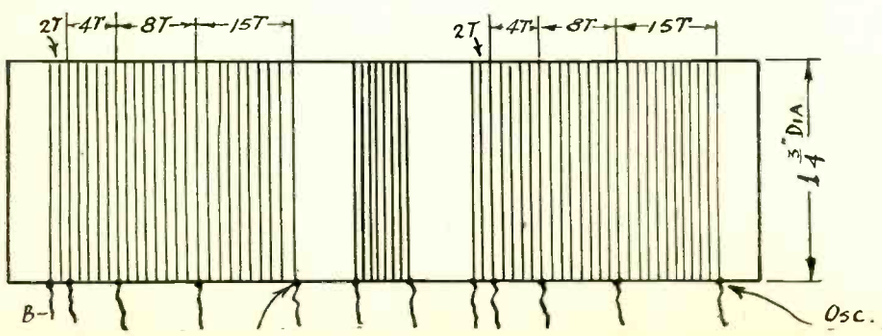

FIG. 2

Detail of the coil construction using 1¾ inch diameter bakelite tubing, separation between oscillator grid winding (right) and plate winding being ¼ inch, and between plate and modulator grid windings ¾ inch.

Curve for Auto Pentode

By J. E. Anderson

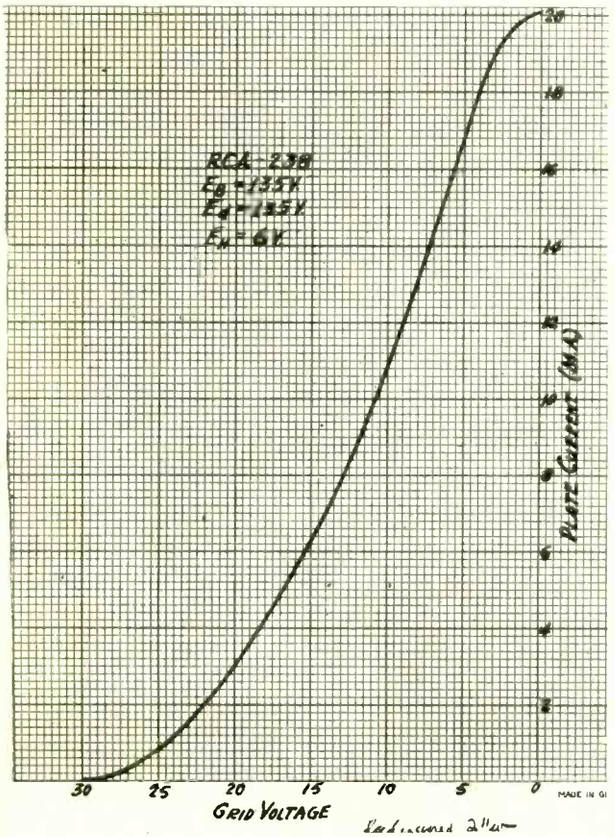

FIG. 1

A grid voltage, plate current curve for the 238 pentode power tube. The operating conditions are as stated on the figure.

THE RCA-238 is the output pentode in the automotive series of tubes, that is, in the 6.3 volt heater series of tubes. It is rated as having an amplification factor of 100 and a mutual conductance of 900 when the plate and the screen voltages are 135 volts, and as giving a maximum undistorted power output of 0.375 milliwatt when the operating bias is 13.5 volts and the load resistance is 15,000 ohms.

In Fig. 1 herewith is a grid voltage, plate current curve for a sample of this type of tube under the operating conditions stated in the figure. This curve was taken without any load resistance, in the plate circuit. Since the heater voltage was only 6 volts instead of 6.3, and also since the curve was taken on a sample, the curve does not represent the average characteristic of this type of tube.

Mutual Conductance

We can obtain the mutual conductance of the sample tube from this curve. It appears to be highest when the grid bias is in the neighborhood of 7.5 volts. Let us take it between 5 and 10 volts. At five volts the plate current is 16.8 milliamperes and at 10 volts it is 10.9 milliamperes. Therefore five volts causes a change in the plate current of 5.9 milliamperes and therefore one volt would cause a change of 1.18 milliamperes. Hence the average value of the mutual conductance between 5 and 10 volts on the grid is 1,180 micromhos.

Use of Tube as Power Detector

The operating point of the tube for maximum output is supposed to be 13.5 volts. Let us take the mutual conductance between 11.5 and 15.5 volts, which we may call the mutual conductance at 13.5 volts. At 11.5 volts the current is 9.3 milliamperes and at 15.5 volts it is 5.9 milliamperes. Hence four volts changes the current 3.4 milliamperes and one volt would change it 0.85 milliampere. Hence at 13.5 volts the mutual conductance is 850 micromhos. For the average tube at this voltage, and

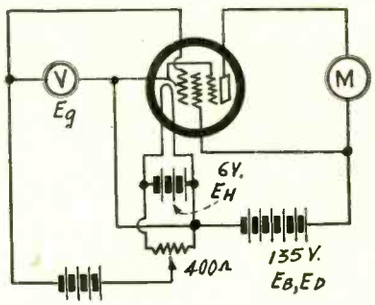

FIG. 2

The circuit used in taking the curve in Fig. 1.

when the heater voltage is 6.3 volts, the mutual conductance is 900 micromhos.

While this tube has been designed primarily for power output tube, it is clear from the curve that it can also be used as a power detector, provided that the intensity of the available radio frequency signal is high enough to justify such use. If the grid bias is adjusted to 25 or 30 volts and the amplitude of the radio frequency is approximately equal to the bias a very high rectified output may be obtained. In fact, if the grid bias be adjusted until the plate current is just zero when no radio frequency voltage is impressed, the rectified and filtered current would be of the order of 6 milliamperes. The tube would have to be followed by a transformer.

Curvature Near Zero Line

The curvature of the curve near zero bias is probably due to two causes. First, the approach to saturation of the emission and second, to the robbing of the plate by the screen.

In Fig. 2 is the diagram used in taking the curve in Fig. 1. As will be observed the screen, which for this tube is the G post on the socket, is connected to the positive side of the milliammeter so that the voltage on the screen is the same as that on the plate except for the negligible drop in the meter. The cap on this tube is the control grid and the K is the cathode. The voltage of the storage battery serving the heater is also used in part for the grid bias, which is made possible by connecting the positive of the battery to the cathode and B minus.

The 238 is the only heater type pentode now available. The control grid is brought out at the top of the tube as in the case of screen grid tubes like the 222 and the 224. The G terminal, which is the control grid connection on the 227 is the screen connection in the 238, just as it is in the 224. For the 238 this should be connected to the same point as the plate return of the tube, which is usually the highest voltage point in the circuit. The cathode connection serves as cathode in this as in the 224 and the 227. In this respect the tube differs from the filament type pentodes such as the 247 and the 233.

Why It Is a Pentode

The question may arise as to why the 238 is called a pentode when it apparently has only four electrodes, the cathode, the control grid, the plate, and the screen grid. This question may also arise concerning the 247 and the 233. Well, in the 238 the fifth element is connected to the cathode inside the tube and is not represented externally by any separate terminal. Geometrically the fifth element is between the plate and the control grid and is really the screen.

In the filament type pentodes, the 247 and the 233, the fifth element is connected to the midpoint of the filament and is not represented by any external terminal. Geometrically it is placed in the same manner as for the 238. What is called the screen for convenience is by some called the space charge grid. Its function is to reduce the internal plate resistance without at the same time reducing the amplification factor of the tube.

The 238, or any power pentode, can be used in push-pull circuits to good advantage just as any other power tube. The main point of superiority of the pentode over other power tubes is that a given amount of output power is obtained with a lower input voltage. thus in many cases permitting the omission of a stage of amplification. The gain is not only in quality due to the omission of the avoidance which would have occurred in the omitted stage but also in economy, the cost of operating an extra stage being avoided.

The Pentode Diamond

New 233 Output Tube is Included

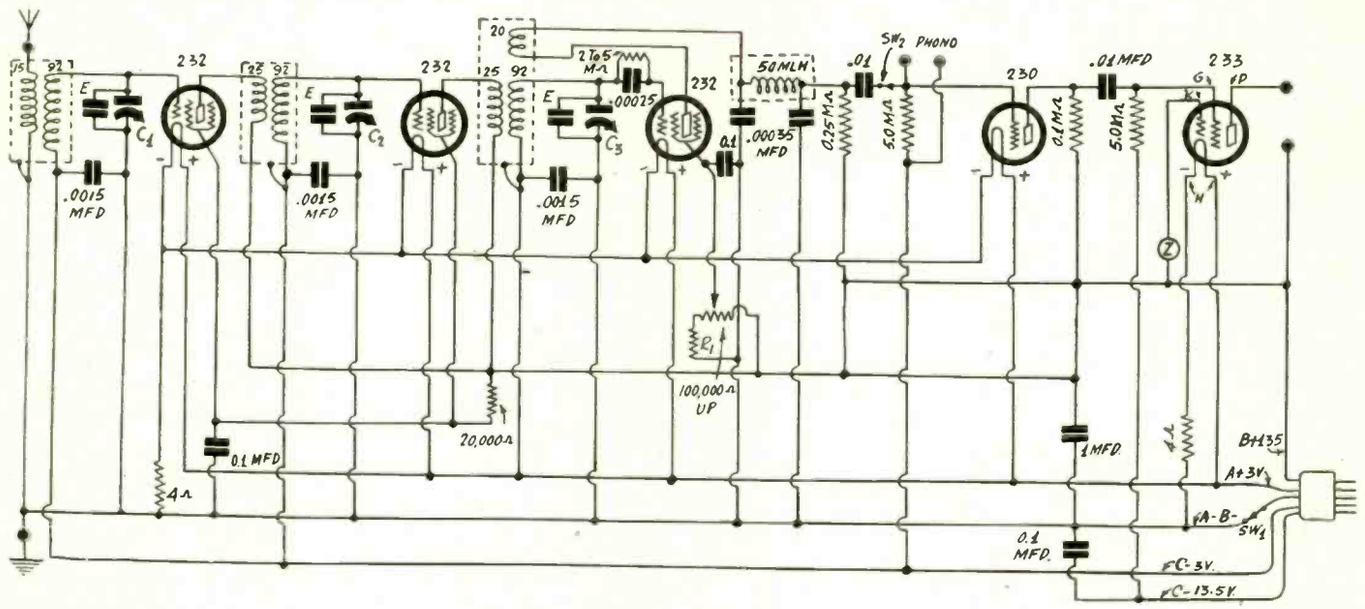

FIG. 1

The battery-operated Pentode Diamond uses 2 volt tubes throughout, including the brand-new output tube for battery operation, the 233.

[The Pentode Diamond in AC form was described in last week's issue, dated May 9th. This week the battery-operated circuit is described. The general layout of parts is approximately the same, except for omission of the B supply parts. and the use of the erstwhile rectifier tube socket as a five-prong receptacle for the five-lead battery cable plug.—EDITOR.]

ONLY three years ago the phrase "a five tube set" meant two stages of tuned radio frequency amplification, tuned detector and two stages of transformer-coupled audio frequency amplification, with performance limitations that were well known by those versed in radio technique. Sets using more tubes and more tuned circuits quickly appeared. Since then laboratories, concentrating on the development of special purpose tubes, have produced valves that permit of a far higher order of performance, with still only five tubes. In other words, fewer of the new tubes do more and better work than a greater number of the old general-purpose tubes, and the quality of reproduction is rendered almost immeasurably better.

"Just Another Five Tube Set"

So popular was the five-tube design of only three years ago that it was a standing jest among radio engineers to refer to one another's circuits as "just another five tube set." In some instances there was more reality than humor in the remark. But today the limitations imposed on five tube designs are removed, and performance that copes with the most up-to-date standards, may be enjoyed.

The result may be achieved with a little sacrifice of tone quality with only four tubes, in a battery design, if transformer coupling is to be used.

In the five tube Pentode Diamond the filament current is 0.47 ampere, the plate-screen currents just under 30 milliamperes.

The three tubes used as radio frequency amplifiers and detector are 232, while the first audio frequency amplifier is a 230 and the output tube a 233 pentode. The 232's are screen grid tubes, the 230 is a general purpose tube, while the 233, although called a pentode because it has five elements, is also a screen grid tube. The fifth element is connected to the filament inside the tube, so the tube symbol represents connections as to a quadrode, that is, regard only the external connections.

2 Volt Tubes Throughout

All three types of tubes in the battery-operated Pentode Diamond are of the 2-volt variety. Assuming a 3-volt source, such as constituted by two No. 6 dry cells in series, the filament resistors should be 4 ohms for the pentode and 4 ohms for the common negative filament lead of the four other tubes. The value is 4 ohms because 1 volt is dropped at 0.23 ampere in the case of the pentode and at 0.24 ampere in the other instance, 4 ohms representing a close commercial value to serve the purpose.

It is recommended that if No. 6 dry cells be used at 3 volts, there should be four cells, two cells in series in two instances an,d each the two series pair in parallel. The No. 6 dry cell should not be worked at more than .25 ampere for long life, and as the total drain will be .47 ampere, the series-parallel method should be employed.

If the voltage source is 6 volts, as in the case of a storage battery, then the voltage drop from source to tube filament would have to be 4 volts instead of only 1 volt, and the resistance values, instead of being 4, would have to be four times as great.

Other Resistor Values

The resistor R1 should have a high value. Its purpose is to enable the builder to select the minimum volume level for the loudest local, and thus not have a volume control that completely kills off the signal, and confines the working range to only a part of the knob's sweep. For R1 a value of .02 meg. (20,000 ohms) is suggested if the potentiometer is 100,000 ohms, but larger values than .02 meg. may be tried, and these will increase the minimum volume because increasing the minimum screen voltage that may be applied to the detector.

