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Eleventh Year—529th Issue

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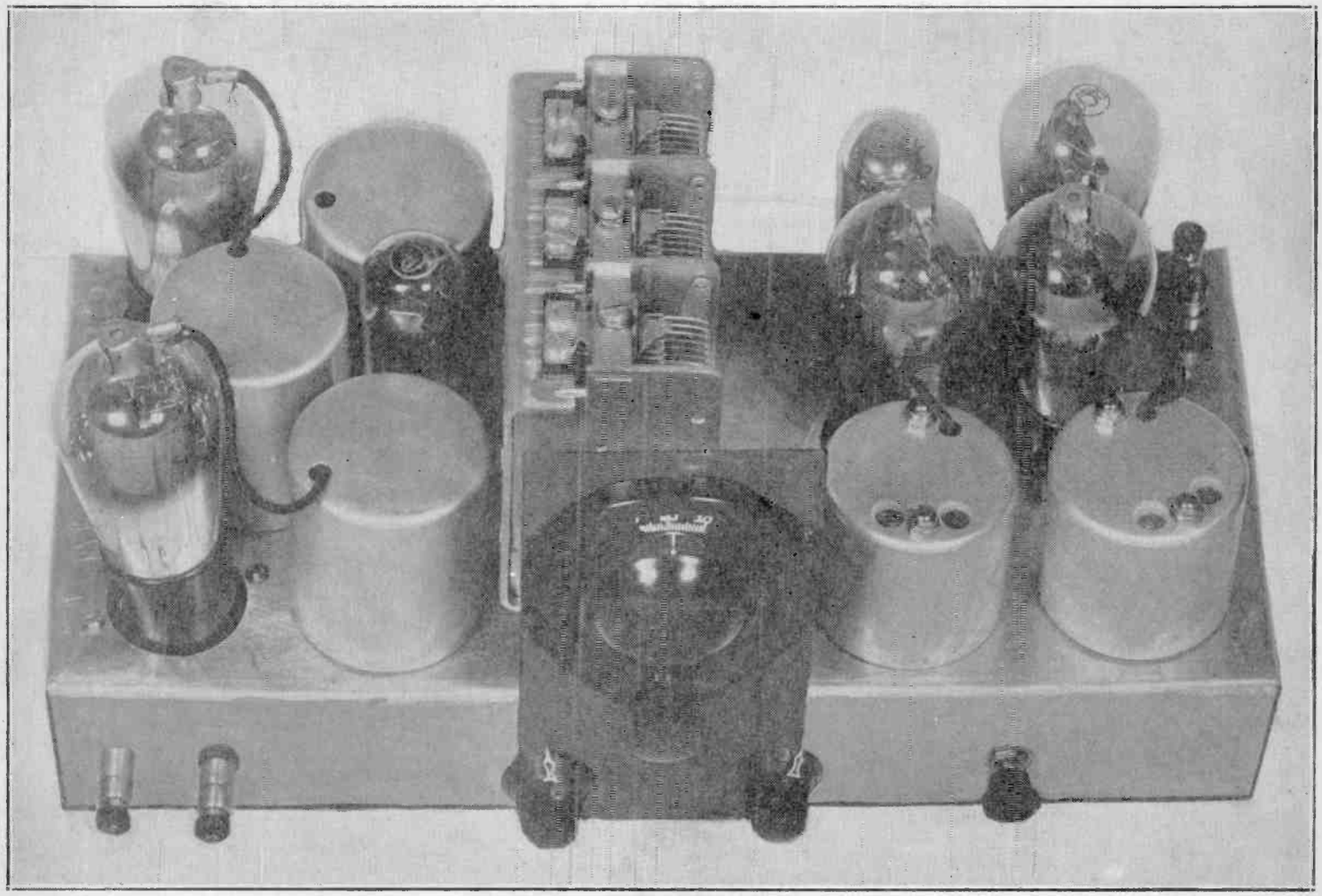