The potentiometer's minimum value is 100,000 ohms, but any value in excess of that may be used instead. The reason for a minimum is to prevent selection of so low a value that the bleeder B current through the potentiometer will be unnecessarily much. At 100,000 ohms, assuming R1 omitted, the current bleeder would be only 0.1 ma. The average screen current, that always flows through at least a part of the potentiometer, is five times as great.

There are radio frequency bypass condensers from the grid return coil connections to ground because otherwise the C battery would be in the tuned circuit. Under certain conditions, particularly when such a battery has been in use a long while, the resistance thereof may be sufficient to impair selectivity, but the condensers will bypass this resistance.

Use of Three 0.1 Mfd.

In the case of the detector the bypass condenser is simply across the A battery, because the grid return is to A plus, while

for Battery Operation

in Up-to-Date Five Tube Design

LIST OF PARTS

Coils

One shielded antenna transformer, 15-92.
One shielded screen grid transformer, 25-92.
One shielded three-circuit transformer, 25-92-20.
One 50 Millihenry copper shielded radio frequency choke coil.

Condensers

One three-gang .00046 mfd. condenser with brass plates and ¼-inch reducing coupler.
Three 100 mmfd. equalizing condensers (E).
Two .00035 mfd. fixed condensers.
Two .01 mfd. fixed condensers.
One 1.0 mfd. bypass condenser.
Three 0.1 mfd. condensers in one block.
Three .0015 mfd. fixed condensers.
One .00025 mfd. grid condenser.

Resistors

Two .02 meg. (20,000 ohm) pigtail resistors (one used as R1 with potentiometer).
One potentiometer, 100,000 ohms or more (insulate from chassis).
One 0.25 meg. pigtail resistor.
One 0.1 meg. pigtail resistor.
Two 5.0 meg. pigtail resistors.
Two 4 ohm filament resistors with mountings.
One 5 meg. grid leak.

Other Parts

One flat type dial with pilot lamp and bracket.
Six brackets for mounting shields.
One 16½ x 10 x 3 1/16 inch metal chassis, with principal holes drilled.
Six rubber grommets.
One antenna binding post with small fibre insulator and flat insulating washer.
One ground binding post.
One phonograph switch (SW2) with two large fibre insulators.
One shaft type switch (SW1).
Two knobs.
Four UX sockets and two UX sockets (one UX for cable plug).
One 5-lead battery cable with UY plug attached.
One "phono" twin binding post assembly.
One "speaker" twin binding post assembly.
One roll of hook-up wire.
Two feet of shielded wire to run to caps of screen grid tubes.
Two dozen 6/32 round head machine screws and two dozen nuts.
Four 6/32 flat-head machine screws, four nuts.
Three grid clips.
One 7 x 18 inch front panel.

the tuning condenser goes to A minus, the rotor being common for the three-gang condenser.

Three instances of the use of 0.1 mfd. call for the inclusion of one block comprising these three individual capacities, with the black lead being common and going to grounded B minus, while the red leads serve the other purposes, that, is, go to the united screens of the two radio frequency amplifiers, screen of the detector and to C minus 13.5 volts.

The high bias is for the pentode output tube, which although a battery-operated tube requires a UY (five-prong socket, whereupon G represents the control grid of this tube and takes one side of the input, K (cathode in other tubes) is the screen, which takes a high positive voltage, the two heaters are for filament minus and filament plus, and P is for plate to which speaker or an output filter is connected.

The voltage effective on the screen (K) should be the same as that effective on the plate (P). The applied voltage in the plate circuit is 135 volts. If you use a speaker or coupling device that has a high DC resistance, say, 800 ohms or more, a DC "pure" resistance may be introduced where the encircled Z is shown, to equalize the effective screen voltage with the effective plate voltage.

In most instances, however, especially where dynamic speakers are used, no regard need be paid to this, since the voltage dropped in the plate load impedance is too small to require any compensation.

How to Wind the Coils

The three letters E represent equalizers, the numbers adjoining the coil symbols represent the number of turns of wire on 1¾ inch diameter tubing, while the other constants are noted on the diagram, excepting R1, which has been explained, and Z, which, if required at all, will vary with different types of speakers used.

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

Variable Mu Tubes in the Da-Lite-R

By ANTHONY SWALE WARING

[*During the last two weeks constructional data on the Moore Da-Lite-R receiver, a development of the "Everyman" and "Moore-Daniels" receivers, have been published. Users of the new Da-Lite-R report distance such as Rome, London and Algiers on the regular broadcast channels.*—EDITOR.]

The one limitation on absolutely perfect 10 kilocycle selectivity that has been found in receivers such as the Da-Lite-R has been the propensity on the part of strong local signals to produce a sound somewhat resembling the blocking of an open grid when the receiver is tuned to the nearest channel. This is not caused by any lack of selectivity in the correct sense, but is rather the result of the first RF tube becoming completely overloaded by the strong local signal which, at this point in the set, has not been sufficiently attenuated to reach the low input valve at which screen-grid tubes are overworked.

The last few issues of this magazine have fully described the operating characteristics of the new type —51 variable mu tubes. These tubes are ideal for use in such a receiver as the Moore Da-Lite-R, and the changes are so small as to need but a few minutes' work to permit the substitution of the variable mu tubes for the 224s previously used.

Changes Noted

Referring to the circuit published last week, remove the volume control from the screen circuits, which are permanently set at 75 volts for the variable-mu tubes and at 60 volts for the detector. This is done by inserting a 100,000 ohm resistor from detector screen to ground and a 10,000 ohm resistor from 75 volts plus to detector screen.

The potentiometer formerly used as a volume control is changed in value to 10,000 ohms, and connected with one extreme to aerial, pointer to ground, other extreme to a 200-ohm biasing resistor that continues on to three cathodes. It increases the control grid bias on the variable mu tubes and at the same time adds a shunt across the antenna circuit. This latter shunt, however, does not affect the input signal until it drops below 2,500 ohms or so, permitting the full value of the increase in selectivity afforded by the high bias to be taken up before the input signal is attenuated appreciably.

One thing will be instantly noted—the altered impedance of these tubes allows much greater amplification to be obtained from the circuit, and the increased selectivity is accompanied by much greater "hop" and distance-getting ability than before.

Cross-Continent Reception

As a matter of fact, in one receiver recently so altered, KFI could not be heard at all in New York City before the change, and directly after came through with more than comfortable room volume.

Less than fifteen minutes elapsed while the change over was being made, so it is improbable that the increase in volume was nearly as much due to changes in atmospheric conditions as to the new tubes, which as we said before, are ideally adapted for use in the Da-Lite-R.

Tubes at a Glance

Complete List, with Guiding Data and List Prices

THERE are now so many different tubes to select from that it is difficult to remember what they are for, what type of socket to use, what filament voltage and current should be used that it is well to summarize some of the principal features. At one time it was possible to tell what socket to use by the code designation of the tubes but this is no longer possible for the designations have been changed without reference to the type of base.

The following tubes fit a UX socket, that is, the four contact socket: WD-12, UX-199, 120, 200A, 201A, 112A, 171A, 222, 240, 226, 210, 250, 245, 230, 232, 231, 280, 281, and 874.

The UV-199 is like the UX-199, but requires a special socket.

The following tubes fit the UY or five contact socket: 227, 224, 247, 236, 237, 238, 233, and 235. Of these the new tubes are 247, 236, 237, 233 and 235.

Power Tubes

The following tubes are rated as power, or output tubes: 120, 112A, 171A, 210, 245, 250, 231, 247, 238 and 233. Of these the new tubes are 231, 247, 238 and 233.

The screen grid or four element tubes are: 222, 224, 232, 236 and 235. The pentodes, or five element tubes are: 247, 238 and 233. Of these the new tubes are 232, 235, 236, 247, 230 and 233.

The WD-11 (special socket) and WD-12 require a filament voltage of 1.1 volts.

The following tubes require a voltage of from 3 to 3.3 volts: 199, 120, 222.

The following are five volt tubes: 200A, 201A, 112A, 240, 171A, and 280.

The following require a terminal voltage on the filament or heater of 2.5 volts: 227, 224, 245, 235 and 247.

The following tubes take 2 volts: 230, 232, 231 and 233.

The tubes in the following list require 6.3 volts: 236, 237 and 238.

The following tubes require 7.5 volts across the filament: 210, 250 and 281.

The 226 alone requires 1.5 volts across the filament.

Filament and Heaters

The tubes in the following list are directly heated, i.e., are filament type tubes: WD-11, WD-12, all the UX tubes, 230, 232, 231, 247 and 233.

The following are heaters or indirectly heated tubes: 227, 224, 236, 237, 238 and 235.

The 240 is a high mu three element tube and the 235 is a variable mu tube of the screen grid type. The 280 and 281 are rectifier tubes and the 874 is a voltage regulator tube.

The following tubes are rated as general purpose tubes because they may be used as radio and audio frequency amplifiers and oscillators and may be used with either transformer or resistance coupling: WD-11, WD-12, UX-199, 201A, 112A, 226, 227, 230 and 237. If we exclude the UX-226 these tubes are also useful as detectors.

All tubes may be operated with direct current on the filament or heater. All heater tubes may also be operated with AC on the heaters. Any power tube, whether it is a heater or filament type tube, may be operated with AC on the filament or heater provided that it is the last tube in the circuit. If the power tube is a heater it may be operated with AC in any position provided it is otherwise suitable for that position.

Almost any tube that may be used as an amplifier may also be used as a grid bias detector provided if it is a filament tube DC is used to heat it. The variable mu tube, the 235 is an exception. It does not make a good detector.

List Prices of Tubes

The following table gives the prevailing list price of the various tubes:

Tube	*Price*	*Tube*	*Price*	*Tube*	*Price*
227	@ $1.25	551*	@ $2.20	200A	@ $4.00
201A	@ $1.25	171A	@ $2.25	222	@ $4.50
245	@ $1.40	112A	@ $2.25	BH	@ $4.50
280	@ $1.40	232	@ $2.30	281	@ $5.00
230	@ $1.60	199	@ $2.50	250	@ $6.00
231	@ $1.60	199	@ $2.75	210	@ $7.00
226	@ $1.75	233	@ $2.75	BA	@ $7.50
237	@ $1.75	236	@ $2.75	Kino Lamp	@ $7.50
247	@ $1.90	238	@ $2.75		
223	@ $2.00	120	@ $3.00		
235	@ $2.20	240	@ $3.00		

* *This is comparable to the* 235.

AC Sets on Short Wave

THE circuits for short-wave reception seem particularly sensitive to hum conditions, and it is only recently that the set makers have been able to construct AC short wave sets that give hum-free results.

Now there are numerous models on the market. Most of them rely upon the well-known and successful circuit using one screen grid tube as a radio frequency amplifier and a regenerative detector of the 227 type. This provides two tuning dials and one volume control, although in a few cases the tuning controls have been joined into one.

One of the unimportant considerations in the short-wave AC set is induction or interaction between the power units and the tuning circuits, since the frequencies are so far apart the coupling is virtually nil. The more successful sets seem to separate the set itself and the power unit, with a flexible cable between them to carry the connecting wires, complete electric shielding of the various parts being requisite. This is sometimes called static shielding, but static means standing, and standing electricity needs no shielding. Coupling between parts carrying audio frequencies is avoided. Also, filtration must be excellent, otherwise tunable hum results. Hum of this type sometimes gets into the signal through the filament transformer.

Choose the Right Tubes

By Brainard Foote

NOWADAYS there is a different radio tube made for every use. In fact, there is a different kind of tube in each socket, in some receiving outfits. In this way full advantage is taken of the individual characteristics of tubes so that each type fits its own particular perfectly.

Let's have a look at the more popular radio tubes and see whether we are employing the tube types we should, in order to get the best results. The day when a radio set used the same type tube in each socket has passed. And with many sets formerly limited to one kind of tube, or perhaps two kinds of tubes, there are new tubes which are adaptable to give us better reception—clearer and stronger tones—greater distance.

Dry Cell Types

For listeners utilizing dry cell A power, and also for any who contemplate a dry battery set for portable and vacation service, there are some rather recent additions to the dry cell tube class which are of interest.

The 232 tube is a screen grid dry battery tube, operating on a 2 volt filament and drawing only .06 ampere of current. The B voltage used is about 135, and the C. voltage about 3. The screen grid is tapped at about 67½ volts. This tube opens to the dry cell set the wonderful possibilities of the screen grid tube, now so widely used for electric and storage battery outfits.

Next in this group we mention the 230. This is an up-to-date dry battery tube for general use, operating on 2 volts filament and 90 volts plate, with a C battery of 4½ volts. Drawing only .06 ampere, this tube, also, is very economical.

231 Is a Power Tube

And another new tube, the 231, operates on a 2-volt filament and is used for volume output. It is very economical as to B current, operating on a B voltage of 135 and 3 22½ volt C battery. It draws .13 ampere filament current.

The three dry cell tubes just mentioned form the basis of a very fine dry cell set for regular or portable use, and only two dry cells are needed, as the filament voltage is 2.

Another point in favor of the newer dry cell tubes is a reduced microphonic noise. The 199 type is particularly bad from this standpoint, and great care must be taken with the —99 to use rubber mountings and such other steps as can be taken to avoid jarring.

The more generally known dry cell tubes are the 199 and the 120, the latter being a power tube for dry cell purposes. These dry cell tubes are also made with special socket pins to fit socket types formerly more widely used.

Storage Battery Tubes

The 322 is the screen grid tube for battery operation. It may be powered by dry cells, though generally used with storage battery. It is suitable for radio frequency amplification, and also for audio amplification in a resistance-coupled circuit. The voltage is 3.3 volts, and filament current .132 ampere. Grid bias is 5 volts and screen grid voltage is 45. This tube should be used wherever possible for a storage battery receiving set, in the radio frequency circuit. It requires careful shielding, that is, complete encasement of the tube and its associated units, in an aluminum, copper or silver can, to get full advantage of its unusual amplification power. In a one-stage radio frequency set, such as we use so widely for short-wave sets, it is far superior to its predecessor, the 201A. It need not be claimed that the screen grid tube is superior to the 201A for purely local reception, of course.

For resistance-coupled sets, such as we use for amplifying the television signals, a special type tube is required. The 240 is suited for this purpose.

Of course, there are many othe rtubes of special and general service. Get acquainted with tube types! It will help you in getting better results and in knowing what to expect from your tubes. A knowledge of tube types will also prove of great value to you when you tackle the problem of building or buying a new radio outfit.

Tube Classification

Although some attempts are made by the various tube makers to use tube names which will identify the tube by its type, the beginner is somewhat confused in many cases by the varying numbers and names employed.

It is worth while to become familiar with the general characteristics of the tubes you require so that you will be able to recognize similar tubes of different manufacturers. The tube characteristics are in general:

(1)—Filament voltage, AC or DC.
(2)—Plate voltage.
(3)—Grid voltage (C battery).
(4)—Grid voltage (screen grid).
(5)—Type of circuit for which intended, such as detector, audio amplifier, radio frequency amplifier, resistance-coupled amplifier, rectifier, regulator, etc.

Four at Once On One Wave to be Tried Soon

Washington.

The Federal Radio Commission has granted an extension until July 1st of a special experimental, authorization granted four stations on the Columbia Broadcasting System to engage in simultaneous operation on the 1,430 kilocycle channel. Equipment for the stations designed to maintain strict frequency adherence will not be ready for installation for 60 days and will be operated 30 days thereafter, the Commission announced in taking the action.

The stations, which are to use matched crystal controls as a means of maintaining their frequencies without objectional interference, are WHEC, Rochester, N. Y.; WHP, Harrisburg, Pa.; WOKO, Albany, and WCAH, Columbus, Ohio.

NEW ENGLAND SHOW

The third annual New England Radio Trade Show, sponsored by the Radio Wholesalers Club, Inc., will be held in the Hotel Statler, Boston, on June 30th, July 1st and 2nd. Forty-five rooms on the fourth floor of the hotel have been reserved for the show and plans are being formulated whereby more than 3,000 radio dealers from all parts of New England will attend.

Use of Plane Beacons Extended in West

Washington.

Plans to equip the Los Angeles-Kansas City section of the Midcontinent Airway with visual radio range beacons—a device for guiding pilots along a given course by radio beams which give a direct indication on the instrument boards of airplanes—were announced by Col. Clarence M. Young, Assistant Secretary of Commerce for Aeronautics.

"The visual radio range beacon transmitting stations," Col. Young said, "will be established by the Aeronautics Branch of the Department of Commerce at Fontana and Daggett, Calif.; Kingman and Winslow, Ariz.; Albuquerque, N. M.; Amarillo, Tex.; Wichita, Kans., and Kansas City.

"The stations, with the exception of the ones at Wichita and Kansas City, are expected to be in operation by September 1st. The visual radio range beacons for Wichita and Kansas City will be established as soon thereafter as delivery can be made."

NEW TRANSFORMERS

Supertone Products Corp., of 216 Wallabout Street, Brooklyn, N. Y., announces 175 kc and 450 kc transformers.

RCA in New Quarters, But Will Move Again

Executive offices of the Radio Corporation of Angeles, which were in the Woolworth Building, New York City, since the organization of the corporation in 1919, were transferred to the new RCA Building, at 570 Lexington Avenue, corner of 51st Street.

Only three persons who took part in the original occupancy of the Woolworth Building in 1913 by the Marconi Company, predecssor of RCA, moved out with the corporation. They were David Sarnoff, president; George De Sousa, treasurer, and Henry Heisel, auditor of receipts. A number of others with the company in 1913 now occupy important places in the various subsidiary companies of RCA.

Prior to negotiations leading to the Radio City project, in which RCA and affiliated interests will lease space, RCA made plans for the construction of the office building on Lexington Avenue, in which it had intended to make its permanent home. However, subsequent crystallization of plans for the construction of Radio City made it apparent that the opportunity for occupancy of this community should not be sacrificed. Hence when Radio City is ready RCA will move into the 60-story office building there. Construction work on the Radio City is about to begin. Demolition of some buildings to make way for the project already has been undertaken.

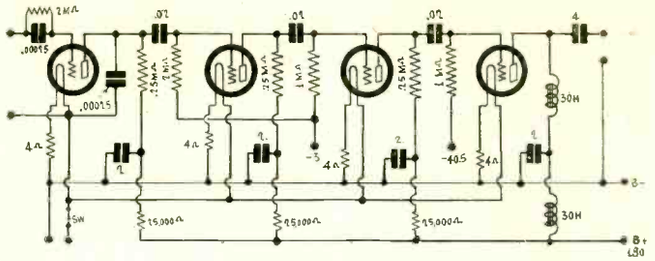

FIG. 1

A battery operated amplifier in which the use of resistances is illustrated. Grid leaks, ballast resistors, plate coupling resistors, and filter resistors are illustrated.

Resistors in

By J. A

Chief Instructor, Nat

UP TO the present time very little has been written in regards to the important part resistors play in modern radio circuits or to the type of resistor used. Although volumes have been written on coils and condensers, the other two important devices necessary to operate radio receiver circuits satisfactorily.

Before considering where resistors are used and the various types used in receivers, it is well to know that a modern radio receiving system may be divided into five sections:

(1) Aerial and ground
(2) Radio frequency amplifier
(3) Detector
(4) Audio frequency amplifier
(5) Plate and filament power supply unit.

In all of these sections some fixed or variable resistances are used, each resistor varying in type or construction. The proper resistor to use depends on the current which must be carried by the resistor.

Resistors are, therefore, described in terms of their resistance value and the amount of current in amperes or milliamperes they will carry without undue heating. The rating of a resistor may be given in the number of watts which the resistor is capable of dissipating under any given condition of temperature rise. The current carrying capacity or watt rating of a resistor is a very variable factor which depends on the temperature rise which can be permitted in the operation of the resistor.

Types of Fixed and Variable Resistors

Resistors which are necessary for the control of current flow and voltage are generally obtained from wires, rods, or bars of metal or carbon. Nickel chromium alloy wire is commonly used for fixed resistors. This wire has a high specific resistance, will withstand high temperature and has a low temperature coefficient. The resistance wire is wound on a ceramic tube tapped by metal lugs at the proper resistance values and protectively coated with either a vitrified or Japan enamel. Some are wound on an asbestos core and in turn wound on a threaded cylindrical core with adjustable taps, which makes for a rugged construction requiring no protective coating on the wire. Sometimes flexible fixed resistors are used. These are wire resistors wound on a flexible core, covered with a flexible sleeving and with terminal lugs at each end.

Fixed metallic and carbon resistors having high resistance values are used in radio circuits where very little current must flow.

Variable resistors are made in two general types—the wire wound and the carbon or graphite. Wire wound variable resistances are usually wound on a bakelite or fibre strip and the contact arm slides over the turns of wire so as to change the resistance value. Where extremely high resistance values are needed or where a variable rate of change is desired the carbon type of resistor is generally used.

Flexible resistors are generally used in radio frequency circuits for "biasing the grids of the tubes," "suppression of RF oscillations," and "isolating of RF currents when in conjunction with by-pass condensers." The value of resistor to use for grid bias varies between 500 to 1,500 ohms. This correct value depending upon the type of tube used and plate voltage.

Oscillation Suppression

For suppressing RF oscillation, flexible resistors are used. These vary in value from 600 to 1,200 ohms, depending on the amount of shielding and the stability of the circuit.

A 5,000 ohm flexible resistance is generally used with an RF by-pass condenser for by-passing RF currents. Fixed resistors are used in a detector circuit for gridleak detection and for power detection, and a high non-inductive resistance having any value from 1 to 15 megohms in parallel with a small grid condenser is used in the grid-leak method. For power detection the tube does not use a grid condenser and leak as it operates on a high negative bias on the grid by using a bias resistor of approximately 30,000 ohms in series with the cathode.

For biasing intermediate AF stages flexible resistors having values of 1,000 to 1,500 ohms are suitable. However, for the bias of a power stage a more substantial resistor must be used as considerable power must be dissipated to obtain the proper bias by the plate potential drop method.

To prevent a push-pull amplifier from oscillating, a high resistance of 10,000 ohms of enamel covered wire and series connected in the transformer center tap lead can be used. In resistance coupling and direct coupled audio frequency amplifiers metallized resistors are used since they are non-inductive and capable of withstanding the power to be dissipated and sufficiently constant for this purpose.

Resistors used in the power supply unit must be capable of dissipating considerable power and of withstanding high voltages. They are used for the following purposes: Ballasting, to compensate for line voltage fluctuation, to obtain the electrical center of the filament transformer winding, and to supply the proper plate voltage to the various tubes in the receiver.

The Ballast Resistor

A ballast resistor consists of a special alloy whose resistance increases or decreases as the voltage increases or decreases. A filament center-tapped resistor across the filament winding should be of sufficient value so that the current flow through the center-tap resistance will be only a small amount compared with

Television on

Washington.

Demonstration in Europe of "microray radio," employing miniature apparatus and ether waves only 7 inches in length, portends "valuable commercial and military applications" of these "ultra ne plus ultra" short waves, Dr. J. H. Dellinger, Chief of the Radio Section, Bureau of Standards, declared orally.

Wide Field Opened

In communications, aviation and television, all affected by shortage of frequencies, this vast new band of wavelengths, reaching as high as 1,700,000 kilocycles (18 centimeters) promises varied benefits, said Dr. Dellinger. The capacity of the ether for many uses of radio, should the microray prove feasible, will be increased greatly, he added.

So high are these frequencies, as contrasted to the existing usable bands, Dr. Dellinger explained, that they may be considered in terms of "light beams" as well as radio waves. Extremely low power may be used, as was evidenced in the reports of the European demonstration of April 1st, when power of one-half watt, only enough to light an ordinary flashlight bulb, was employed for telephone communication across a 20-mile span including the English channel.

Clear Reception

Reports of the European test, conducted by the International Telegraph and Telephone Corporation, declared Dr. Dellinger, state that the communication between Dover, England, and Calais, France, was unusually clear. Conversations across the English channel were described as comparing favorably with telephone wire

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the total current flow. A resistance unit of about 20 to 60 ohms is usually used for this purpose.

For plate voltages a resistor called a voltage-divider is used. This is connected across the high voltage source and tapped at the proper resistance points. This voltage-divider is usually a wire wound resistor having sufficient radiating surface to dissipate the power consumed in the divider without undue rise in temperature. Resistors are also used for volume controls, the most popular ones being antenna control, grid-bias control and screen grid control. The antenna control is generally a potentiometer type resistance having a value of 25,000 ohms, specially tapered, or 5,000 ohm rheostat in parallel with the antenna and grid terminals.

A series resistance in the cathode lead having a value from 25,000 to 75,000 ohms, depending on the number of RF tubes, is used for volume control.

The method of volume control used in some screen grid sets is by connecting a potentiometer of 10,000 ohms between the maximum voltage applied to the screen grid and the ground terminal. Resistors are also used for tone controls in some sets in the last stage of audio frequency amplification. This is a non-inductive adjustable resistor in series with a .002 mfd. fixed condenser across the secondary of the last AF transformer. Varying the high resistance changes the high audio frequency response according to one's taste.

Application of Ohm's Law

Radio-Tricians and service men when replacing a defective or burnt-out resistor should have a working knowledge of Ohm's Law (R=E÷I), so that he may determine the proper resistor to be used. For example, if the grid bias is to be 40 volts and the plate current is 20 milliamperes or 0.02 ampere, the resistance value required would be 40÷0.02 or 2,000 ohms. When one resistance unit is used for several tubes of the same type, the calculations for the proper resistance are similar. The total current flowing through the resistor should be used.

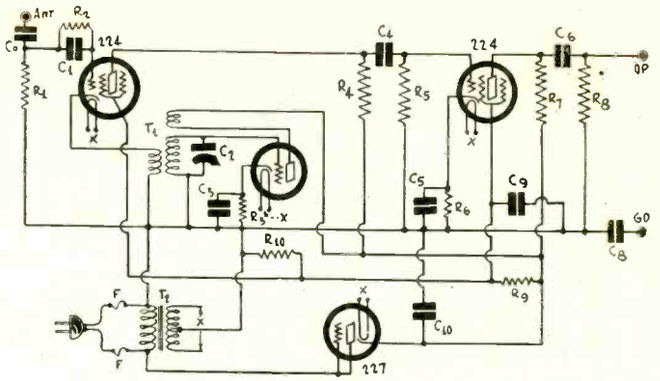

FIG. 2

In this AC operated circuit grid leaks, plate coupling resistors, bias resistors, and voltage divider resistors are illustrated.

If the type of resistor to be replaced is rated in watts instead of current carrying capacity, the service man can calculate the wattage required by substituting the voltage and current values in one of the two simple Ohm's Law formulas, $W=E \times I$ or $W=I^2R$. For example, if a 50,000 ohm resistor is used in some portion of the circuit, and this resistor carries 4 milliamperes (0.04 ampere), the wattage is obtained taking the current squared, giving a figure of (.004x.004)=.000016, and multiplying it by the value of the resistance, 50,000 ohms. Thus the power rating should be .000016x50000, or 0.8 watt, which will indicate that a resistance rated at not less than approximately 1 watt should be used in this case.

A Radio-Trican, or service man, should also understand the formulas for series and parallel resistance, so as to be able to calculate replacements and calculate the value of resistances obtained by connecting resistors of known values in series or in parallel to obtain the value he desires to use. Resistors in series equal R_1+R_2 and resistors in parallel equal $R_1 \times R_2/(R_1+R_2)$.

Computing Resistance Combinations

By knowing these two simple formulas he can quickly, readily and accurately pick out from a combination of resistors which not only will give him the desired value for replacement, but can also employ for that purpose the smallest number of those resistances which is necessary.

An instrument for measuring an unknown resistance is an ohmmeter. However, other instruments can be used for this purpose. For instance, a 0-1 milliammeter can be used as an accurate ohmmeter by using a precision wire-wound resistor in series with the milliammeter and a battery of known voltage, part of the circuit being left open with binding posts to take the unknown resistance. For example, if the known resistance is 22,500 ohms and the battery 22.5, the meter will read 1 milliampere volts when the binding posts are shorted. Now if we place 22,500 ohms across the binding posts, the meter will read .5 milliampere, since $E/R=22.5/22{,}500+22{,}500=.5$.

By making a calibration curve and calibrating the scale of a milliammeter in terms of resistance it is possible to have a direct reading ohmmeter which will correspond to each reading on the milliammeter when a definite value of resistance is connected across the test points or binding posts. A voltmeter can also be used to measure an unknown resistance by means of another resistance of known value. The known and unknown resistance are connected in series and to the terminals of a battery or other source of e.m.f. The voltmeter is connected across the known and across the unknown resistance in succession. The value of the unknown resistance is then equal to $R=R_1 \times E/E_1$, in which R is the unknown resistance, R, the known, E the voltmeter reading across R, and E the reading across R_1. This method is not accurate unless the resistance of the voltmeter is very high compared with R and R_1.

High reading voltmeters may be used to measure high values of resistance by connecting the battery, resistance and voltmeter in series, then using the following formula: $R=R_1\ (E/E_1-1)$, in which R equals unknown high resistance in ohms; R_1 equals resistance of voltmeter in ohms; E equals battery voltage, or reading of voltmeter with resistance shorted. E_1 equals reading of voltmeter with unknown resistance in the circuit.

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"The United States rted that rain or fog mpede the micro ray. ves these micro rays value to television. nds are essential for picture transmission, n these upper reaches um "plenty of kilo- cycles are available for the wide band necessary for perfected television."

Radio engineers believe, continued Dr. Dellinger, that with these extremely high frequencies, it will be possible for television stations to cover local but not distant areas.

Vision Range

Since these waves are similar to light, he explained, anything that falls within their path would have the effect of blocking off the light impulses.

"It appears likely," he said, "that with these extremely high frequencies, television station should be located at great heights above the ground, so that the antenna actually can be seen from any point in its service area. Thus these light waves would be unobstructed and picked up by receivers within what might be termed the vision of the station itself. This probably will not work over any great distance, since the waves, like ordinary light beams, can be seen only over a limited distance."

Secret Communication

Curvature of the earth also effects use of micro-ray radio, Dr. Dellinger added. Over any appreciable distance, unless the aerials are sufficiently high, reception would be impossible. Unlike ordinary radio waves, these waves do not pass freely through obstacles, but must travel in a straight line, unimpeded.

These new frequencies, according to Dr. Dellinger, are well adapted to secret communications, since a beam of these rays can be focused sharply in a given direction. Such communication should be possible over short ranges, between aircraft, ships and land, he said.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Answers printed herewith have been mailed to University Members.

Radio University

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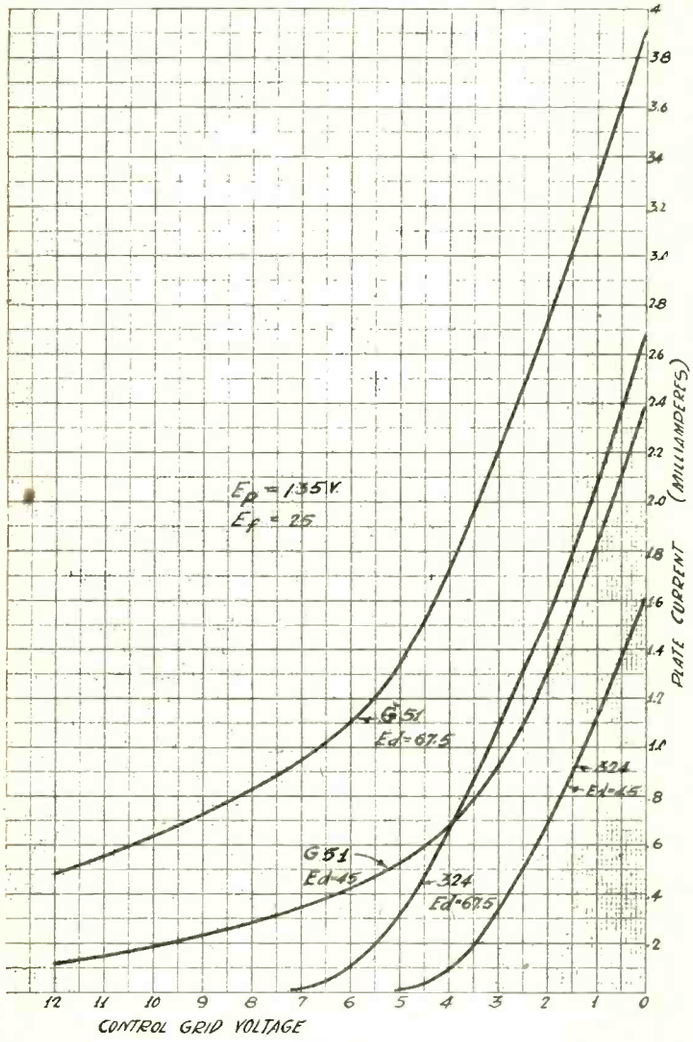

FIG. 918

Curves showing the difference between fixed and variable mu screen grid tubes. The variable mu tube becomes a low mu tube when the grid bias is high.

Variable Mu Tube Characteristics

WILL you kindly publish diagrams showing the difference between the 235 variable mu tube and the 224 screen grid tube? Would you recommend the variable mu tube for detection?—E. W. F.

You will find characteristic curves of both these tubes in Fig. 918. The variable mu tube curves were taken on a G51 made by Majestic. This differs from the RCA-235 but both are in the same class and the variable mu feature is shown by the trend of the curves for high bias. You will note that the two curves for the variable mu tube do not drop to zero as rapidly as those for the 224 but taper off. For low bias the slope of the curves is the same for both tubes, showing that the amplification factor is the same for low bias. The variable mu tubes are not good for detection.

* * *

Meaning of Harmonic

PLEASE explain what is meant by a harmonic? You hear a lot about harmonics in radio work.—L. A.

A harmonic is a frequency that is some multiple of the main frequency being considered. Consider a piano string vibrating at middle C, or 256 cycles per second. Since parts of the string also vibrate, there are frequencies present that are multiples of 256, a second harmonic, 512, a third harmonic of 768, a fourth harmonic of 1,024 cycles, and many still higher. The harmonics enable one to determine the nature of the sound, such as to identify piano from banjo, etc. A radio set should be able to amplify the harmonics of higher frequency well.

* * *

Use High Vacuum Tubes

WHICH should be used, a gas tube or a hard tube in a radio set?—W. J.

The hard tube is used in almost all modern radio sets. The term "hard" means that all possible air has been removed, even from the "pores" in the metal elements in the tube. Soft tubes are used for detection, the UX200A illustrating this type.

* * *

Free Edge Cones

IS the cone used on a dynamic speaker a free-edge cone? The edge is fastened, however.—C. W. Q.

Yes, because the fastening is a very thin strip of leather or other light material, allowing the entire cone to be moved by its tip.

* * *

Reducing Hum

HOW can I attach an extra "A" condenser to a cone dynamic speaker in order to reduce the amount of hum?—F. B. C.

Unless you are familiar with radio circuits, it would be necessary to obtain a wiring diagram of the speaker, or have the condenser installed by a radio mechanic or dealer. The manufacturer should be able to tell you where to connect the extra condenser.

* * *

Condenser Microphone

WHAT is a condenser microphone? Can one be used on an amateur phone station?—F. X. C.

Yes, but that type is generally too costly for such purposes and requires too much incidental apparatus. The microphone consists essentially of two thin diaphragms which are tightly stretched and separated by only a few thousandths of an inch. Change in capacity as vibrations strike it forms the principle of its operation. So far as voice is concerned, there is no special superiority of this type.

* * *

Three Types of Electricity

I READ a statement that there were three kinds of electricity but I have only heard of two: AC and DC. What is meant?—I. K.

Not knowing the context, I cannot be sure of the correct intent. However, pulsating direct current may have been meant, as distinguishable from steady direct current. Of course, static electricity also may have been under consideration, and although this is the same fundamentally as other forms of electricity, the different means of producing it may have placed it in another classification. Electricity is produced by friction as static electricity, and by batteries or generators as the more familiar forms of AC and DC.

* * *

Test for Overloading

HOW can I tell whether my power tube is being overloaded? The quality used to be good but is poor now.—J. W. H.

If you have a milliammeter, insert it in the plate circuit of the power tube. It should fluctuate very little if the tube is operating properly. Is the tube in need of replacement perhaps? Your dealer could test its plate omission for you, in comparison with a new tube.

* * *

Parallel or Push-Pull

WHICH is better, operating two power tubes in parallel or in push-pull? I want to use two of the 112A tubes to get louder results.—G. H.

The push-pull connection is better than the parallel connection, but both methods have disadvantages. A single power tube of larger size, say the 245 or 171A, would be better. Besides, using more power tubes or larger tubes will not increase volume noticeably. The set as a whole may need improvement for that.

* * *

Silencer Switch

WHAT is the advantage of a switch that will shut off the loud speaker momentarily when one answers the doorbell or telephone? Won't it injure the set to throw off the current from the speaker?

No, because the special device you describe is provided with a special coil which absorbs the "load" in place of the speaker. Most electric sets take so long to "warm up" after they are shut off that this new device is finding favor. The set is

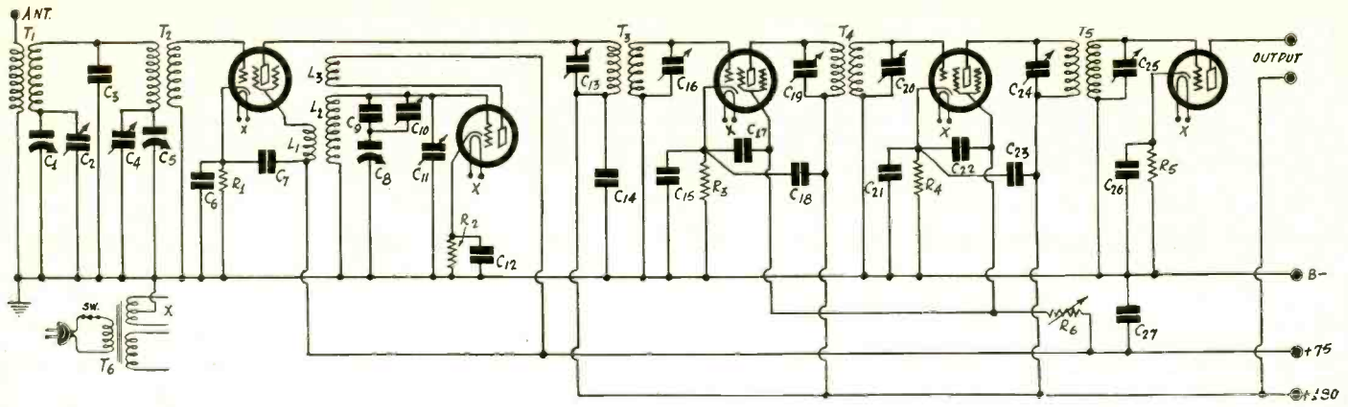

FIG. 919
The circuit of a superheterodyne mixer and amplifier in which the first selector is a band pass filter.

"on" and ready for use instantly when the special switch is thrown.

* * *

Superheterodyne With Band Pass Filter

I AM looking for a superheterodyne tuner and mixer with a band pass filter in front of the first tube. If you have such a circuit will you kindly publish it?—S. W.

In Fig. 919 is such a circuit. It contains three 175 kc intermediate frequency transformers in which both the primaries and the secondaries are tuned.

* * *

Motor for Television

PLEASE advise whether I should purchase a synchronous motor for my television experimental set?—B. L. W.

No, unless you receive from a television station that uses power from the same power company or plant that supplies your home. Only under these conditions can you be sure of absolute synchronism with the transmitting set. You would be cut off from any other television station, in addition, although it would certainly make a great improvement so far as reception is concerned from the station which uses the same power company's current.

* * *

Learning Code

IN learning the radio code, should I buy a buzzer or a sounder? Is it better to use a double-speed key or telegraph key?—P. L. G.

By all means use a buzzer if you intend to learn to receive radio messages. Better start with a regulation telegraph key, and learn that well, first. This is quite important if you have in mind ever going into radio commercially. The double-speed key is easily picked up later, and is only used as a rule by operators who have their own keys with them.

* * *

Measuring Ohms Per Volt of a Voltmeter

WILL you kindly suggest a method of measuring the ohms per volt of a voltmeter? Can it be done without measuring the current through the meter?—T.J.H.

The simplest way of measuring the ohms per volt of a voltmeter is to connect the meter in series with a milliammeter and a battery of known voltage. Divide the voltage of the battery used by the current indicated by the voltmeter. This gives the total resistance of the meter. To get the ohms per volt divide the total resistance by the maximum voltage of the meter. For example, suppose the battery voltage is 45 volts and the current is 6 milliamperes. The total resistance is then 45/.006, or 7,500 ohms. If the full scale reading of the voltmeter is 100 volts, the ohms per volt is 75 ohms. It is not really necessary to know the voltage of the battery because it can be read on the voltmeter itself. If the deflection of the voltmeter is V volts, the full scale reading is Vm volts, and the deflection on the milliammeter is I amperes, then the resistance per volt is V/IVm. The resistance per volt can be measured without a current meter if you have a Wheatstone bridge.

* * *

Cathode Ray Oscillograph

PLEASE explain the principle of the cathode ray oscillograph and state what its main uses are.—B. J. L.

A cathode ray oscillograph is a special type of vacuum tube in which a narrow beam of electrons is made to describe certain patterns. The source of electrons is a heated filament just like the filament of an ordinary vacuum tube. The plate, or anode, is a cylinder which is charged to a positive voltage of suitable value. The anode attracts electrons from the cathode. Most electrons fall into the anode but some of them have such high velocities that they shoot through it like a bullet from a gun. When they get out they pass between two sets of parallel plates, the two sets being at right angles to each other. If voltages are impressed between these plates the electrons are deflected in proportion to the intensity of the voltage. Finally the electrons impinge on a fluorescent screen on the flattened top of the tube, causing a spot of light wherever they strike. The principal use of the oscillograph is to study wave form, but it can also be used for comparing frequencies, for creating a television image, for measuring voltage, and for many other purposes.

* * *

An Electrostatic Voltmeter

WHAT is an electrostatic voltmeter? Can it be used for both steady and alternating voltages? Is it suitable for measuring low voltages such as occur in radio frequency amplifiers?—T.P.V.

An electrostatic voltmeter is a meter in which the deflection is due to electrostatic forces between two plates of metal, one of which is free to turn and the other fixed. The two plates really form a small condenser. It can be used for both alternating and steady voltages but if the plates are made of different metals the calibration is not the same for AC as for DC. If the instrument is calibrated on DC the polarity of the plates should be reversed and the mean of the two readings taken. The mean is very nearly equal to the calibration that would be obtained with AC. This instrument is not suitable for low voltages such as occur in radio frequency amplifiers in receivers.

* * *

Measuring Distributed Capacity of Coils

IF there is a simple method of determining the distributed capacity of a tuning coil will you kindly explain it?—F.H.

The method ordinarily employed is plot a curve between capacity and wavelength squared, or the reciprocal of frequency squared. Suppose p is equal to 6.2832 times the frequency in cycles, L the inductance of the coil across which the condenser is connected, Co the distributed capacity, and C the variable capacity, then $(1/p)^2 = L(C + Co)$. This is the equation of a straight line. If C is used for abscissas and the square of the reciprocal of the frequency as ordinates the curve, or straight line, will cross the C axis at a certain distance to the left of the axis of ordinates (vertical axis) and this distance is the distributed capacity Co. Broadcast frequencies can be used. The circuit form of L and C may be used as a wave trap, coupled very loosely to the antenna of a broadcast receiver. Tune in the lowest frequency station available. Then tune it out with the wave trap by varying C. Note the value of C at the time and the frequency of the station. Enter the point on the graph. Next tune in another station somewhat higher in frequency and tune it out with the trap. Again note the frequency and the capacity and enter another point on the curve. Continue this process until the highest broadcast frequency to which both the trap and the broadcast receiver will tune. Draw a straight line through the points and note where it crosses the C axis. Read the distributed capacity. Note that the tuning condenser in the trap should be calibrated in capacity. Dial settings will not do, for the condenser may not be strictly straight line capacity and the distributed capacity is desired in capacity units and not dial divisions. The inductance of the coil in use can be found at the same time. It is slope of the curve, or $(1/p)^2/(C + Co)$. For this computation use the value of $C + Co$ for the lowest frequency used and also the lowest frequency. Suppose that the lowest frequency is 550,000 and the sum of C and Co is found to be 550 mmfd. Then the inductance is 152.2 microhenries.

* * *

Body Capacity Effects

IN the May 9th issue you published a circuit by A. S. Waring in which the plate of the detector is connected by means of a variable condenser to a coil in the grid circuit. Presumably this condenser is for controlling the regeneration. If this is a fact, is not the condenser subject to body capacity effects, since both sides of the condenser are at high potential? What precautions are necessary to overcome the effect if it is annoying?—R.M.L.

If the panel is of metal it is only necessary to put an insulating bushing on the condenser shaft between the condenser and the knob. This will solve the problem completely. If the panel between the knob and the condenser is not of metal a metal sheet may be placed between the two, grounding this metal.

STIFFER RULES FOR STATIONS; CAMPAIGN ON

Washington.

A campaign to improve reception of radio broadcast programs by stiffening the requirements imposed on stations is being waged by the Federal Radio Commission.

The uppermost consideration at the moment is the proposal to reduce the maximum deviation from carrier frequency. The present limit is 500 cycles but the proposal is to make it 50 cycles, so that heterodyne interference will be removed, beause the beat between two stations on adjoining channels, off their frequency by 50 cycles or less, would not be audible in broadcast receivers.

General orders that have just gone into effect require that all stations use at least 75 per cent. modulation. The best stations almost invariably have 100 per cent. modulation. The percentage of modulation is the ratio of the audio frequency amplitude to the radio frequency amplitude, multiplied by 100.

Transmitter Power Limited

Another order in effect now is that no broadcasting station will be licensed at a power in excess of that which the transmitter can deliver effectively and in accordance with the best engineering standards. This prohibits the installation of high-power apparatus to be operated at a power lower than the capacity of the transmitter—a situation that provoked several demands for increased power simply because the plant could furnish that power.

Investigations made pursuant to the campaign for clearer and better reception has brought out the fact that the percentage of modulation has a big influence on the effective service area of a station, for instance, that a 100-watt station with 100 per cent. modulation has a wider service area than a 500-watt station with 40 per cent. modulation.

The service area, rather than the rated power, is being put forward as a preferred method of rating a station.

All stations are encouraged to use automatic frequency control. This method usually consists of the employment of a crystal in a specially constructed holder that renders the crystal relatively free from changes in temperature.

The adoption of a general order restricting the "wobbulation" to 50 cycles would in effect compel the use of crystal control of frequency.

Synchronization Considered

Soon a regulation will go into effect requiring stations to keep two separate logs of their doings, one in regard to programs, the other in regard to technical operations. Several entries are compulsory, including 15-minute entries of deviation from assigned frequency.

Synchronization also promises to evoke some new regulations. While the synchronized stations have been heralding the complete success of their conjunctive efforts, Commission engineers state that distortion has been produced, due to the effect of the Kennelly-Heaviside layer on the sky wave. Radiation is divided into two parts, that sent out on the ground wave and that which goes out on the sky wave to encounter the ionized layer or radio ceiling. The Commission engineers suggest the use of high antennas by the synchronized stations to suppress the sky wave radiation.

Americans Submit World Proposals

Copenhagen, Denmark.

The Technical Consulting Committee on Radio Communications will meet here May 27th to June 8th, preparatory to the International Radiotelegraph Conference, which will take place in Madrid, Spain, next year.

American proposals for both the preliminary and the final conferences have been completed, and have to do with improvement of methods of transmission and reception, as well as regulation thereof.

STORM DOESN'T REDUCE SIGNAL

Washington.

Extensive research is conducted by the Bureau of Standards, of the Department of Commerce, in radio wave transmission, the Bureau's director, George K. Burgess, said, addressing the Section of Terrestial Magnetism and Electricity of the American Geophysical Union. He added:

"The work on the recording of broadcast station reception is done by automatic and semiautomatic recorders. Information on fading, polarization, and other properties of the waves is accumulated. The measurements have indicated that magnetic storms do not affect the received wave intensities, but increases atmospheric disturbances. The eclipse of April 28th, 1930, did not affect the records.

"The observations on low frequencies have indicated correlations with solar and magnetic activity. Some connection has been shown between the annual averages of sunspot numbers and daylight radio field intensities from some transatlantic stations. A definite correlation has appeared between monthly averages of transatlantic field intensities and terrestrial magnetic activity.

"The height of the Kennelly-Heaviside layer is measured by means of pulse-signals transmitted from a special transmitter and received a few miles away. The difference in time of arrival between the waves traveling along the ground and those reflected from the Kennelly-Heaviside layer is measured on an oscillograph.

"The observations, which continue in progress, have been made over a wide range of frequencies, especially at very high frequencies. They show variations in the height of the layer with time of day and time of year.

"The effects are brought out with particular clarity by their study at various radio frequencies. The research has established the existence of a layer of fairly constant height at about 110 km. [nearly 70 miles] and another layer at a greater height which varies with the conditions just mentioned."

New Corporations

William G. Dixon & Co., Newark, manufacture of radio supplies—Atty. Robert E. Burke, Morristown, N. J.

Solow Radio Co., Paterson, radio supplies—Atty. A. I. Bluestein, Paterson, N. J.

Alan Radio Corp.—Attys. Albany Service Co., 299 Broadway, N. Y.

American Picture Talking Record Corp., talking machines—Atty. H. H. Oshrin, 1,501 Broadway, N. Y.

Bruno-New York, radio—Attys. Lesser Bros., 299 Broadway, N. Y.

50-CYCLE LIMIT TO DEVIATIONS WINS APPROVAL

Washington.

Elimination of squeals and howls due to heterodyne interference, or the wave of one station beating with that of a station on an adjoining channel, where one or both are off their assigned frequency, will result if the present maximum allowable deviation of 500 cycles is reduced to 50 cycles, engineers stated before the Federal Radio Commission.

A proposal is before the Commission for action, whereby the lower limit would be fixed, since engineers attest to the utter practicability of maintaining such a close adherence to assigned frequency.

Deviation from assigned frequency is called "wobbulation."

The Commission called a conference which was attended by its own engineers, and by engineers of broadcasting stations and radio factories and laboratories.

Agreement on One Point

At present stations are separated on adjoining channels by 10,000 cycles (10 kc), and the 500-cycle deviation allowance permits a relative change from one extreme of deviation to the other of 1,000 cycles, or 10 per cent. of the inter-channel separation. The 50-cycle rule, permitting a maximum total change of 100 cycles, would confine this total change to 1 per cent. of the inter-channel separation. The 10 kc. separation is in no way affected by the 50-cycle proposal.

It was agreed that there would be a sharp reduction in heterodyne interference if a 50-cycle rule were adopted, but some who opposed the change pointed out that it would not necessarily mean that more stations could be accommodated with less interference. The increase in the practical number of stations was suggested as a natural consequence of 50-cycle limitation because of reduction in the geographical distance between stations on the same frequency or on closely adjoining frequencies.

Seek to Avoid Audibility

Dr. C. B. Jolliffe, chief engineer of the Commission, said that progress in radio technique made it wholly practical to impose a 50-cycle deviation limit, and that such a limit "would reduce the beat note in modern receivers below audibility."

Little would be gained if the reduction were made to a limit higher than 50 cycles, even though considerably lower than 500 cycles, he explained, because then the beat note still would be audible.

Dr. John H. Dellinger, chief of the radio section, Bureau of Standards, Department of Commerce, concurred in Dr. Jolliffe's statement, and mentioned the impending 24-hour standard frequency signals that the Bureau will transmit from a carefully checked transmitter.

The Bell Telephone Laboratories, through E. L. Nelson, said that beat note interference was one of the oldest radio problems, and that the 50-cycle limit would constitute "a noteworthy improvement in general broadcasting."

Western Electric, General Radio Company, RCA-Victor, the United States Navy, the Columbia Broadcasting System and the National Broadcasting Company reacted favorably to the suggestion, although the chains had not obtained unanimous approval from member stations. For instance, Columbia discovered 41 stations in favor, 22 undecided and 13 opposed.

MOON O'ERHEAD UNPOETIC MAR TO RECEPTION

The effects of the sun and moon on radio reception were discussed by Dr. Harlan T. Stetson, director of Perkins Observatory, Delaware, Ohio, at a recent meeting in New York City, under the auspices of the New York Section of The American Institute of Electrical Engineers and the New York Electrical Society.

Dr. Stetson described in detail the co-relation of radio reception with solar activity and the moon. Results of thousands of radio observations recently analyzed by Dr. Stetson show that radio reception is poorer when the moon is above the horizon but increases on the average 100 per cent after the earth's satellite has set.

This confirms an old superstition of practical radio operators that radio is always poorer on a moonlight night.

Layer Depressed With Moon Overhead

"Our latest results," said Dr. Stetson, "show an apparent depression in the Kennelly-Heaviside layer of electrons in the upper atmosphere, when the moon is overhead, suggesting that the moon is an electrostatically charged body."

This depression of the radio reflecting layer is believed responsible for the temporary diminution of radio reception.

Probably the sun is the one astronomical body most responsible for changes in our terrestrial affairs, Dr. Stetson pointed out, adding:

"Every radio fan knows that day-time reception is vastly poorer than night-time reception in the broadcasting zone. Here is the most obvious exhibition of the effect of the sun's rays upon radio.

"For nearly a century and a half accurate records of the appearance of sunspots have been made, so that if we plot the degree of spottedness of the solar surface year by year we discover a periodic rise and fall in the stormy condition of the sun's surface, spanning approximately eleven years, and also a corresponding variation of the earth's magnetic conditions.

"When a broadcast radio wave travels over the earth, it is propagated by being refracted or reflected back to earth from an ionized layer of the earth's atmosphere known as the Kennelly-Heaviside layer, which lies some 100 miles above the earth's surface. Any change in the intensity or degree of this ionization or electrification of the earth's upper atmosphere would have the effect of bending the ray more abruptly or less abruptly towards the earth and thereupon the effect would be noticed at once in the intensity of radio reception.

"The more rapid changes of this sort are doubtless responsible for the phenomena of fading, with which every radio fan is thoroughly familiar."

Effect Lasts 14 or 15 Months

According to Dr. Stetson's theory the sun constantly bombards the earth's atmosphere with electrons or bundles of energy of high frequency which in turn tear apart the positive and negative charges of the atmospheric molecules, in other words, ionize it to a very considerable extent, thus producing the Kennelly-Heaviside layer. If the sun is more active on occasion, as when large spots appear on its surface, the degree of ionization increases, producing substantially the effect of lowering the Kennelly-Heaviside layer and upsetting the radio reception. When the sun is again less active, the atmosphere tends to return to its normal state of ionization and the radio broadcasting reception tends to improve as the ionized layer lifts. Further study of the data shows a definite fourteen- or fifteen-month period in solar activity to be exhibited both in the matter of sun-spots and in radio reception.

Bureau Discovers Second "Ceiling"

Washington.

The existence of an ionized layer in the upper atmosphere, at an elevation of about 100 miles, although the distance varies, was disputed for several years, but since has become generally accepted. However, the statement is made on reliable authority that not only is there such a radio ceiling but there are two such ceilings!

G. W. Kenrick, of the Bureau of Standards, Department of Commerce, reading a paper before the American Section of the International Scientific Radio Union, stressed the importance of uninterrupted studies of the height of the Kennelly-Heaviside layer, or radio ceiling, from which the sky wave of every radio transmission is reflected back to earth. This reflection is cited by some as a cause of fading.

"In studies made during 1930," said Mr. Kenrick, "evidence was adduced as to the existence of two such layers, instead of only one layer. This situation developed in tests during daylight on the higher frequencies, between 3 and 5 megacycles. (100 and 60 meters respectively).

"Reflection phenomena are suggested as one possible explanation for the not infrequently observed coexistence of sky waves from both layers."

SUN AFFECTS SHORT WAVES

Washington.

That solar activity in the form of sun spots as well as thunderstorms and other types of magnetic disturbance of the "ether" have very definite effects upon radio transmission is indicated in a report of Dr. L. W. Austin, of the Bureau of Standards, covering the present status of knowledge of the connection between radio waves and atmospherics.

The Bureau scientist's study indicates that the shorter the wavelength the more sensitive do radio telegraph signals become to solar or magnetic activity. Below a wavelength of 60 meters, Dr. Austin finds, magnetic storms generally are accompanied by depression of signals by night and day and the effects become greater the closer the signal path approaches the magnetic poles of the earth.

Dial Uses System of Planetary Transmission

According to a recent announcement by the American Radiostat Company, engineers working on the development of the Stenode receiver have designed a special tuning dial on the principles employed in the planetary transmission of the old model T Ford car.

The ratio of the dial is changed by holding an idling gear stationary or permitting it to revolve with the tuning knob. Thus a single tuning knob, permits the usage of a rough tuning adjustment for the quick locating of a desired station and a fine regulation in the order of 200-to-1 for the elimination of interference and background noises.

WAVES WEAKEN THROUGH ROCK; REMEDY NEAR

Washington.

The Federal Bureau of Mines is actively engaged on tests of radio wave penetration of rocks, and is especially interested in the measurement of the waning effect due to the substance through which the wave passes.

J. Wallace Joyce has reported on tests already made. Radio frequency currents were passed from above ground through to the interior of Mammoth Cave, Ky., and while absorption was large, progress has been made in achieving means of overcoming this.

Bureau's Report

The Bureau reported as follows:

"The question of the degree to which the waves penetrate the earth's surface is vital to geophysics, since the successful operation of all induction methods depends on this factor.

"That the electromagnetic field weakens as it spreads itself out in ever-increasing volume of space is quite generally admitted without comment. However, a need has been felt for investigation of the loss of energy of the magnet fields resulting from absorption by the material through which it passes. It was to provide information of this type that the experiments at Mammoth Cave were conducted.

"One phase of the investigations covered a study of the ability of waves used in commercial radio broadcasting to penetrate the rock. Frequencies ranging from 650 to 810 kc. were employed. A portable receiving set was moved to several points inside the cave. A loudspeaker was operated at a point 2,000 feet from the entrance of the cave.

Clearness Diminished

"The fact that the clearness of the signals diminished as the receiver was moved to places where the amount of rock between the instrument and the surface of the earth was increased led to confirmation of the conclusions concerning ability of the waves to pass through the rock.

"In addition to the work with the frequencies used in commercial broadcasting, the experimenters also employed waves of frequencies ranging from 500 cycles to 610 kilocycles.

"When signals were received in positions so situated that there could be no means for them to reach the receiver except through the overhead rocks, the work of determining the amount of absorption of the magnetic field by the rock was undertaken. This was done by making comparisons of the reception of signals transmitted on various frequencies."

EDUCATIONAL CONFERENCE

An international conference on educational broadcasting will be held in Vienna, Austria, late this summer, at which the United States Public Health Service will be represented in a discussion of promotion of public health by radio.

LITERATURE WANTED

Philip C. Gilliard, 1210 H St., Brunswick, Ga.
J. Laporta, 211 N. Washington St., Wilkes-Barre, Pa.
E. Bratz, Billiard Hall, Fort Benton, Mont.
R. A. Greiner, 4947 N. 16th St., Philadelphia, Pa.
H. W. Lovell, 321 Harrison St., Davenport, Iowa.

A THOUGHT FOR THE WEEK

MERE man is to be given a chance to become a Beau Brummell, 1931 model, through the medium of tips over the air. Broadcasters have given much attention to the toilette of My Lady Faire during the past several years and now men are to be told what to wear and when to wear it and the thrilling information is not to be given out as an advertising proposition, either. American men are well dressed enough, as a rule, but somebody in authority seems to think that they need some specific hints as to the finer aspects of exquisite grooming. Well, let's have them, even if the average man thinks he is all right when he shaves and has his shoes shined. We'll wager much against a little that when this new program goes on the air father and the boys will tune in on the stations that give the baseball returns or the latest batch of he-man narratives by Floyd Gibbons.

RADIO WORLD

The First and Only National Radio Weekly
Tenth 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, managing editor and business manager; J. E. Anderson, technical editor; L. C. Tobin, advertising manager.

Broadcast of Lotteries

THE action of the Federal Radio Commission in refusing to prohibit the broadcasting of lottery advertisements used by some sponsors of programs to stimulate sales should not be taken as a backhand indorsement of broadcast lotteries, or as anything else save what it plainly is—an admission of lack of legal authority to prohibit such broadcasts.

Indeed, from the legal memorandum submitted to it by its general counsel, the Commission had no other course, and itself would be guilty of a violation of the Radio Law if it presumed to censor programs to the extent of ridding the air of lotteries or any other objectionable schemes.

Probably the Commission is just as much opposed to such lotteries as is the American Newspaper Publishers Association, that submitted the protest and request. While the association decided that the Commission was in full possession of the power sought to be exercised, the Commission was bound by the opinion of its Legal Department, and indeed the Commission's own lawyers obviously have the better of the legal argument. Congress was most careful to restrict the powers of the Commission, giving merely wide quasi-judicial powers but limited quasi-legislative powers confined to adopting rules and regulations for the carrying out of the powers legislated to it by Congress.

The publishers not only have a grievance against the radio stations, in that they feel the competition sponsored programs offer to the printed page, but they naturally resent the inequality whereby stations broadcast lotteries that are prohibited to all other media, since all the others use the mails, and the Postal Law prohibits the lotteries. Perhaps the publishers would be just as well satisfied if the lottery prohibition were removed from the statute books, thus to establish equality, rather than merely to have both the press and the air put on the same prohibited basis. Nevertheless, the advertising of lotteries is contrary to public policy, whether conducted through one medium or another, and it is simply an accident that the same denial encompassed in the Postal Law is not in substance included in the Radio Law. If anyone had raised the point at the time the Radio Law was framed, the equality of restriction probably would have been in existence from the beginning.

While in recent sessions of Congress bills have been introduced that sought to prohibit lottery and gift advertisements over the air, only to fail of passage, this means nothing more than lack of public interest in the subject at the time. Since then the interest of both the public and its official bodies, as well as the somewhat jealous energy of the publishers, has grown to proportions suitable for obtaining satisfactory Congressional action. The Commission's Legal Division actually has drawn up a more extensive bill to the same purpose, for introduction at the next session of Congress, and in due time some such should be enacted, as it represents the public wishes, and appeases the statutory conscience of the nation. The statutory conscience must be different from the practical conscience, otherwise there would be scarcely such a fertile field on which lotteries could thrive.

Meanwhile the Commission may well require, as part of its increased vigilance over station activities, that the compulsory log of broadcasts, to be kept by each station, include a notation of every lottery advertisement broadcast, together with the full verbatim text thereof, and the name and address of the advertiser. When offending stations ask for increased privileges or license renewals, the log may be wisely consulted.

Less Announcing

RADIO announcers are becoming less necessary on some types of programs and the programs are smoother as a result, according to William Fay, manager of WHAM, Rochester, N. Y.

"Heretofore no part of a broadcast was considered complete unless heralded by an announcer," said Fay, "but today the tendency to omit unnecessary introductions is becoming pronounced."

The Rochester station has come to rely upon the listener's intelligence in identifying and classifying the components of a program and smoother presentations without distracting interruptions are the result.

There are sixteen such programs on WHAM each week, including two commercial accounts which present concert orchestras with only bare statements of the sponsor's name at the opening and closing.

"It is obvious," Mr. Fay points out, "that such practice is restricted to the use of organizations which rely upon advertising only for the development of institutional good will."

RCA Earnings $263,647 for First 1931 Quarter

Total gross income of $24,843,371 and net income of $1,566,519 for the Radio Corporation of America and its subsidiaries for the first quarter of the year 1931 were announced by David Sarnoff, president of the corporation.

The statement disclosed earnings of $263,647 in excess of dividend requirements on the preferred stocks. Preferred stock dividends totalled $1,302,871.

Studio Personalities

Peter Dixon, author and leading man in the daily series, "Raising Junior," has turned sailor and purchased the auxiliary sloop "Alluna", well known on Long Island Sound (N. Y.) as holder of the time record in the annual Huntington-Cornfield Lightship race.

* * *

Paul Robeson, American Negro singer and actor, who broadcast as guest artist on the Maxwell House program, was born in New Jersey. His father was a Methodist minister and his mother a school teacher. At Rutgers University he established a record, winning a coveted Phi Beta Kappa key and becoming a four-letter man in sports. Grantland Rice described him as "one of the greatest defensive ends in American football." Robeson had turned to the practice of law until the playwright, Eugene O'Neil, saw him performing in a Y. M. C. A. show. O'Neil immediately cast him in "Emperor Jones." Subsequent success in this and other productions, as well as on the concert stage, made Robeson an outstanding figure. Earlier this season he played Shakespeare's "Othello" on a London stage.

* * *

Jim Holistein of the Jim and Bob Hawaiian guitar team, heard on a number of Chicago programs, is one of eleven sons. All the brothers are guitar entertainers, but Jim is the only one appearing in the United States, the others being heard in and about Honolulu. Jim is a graduate of the Honolulu University.

* * *

"One way to curtail the number of payroll holdups," suggests Charles Francis Coe, criminologist, whose talks are broadcast weekly over a National Broadcasting Company network, "is for the insurance companies to issue policies which cover no more than sixty per cent. of the amount lost. This would make employers more careful in payroll delivery. An amazing number of these burglaries are inside jobs."

KPSN is Ousted; KGER on Full Time

Washington.

Removal from the air of KPSN, at Pasadena, Calif., and award of its one-fourth time assignment to KGER, at Long Beach, Calif., which now uses the remaining three-fourths time on the 1,360 kilocycle channel, was approved by the Federal Radio Commission, in granting the application of KGER for full-time operation.

The Commission found, after a hearing, that KGER is now being operated in such manner as to make full and efficient use of its present facilities and in accordance with modern engineering standards and regulations. KPSN, on the other hand, it states "is not making full use of the present facilities assigned to it and such programs as are broadcast by this station are a duplication of programs offered by other stations serving the same area."

The transmitter used by KPSN, said the statement, "does not conform to modern engineering standards and requirements of the Commission."

SPEAKER PLACEMENT

Don't crowd your set or speaker against the wall. Give it a little room in back. Put it across a corner if you can, as this allows better reflection of the sound waves. Grid and plate voltages may need correction, or a tube in the audio amplifying system need replacement.

AID BUSINESS BY HIGH POWER, PLEA TO BOARD

Washington.

A. L. Ashby, vice-president and general counsel of the National Broadcasting Company, appearing before the Federal Radio Commission at the final hearing on the request of twenty-four stations for authority to use 50,000 watts of power, the legal maximum, exhorted the Commission to grant the application of every clear-channel station that desired to use this power, on the basis of assisting business recovery. Mr. Ashby said:

"To bring business back to normalcy, all Federal, State and local governmental agencies have been making huge appropriations for public works. Your Commission can take its place by the side of these Federal, State and local governments in bringing back good times by granting to every applicant occupying a cleared channel position construction permits for the installation of new apparatus which will entail the expenditure of several millions of dollars and will give employment to many men in the construction of the apparatus and in the erection of buildings to house the same and for towers and other necessary equipment."

Only Two Oppose

The stations are competing for eight vacant assignments for the maximum power. The Commission is asked to amend its present regulation limiting the use of this power to 20 of the 40 cleared channels.

The Commission has held that high power is yet experimental, and that broadcasting is in a process of transition that might make it unwise to permit stations to invest large amounts in new apparatus at this time.

Only two arguments in opposition to increased power were presented during the hearings, both by educational interests which were represented at the closing hearing. Dr. J. H. McCracken, representing the National Committee on Education by Radio, said the applications of the 24 stations for the privilege of using the maximum power "appears to our Committee to be a step toward a commercial monopoly of all broadcasting channels."

Dr. McCracken asked that the Commission defer the granting of the high-power applications at least until Congress considers or acts upon proposed radio legislation "intended to preserve the rights of the public in radio, and if it will refuse to encourage monopolistic commercial corporations to become so firmly entrenched in the public domain of the air that it will require a constitutional amendment to recapture the rights of the public."

Pleas for KPO and WGN

Gross Alexander, of Pasadena, Calif., director of the Pacific-Western Broadcasting Corporation, an educational radio project, also offered objection to the high-power application on generally similar grounds, according to "The United States Daily." His company is an applicant before the Commission for both a broadcasting station and a short-wave relay broadcasting station.

On behalf of WGN, of Chicago, recommended for an increase to 50,000 watts, Louis G. Caldwell, as counsel, concluded his arguments. He also appeared for KPO, at San Francisco.

They Say

FRANK A. D. ANDREA, president, Fada Radio Co.: "I am thoroughly convinced that more millions of up-to-date radio receivers will be in American homes during the next few years, as there is no indication of any decline in this form of entertainment which costs millions a year to broadcast and is received absolutely free by the listeners."

* * *

MAJ.-GEN. GEORGE O. SQUIER, former chief signal officer U. S. Army: "Space radio has now reached the saturation point in its assigned band of frequencies. The free principle in broadcasting has been pushed too far, a reaction has set in, and the people of the cities are demanding the privilege of paying for their radio free from advertising, as in the case of the electric light and telephone. Space radio is entirely unsuited to the congested steel skyscrapers of the cities and it must be reserved for the longer reaches in the open country, for aviation and for ships at sea."

SENATOR ASKS LAW INQUIRY

Washington.

Senator King (Dem.), of Utah, in a recent statement proposed that Congress should investigate the provisions and operation of the Radio Law, especially the equalization amendment, monopolistic operation of stations, and the need for special legislation to take care of television.

Senator King said:

"It might be considered that the ownership or operation of groups or networks of stations is not actually a deterrent to the development of broadcasting, but anything bordering on violation of the anti-monopoly laws or tending to restrain trade in an industry should be subjected to scrutiny.

"Television is so new and so important in its public aspects as to stagger the imagination. Few are aware of its potentialities, and for that reason Congress should become acquainted with it so as to safeguard and protect its development in the interest of the people.

"I am not prepared at this time to say whether there should be censorship of television, just as the motion pictures are censored. That, too, is a matter to be considered from all angles.

"I am told by radio authorities of the Government, that were it not for the provisions of this equalization law, great areas in the West now underserved by radio would be permitted to accommodate more broadcasting stations. This can be done under the laws of nature, but not under the laws of Congress, which now apparently need remodeling.

"In other words, the State of New York, with its great center of population, is entitled to, and has more radio facilities than a half dozen of the sparsely populated States of the West. In the New York area, therefore, the congestion is reported to be so great that interference results with reception, while out in the Intermountain Empire many barely can receive one station.

"I have not mapped out definite plans for amendment of the law, but believe a thorough study should be made by Congress to find its shortcomings and inequalities."

NO DISSOLUTION OF RCA SOUGHT OVER CLAUSE 9

Washington.

Dissolution of the interlocked ownership of large corporations in the "radio trust" group is to be sought by the Federal Government in a suit against Radio Corporation of America, General Electric Company, Westinghouse Electric & Manufacturing Company and the American Telephone and Telegraph Company. Warren Olney, special assistant to the Attorney General, said the object is to "break up a combination in restraint of trade," but that the object was not the dissolution of the Radio Corporation of America.

Interest focused on the Radio Corporation because of the refusal of the Supreme Court of the United States to disturb the finding of a lower court that the corporation had violated the Clayton anti-monopoly law by including "clause 9" in the corporation's contracts with set manufacturers it licensed. This clause provided that all licensed set manufacturers had to include only Radio Corporation tubes as "initial equipment" in receivers.

Damage Suits Next

To this a group of independents, led by the DeForest Radio Company, objected, and an injunction suit was started. This the independents won, the final word having been spoken in the Supreme Court decision.

Meanwhile the independents have damage suits against RCA, due to alleged loss of business occasioned by the clause 9 restriction against the use of any save RCA tubes. However, clause 9 has not been in effect since July, 1928, when it was abandoned by RCA as an admittedly bad policy. Also, since the suit began most of the so-called independents have themselves obtained tube manufacturing licenses from RCA.

Under section 13 of the Radio Law "the licensing authority is hereby directed to refuse a station license * * * to any person, firm, company or corporation, or any subsidiary thereof, which has been finally adjudged guilty by a Federal Court of unlawfully monopolizing, or attempting unlawfully to monopolize, after this act takes effect, radio communication, directly or indirectly, through the control of the manufacture or sale of radio apparatus, through exclusive traffic arrangements, or by any other means, or to have been using unfair methods of competition."

Section 13 Called Irrelevant

For RCA John W. Davis, chief counsel (who was a candidate for President of the United States), said that clause 9 "involved no issue and resulted in no adjudication of the kind contemplated by section 13 of the Radio Act."

The direction that licenses be refused to violators of the anti-trust laws is said by those who side with RCA to refer to violations covered by a final decision adverse to the defendant in cases where the prosecution is a penal one under those laws, hence would not apply where the anti-trust laws were only indirectly in issue, as where there was an injunction suit as part of a system of cases seeking money damages.

CAN NOT ORDER LOTTERIES OFF AIR, SAYS BOARD

Washington.

A legal memorandum received from Thad H. Brown, general counsel, by the Federal Radio Commission, resulted in the Commission refusing to prohibit the inclusion of lottery propaganda in radio broadcasts, on the ground the board lacked legal authority to take such action.

The Legal Division of the Commission prepared the memorandum, which set forth that the Radio Law expressly prohibited the Commission from exercising any censorship of programs. Censorship was regarded as the appraisal of a program, and action thereon, prior to a broadcast, and was distinguished from consideration of the type of broadcasts made or permitted by a station, and weighed in regard to the renewal of a license or in regard to application for higher power, a better position on the ether spectrum, etc.

Doubtful About Extent

The memorandum wound up with the following statement:

"Throughout this memorandum we have purposely avoided consideration of any question of policy. We have no reliable information as to the extent of the practice complained of.

"It should be observed, however, that the Commission has heretofore taken the position that the matter of prohibiting lottery advertisements by radio was a matter for legislation by the Congress; that certain bills of this nature were introduced in the last session, and that the Legal Division has been called upon to make an examination of a further bill of this character which will be introduced at the next session of Congress."

The American Newspaper Publishers Association, at its recent convention in New York City, adopted a resolution asking the Commission to take action, consistent with the prohibition of publication of lottery announcements and advertisements in periodicals that use the United States mails.

Received Other Complaints

The Commission's position is that while the suppression of lottery broadcasts is commendable, no legal authority exists for the Commission to take such action.

The anti-lottery provision affecting newspapers and periodicals is a law enacted by Congress. During the past two years several bills have been introduced in Congress applying the same prohibition to broadcasting, but none of these bills was enacted.

However, the growth of lottery propositions in sponsored programs, with increasing opposition to such schemes and heightened demand for a law against them, is believed to be sufficient to encourage the passage of an anti-lottery bill at the next session of Congress.

The radio law does not prohibit broadcast lotteries, but it does prohibit the Commission from acting as a censor of programs, therefore the Commission believes that the only avenue of relief is through the halls of Congress.

Complaints similar to the grievance voiced by the publishers' association have been received from the Commission from individual newspapers and from individual listeners.

Bill Drawn up to Stop Lotteries

Washington.

The fact that the Federal Radio Commission is itself opposed to lottery broadcasts, and advertising of other games of chance over the air, is gleaned from the action of the Commission in ordering its Legal Division to draw up a bill for submission to Congress, prohibiting such broadcasts.

The bill is wider in scope than previous bills backed by others, which failed of passage during the past two years.

Considerable backing is expected for the new bill, so that it will not get lost in the shuffle of thousands of bills introduced each year.

'WILDCAT' SUES ON CONVICTION

Washington.

Robert Gordon Duncan, of Portland, Oregon, self-styled "Oregon Wildcat" and enemy of chain stores, filed with the Supreme Court of the United States a petition for review and reversal of his conviction under an indictmet charging violation of sections 29 and 33 of the Radio Act of 1927 in the use of "obscene, indecent and profane language" in broadcasting.

The conviction was upheld by the Circuit Court of Appeals for the Ninth Circuit.

Sections 29 and 33, Mr. Duncan says, were intended solely to regulate the granting or refusing of licenses and the punishment of offenses committed in applications for or hearings of complaints against the granting or forfeiture of licenses.

If construed to authorize prosecutions like the one against Mr. Duncan, it is contended in the petition that the sections are unconstitutional, because they are an unwarranted interference with the police powers of the States.

Federated Purchaser Moves to Larger Quarters

Having outgrown its former location at 16 Hudson St., New York City, Federated Purchaser now occupies three floors, with an aggregate of 27,000 square feet, of the building recently vacated by "The Daily News," at 23-25 Park Place and 24-26 Murray St.

On the street floor, facing Murray St., are the receiving and shipping departments. Experimental laboratories, and construction and repair departments are in the basement, while the entire subbasement, comprising 10,000 square feet is given over to stock. There are also sound-proof demonstration rooms and large sales offices.

The executive personnel of the firm are Samuel Roth, president; Louis Weinrib, general manager and purchasing agent; Ben Joseph, advertising manager; Nathaniel Feiner, technical service manager; Marvin Roth, production manager; Arthur Slifer, adjuster. The firm issues a monthly catalog, "Radio Bargain News," which is distributed to dealers and servicemen throughout the world.

$1 LIST PRICE FOR AIR LIBEL FIXED BY JURY

Lincoln, Neb.

A verdict in the suit of C. A. Sorensen, Attorney General, against Richard F. Wood and KFAB Broadcasting Company, of Lincoln, involving alleged libel in the broadcasting of a political speech, has just been returned by a jury in the District Court of Lancaster County, finding the plaintiff entitled to $1 damages against Mr. Wood but absolving the broadcasting station.

The plaintiff sought $100,000 damages against each defendant on account of alleged libelous statements in a broadcast speech delivered by Mr. Wood, who was a candidate for State Railway Commissioner at the last election.

Counsel for Mr. Sorensen gave notice of appeal to the State Supreme Court on the ground that instructions of the trial court required the plaintiff to prove malice.

The broadcasting company, in answer to the suit, had alleged that under Federal regulations it had neither power to prevent a candidate from broadcasting nor authority to censor his speech.

Two other suits against the same defendants, each claiming $100,000 damages based on the same facts, are pending in the District Court, Irvin A. Stalmaster, Assistant Attorney General, and Harry A. Lapidus, of Omaha, being the plaintiffc, according to "The United States Daily."

The trial court, in overruling a demurrer to the complaint, held that the speech was a written one and therefore the suit involved libel and not slander.

Radio Census

Washington.

Following are reports from the Department of Commerce regarding the answers to the radio questionnaire on the 1930 national census:

Georgia

The whole number of families in the State on April 1, 1930, was 654,009, as compared was 628,525 in 1920. The number of persons per family in 1930 was 4.5, as compared with 4.6 in 1920. The number of families reporting radio sets in 1930 was 64,908, or 9.9 per cent of the total.

New Mexico

The whole number of families in the State on April 1, 1930, was 98,820, as compared with 83,706 in 1920. The number of persons per family in 1930 was 4.3, the same as in 1920. The number of families reporting radio sets in 1930 was 11,404, or 11.5 per cent of the total.

ANNOUNCES PHONE SWITCH

The Insuline Corporation of America has an automatic switch which serves to turn off the radio set when the telephone receiver is taken off its hook, and to turn on the set once more when the receiver is placed back in position. The switch is a compact, platform switch on which the telephone is placed, the switch being connected with the radio set by means of a 25-foot double-silk cord.

U. S. LOSES SUIT OVER PATENTS OF EMPLOYES

Wilmington, Del.

The suit by the Federal Government against the Dubilier Condenser Corporation, involving three patents assigned to Dubilier by Percival D. Lowell and Francis W. Dunmore, was dismissed by Judge Nields in the Federal District Court.

Lowell and Dunmore were employes of the Bureau of Standards when they invented a system of operating a radio set from the house alternating current line, including a method of filtration for hum elimination and a power amplifier, and these inventions were the basis of two of the patents issued. The third patent related to the remote control of a telegraph recording instrument by a radio signal.

Dubilier bought these patents, which were subject to a non-exclusive, personal non-transferable license grant thereunder to the United States Government. The Government was not content with such license grant and sought in the suit to obtain a decree compelling Dubilier to convey to the Government all the defendant's right, title and interest to the patents, on the theory that Lowell and Dunmore were employes of the Government and doing Government work, when they developed the apparatus which is the subject of the patents.

Judge States the Case

The validity of the patents already had been adjudicated in the case of Dubilier Condenser Corporation versus the Radio Corporation of America.

The Judge in his opinion summed up the situation as follows:

"The United States claims that the inventions covered by the three patents in suit, being the product and the result of the work of employes of the United States in solving radio research problems assigned to them by their superior in the course of their employment, became ipso facto and are the property of their employer, the United States.

Defendant's Claims Stated

"The defendant, on the other hand, asserts that there was no written or oral agreement on the part of the patentee to convey any patents devised in the course of their employment to their employer that the character of their employment raised no implication of an agreement to convey patents; that there was no assignment by any superior of Lowell and Dunmore, or of either of them, of a problem or problems involving the inventions covered by the patents in suit; and that no duty rested upon the patentees to convey their patents to their employer, even though to perfect their inventions they used their employer's property, received the assistance of others in their employer's pay and took time which should have been given to their employer's business, their employer, the United States, being fully compensated in this regard by a nonexclusive license under the patents."

In connection with the finding the Judge said:

"It is well settled that the Government as an employer has no greater right to inventions made by its employes than other employers. It is conceded that there was no express contract between the two employes and the United States that patents covering inventions made by the employes during their employment should belong to the employer."

WLW Gets Record Of DX Reception

Cincinnati.

A DX reception record has just been received by WLW in the form of a phonograph recording.

Captain E. H. Sherwood, 718 Forty-second Avenue, San Francisco, Calif., at 3.55 a.m. Pacific time, made a record of McCormick's Old Time Fiddlers playing at WLW at Cincinnati at 6:55 a.m. Eastern time. He sent the disc, made on a home recording device, as evidence of the reception of WLW in San Francisco.

Played on a phonograph in the WLW studio, the recording proved as clear as if made in the same room with professional recording apparatus. It included the 6:55 a.m. time announcement by Sidney Ten Eyck, a number by the Fiddlers together, and a harmonica solo by McCormick introduced by a brief dialogue between him and Ten Eyck.

NEW STAGGERED LICENSE BASIS

Under its new "stagger" system, the Federal Radio Commission has extended the licenses of the 613 stations of the country for varying periods from three to eight months. When these license periods expire licenses will be renewed for six months.

The licenses of WEVD, New York; WNJ, Newark, N. J., and WLBX, Long Island City, N. Y., were extended to July 1st only, to await the decisions on hearings already held. The license of WOCL, Jamestown, N. Y., was extended to July 1st to await the result of investigation.

A temporary license until July 1st was granted certain stations because they have not complied with General Order No. 97, providing for over 75 per cent. modulation. They were: WBBC, Brooklyn, N. Y.; WBNX, New York; WHAZ, Troy, N. Y.; WMAK, Buffalo, N. Y.; WOAX, Trenton, N. J., and WPOE, Patchogue, N. Y.

De Forest Co. Sues Radio-Victor on Tubes

Baltimore.

The De Forest Radio Company has filed suit in the Federal District Court here against the Radio-Victor Corporation of America, asking an injunction and damages for alleged infringement of certain patents. The De Forest Company charges infringement of thirteen basic patents.

It is understood that the suit involves all instruments employing vacuum tubes in the synthetic reproduction of music, such as talking moving pictures, electrical phonographs, electric chimes, and the new electric organs.

First Zone Stations Fight for Super Power

Four stations in the first radio zone are fighting for the 50,000 watt license which is still to be assigned in this zone. They are WOR, of Newark, N. J.; WJZ, of Bound Brook, N. J.; WHAM, of Rochester, N. Y., and WBZ, of Boston, Mass. A commission examiner has recommended that WJZ receive the license for 50,000 watts and that WOR be assigned 25,000 watts. The contending stations will be given opportunity to present oral argument.

HOTELS TAXED BY COMPOSERS FOR AIR MUSIC

Washington.

A two-fold effect has been produced by the decision of the United States Supreme Court in favor of the American Society of Composers, Authors and Publishers, against the La Salle Hotel, of Kansas City, Mo., holding the hotel liable for copyright infringement in delivering to guests a radio program that contained an unauthorized broadcast of a copyright song.

First, hotels, restaurants and other public institutions catering to the public are warned by Thad H. Brown, general counsel of the Federal Radio Commission, that they must be on their guard against picking up programs from broadcasting stations that are not authorized to transmit copyright music, and, second, the society has announced it will charge hotels, etc., for permission to give even authorized radio service to its patrons.

New Fee Bureau

The society has instituted a radio entertainment licensing bureau under which hotels and similar institutions conducted for profit will be assessed for the picking up of copyrighted radio programs on a sliding scale fee basis.

At present broadcasting stations pay for the privilege of transmitting such copyrighted music and programs, the society's fee ranging from $250 per annum for small stations to $5,000 per annum for networks.

The practice of hotels supplying radio entertainment to guests has been growing fast. The hotel maintains a master receiving set, in some instances with a few different channels, each tuned to a separate station, and the guest enjoys radio entertainment in his room, turning on the speaker and picking out the desired program with a selector switch.

Compared to a "Performance"

Brown said the Supreme Court held that a hotel furnishing radio entertainment to the guests committed an act equivalent to a "performance" under the copyright law, and if the law was infringed, was liable thereunder. The penalty ranges from $250 to $5,000 fine for each violation.

"The effect of the opinion, it seems to me," said Brown, "is to throw on their guard the owners of receiving sets in public places against the picking up of copyrighted musical compositions from stations not licensed for transmission of copyrighted music.

"This is a large order, since it is difficult to know just when a particular station is broadcasting a licensed copyrighted composition and when it is not."

WESTINGHOUSE ELECTS OFFICERS

Westinghouse Electric and Manufacturing Company officers were elected as follows: A. W. Robertson, chairman of the board; F. A. Merrick, president; J. S. Tritle, vice-president in charge of manufacturing; S. M. Kintner, vice-president in charge of engineering; W. S. Rugg, vice-president in charge of sales. L. A. Osborne, H. P. Davis, H. D. Shute, J. S. Bennett, H. T. Herr, Walter Cary, T. P. Gaylord, and Harold Smith were re-elected vice-presidents. C. H. Terry was elected an honorary vice-president. E. M. Herr was re-elected vice-chairman.

The New 2-Volt Tubes at $1.00

List of Tubes and Prices

230	$1.00	224	$1.00
231	1.00	227	1.00
232	1.00	245	1.00
222	2.10	210	2.95
171A	1.00	250	2.95
171 (for AC)	1.00	226	1.00
112A	1.00	280	1.00
112 (for AC)	1.00	281	2.95
201A	1.00		
240	1.00	**SPECIAL TUBES**	
UX-199	1.00	Tellon, neon gas tube.	
UV-199	1.00	for television ..	$3.85
120	1.00	Photo-electric cell, 2-	
200A	1.00	inch cell height	$4.50
WD-12	1.00		

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143 West 45th Street, New York, N. Y.

Enclosed please find $..... for which ship at once, on 10-day money-back guarantee, the following tubes:

☐ 230 ☐ 240 ☐ 226 If C.O.D is desired please put a cross in square at left.
☐ 231 ☐ UX-199 ☐ 280
☐ 232 ☐ UV-199 ☐ 222
☐ 171A ☐ 120 ☐ 210
☐ 171 ☐ WD-12 ☐ 250
☐ 112A ☐ 200A ☐ 281
☐ 112 ☐ 224 ☐ Tellon
☐ 201A ☐ 245 ☐ Photo cell

Name .....

Address .....

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

SOLDERING IRON FREE!

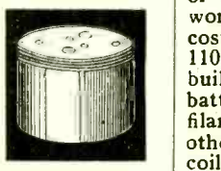
Works on 110-120 volts, AC or DC; power, 50 watts. A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for Radio World and get these free! Please state if you are renewing existing subscription.

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

Parts for the PENTODE DIAMOND

Battery model parts, Cat. PND-B, @.....$31.27
AC model, parts, Cat. PND @..... 39.38

175 KC Transformer



A doubly tuned fixed-frequency transformer, 1 to 1 ratio, tuned to 175 kilocycles, is one of Supertone's new precision products. Two loosely coupled duolateral-wound high-inductance choke coils constitute primary and secondary. Suitable for all uses where 175 kilocycle frequency is desired, and affording high selectivity, without sideband cutting. The transformer may be mounted on the side of a chassis, in horizontal position, or upright either above or below the chassis top.

Supertone 175 kc. transformer, for screen grid tubes, with tuning condensers across primary and secondary, both accessible; in aluminum shield 2¼ inches diameter, 2½ inches high, with removable bottom, both horizontal and upright mounting facilities. Order Cat. FF-175, net price.....$3.00

For other than screen grid tubes (secondary alone is tuned to 175 kc.; ratio is 1 to 4). Order Cat. FF-175-G, net price..... .....$2.65

450 KC Transformer

Doubly tuned, primary and secondary, in same type shield as the 175 kc. transformer, for use with screen grid amplifier tubes, and any type detector tube. Order Cat. FF-450, net price $2.50

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[Either transformer, assembled on tube socket, 50c extra. Add "S" to catalogue number]

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110 v. DC output at 20 ma, using 227 rectifier. For short-wave converters and sets and other uses. Wired, Cat. MBS-W @.....$9.25

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Short-Wave Converter Series

In the November 8th issue of RADIO WORLD there began a remarkable series of articles dealing with the construction of short-wave converters that really do work, and that work well. Besides, the cost of parts is low. One model, 30 to 110 meters, no plug-in coils, may be built of parts costing less than $5, for battery operation, or for AC with extra filament transformer external, while another model, 10-200 meters, two plug-in coils, using somewhat superior parts, filament transformer built-in, can be made up by you for less than $10. Surely these are prices within the reach of all.

Low price and high achievement go hand in hand in these designs by Herman Bernard.

The series ran in the November 8th, 15th, 22nd and 29th, and December 6th, 13th, and 20th issues. Send $1 and we will forward these seven issues and a blueprint of the AC $5 model. Or send $3.00 for 6 months' subscription and these copies and blue print will be sent FREE.

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Enclosed please find $1.00 for which send me the November 8th, 15th, 22nd and 29th, and Dec. 6th, 13th and 20th issues, containing the series of articles on short-wave converters of extremely low price, and a blueprint of the AC $5 model.

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

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[WET]

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If the mounting surface is insulated, as in a bakelite subpanel, a special lug makes the contact.

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Rating: Peak voltage, 420 volts; recommended maximum working voltage, 375 volts.

Performance: Self-healing in case of puncture of electrolytic film due to application of great overload of voltage. Very low leakage. The high capacity lasts.

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[DRY]

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Cat.	*Mfds.*	*Volt.*	*List*	*Net*
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E5-2	2	450	1.80	1.03
E5-22	2-2	450	3.50	2.00
E5-222	2-2-2	450	4.50	2.57
E5-2222	2-2-2-2	450	5.50	3.14
E5-4	4	450	2.10	1.20
E5-44	4-4	450	4.00	2.28
E5-444	4-4-4	450	5.25	2.99
E5-4444	4-4-4-4	450	6.50	3.71
E5-5	5	450	2.35	1.34
E5-6	6	450	2.40	1.37
E5-8	8	450	2.50	1.43
E5-88	8-8	450	4.50	2.57
E5-888	8-8-8	450	6.00	3.42
E5-8888	8-8-8-8	450	7.25	4.13
E5-248	2-4-8	450	5.50	3.14
E5-288	2-8-8	450	5.75	3.28
E5-2816	2-8-16	450	6.50	3.71
E5-20	20	450	4.50	2.57
E5-30	30	450	6.75	3.85
E200-10	10	180	2.50	1.43
E100-10	10	100	2.25	1.28
E100-50	50	100	3.50	2.00
E100-75	75	100	4.00	2.28
E100-100	100	100	5.75	3.28
E25-10	10	20	1.50	.86
E25-25	25	20	1.75	1.00
E25-50	50	20	2.25	1.28
E12-1500	1500	10	3.50	2.00
E12-2000	2000	10	4.00	2.28
E12-4000	4000	10	7.50	4.28
6A-1500	1500	10	3.50	2.00
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Push-pull input transformer, turns ratio, 1-to-2⅛; single primary; two separate windings for secondary; Cat. 151, list price, $12; net, $7.05.

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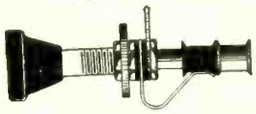

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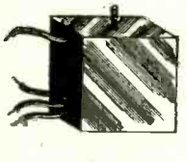

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25,000 ohm potentiometer, wire-wound; Electrad Tonatrol. Will pass 30 ma. Excellent volume control or for tone control in series with .3 mfd. condenser. Cat. ELTT @ **99c**
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"1931 Trouble Shooter's Manual," by Rider.... 4.50
"115 Latest Commercial Set Diagrams," by Rider 2.50
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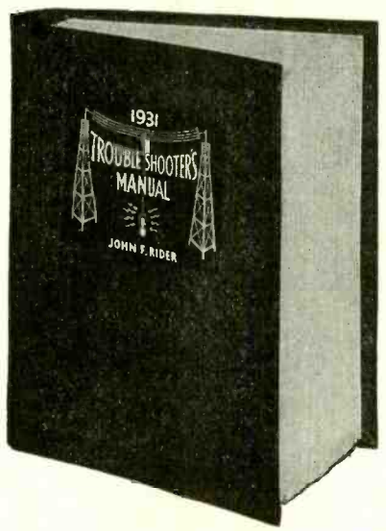

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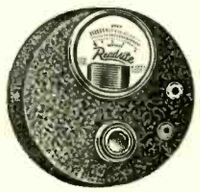

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