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Servicing a Super

How Troubles Were Taken Out of Portable

By J. E. Anderson

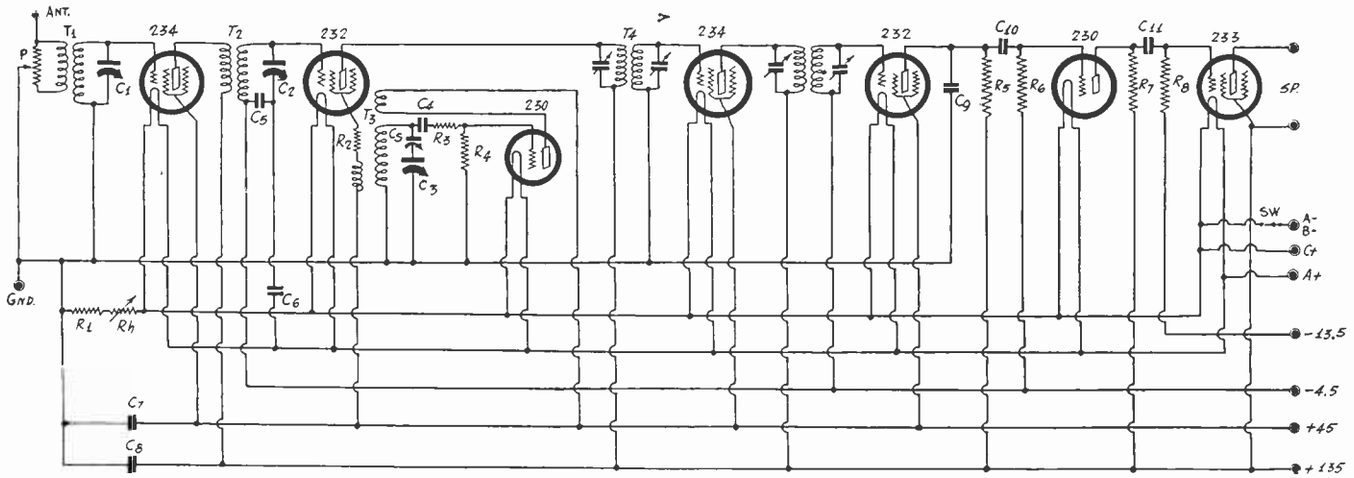


FIG. 1
The circuit diagram of the seven-tube portable battery operated superheterodyne. Designed for 400 kc intermediate

BUILDING a superheterodyne seems to be as easy as to build any other receiver. But sometimes unexpected difficulties develop, a fact emphasized by a number of complaints about receivers which had been very carefully engineered, and which had been built by fans who knew better than to make mistakes. Ordinarily when a circuit has been assembled "exactly as described," the assumption is that some grievous error has been committed, and usually a check-up proves the assumption to be true. But we are not interested in mistakes this time, but in the complaints of those who know when the circuit is wired correctly and yet who cannot make the circuit function properly.

If the circuit works as a t-r-f set there is nothing wrong with the r-f amplifier, the second detector, and with the a-f amplifier. These legitimate complaints rarely concern these parts of the circuit. Hence we must conclude that the trouble lies in the first detector, in the oscillator, or in the intermediate frequency amplifier.

Trouble in Oscillator

But in most instances a test on the intermediate amplifier has ruled this out as a possible source of the trouble because it has been "peaked" with the aid of an oscillator. That confines the trouble to the first detector or to the oscillator. It is quite possible at the time the test on the intermediate frequency oscillator to test the first detector circuit as an amplifier, and in that way practically eliminate it as the source of the

(*Continued on next page*)

LIST OF PRINCIPAL PARTS

Coils

T1, T2—Two shielded r-f transformers for 350 mfd. tuning condensers.
T3—One oscillator coil for 400 kc i-f and 350 mmfd. tuning condensers.
T4, T5—Two 400 kc intermediate frequency transformers.

Condensers

C1, C2, C3—One gang of three 350 mmfd. tuning condensers, with trimmers.
C4—One 0.001 mfd. fixed condenser.
C5—One 0.25 mfd. fixed condenser.
C6—One 0.5 mfd. fixed condenser.
C7, C8—Two 1 mfd. bypass condensers.
C9—One 350 mmfd. fixed condenser.
C10, C11—Two 0.1 mfd. condensers.
Cs—One 350-450 mmfd. adjustable condenser.

Resistors

R1—One 1.5 ohm ballast resistor.
R2—Omitted.
R3—One 2,000 ohm resistor.
R4—One 30,000 ohm resistor.
R5, R7—Two 250,000 ohm plate resistors.
R6, R8—Two one megohm grid leaks.
P—One 10,000 ohm potentiometer.

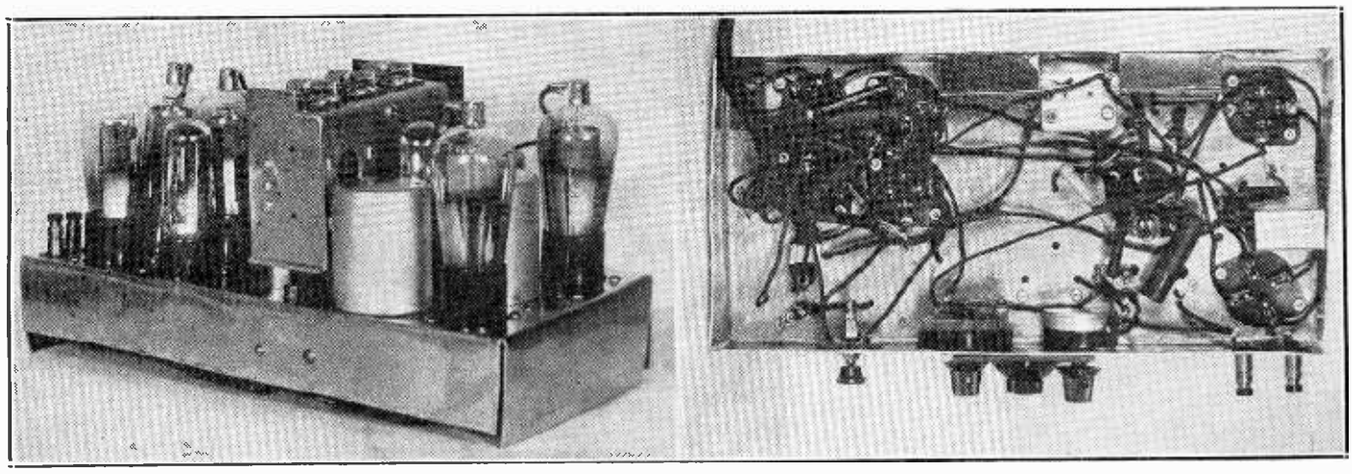


FIG. 2
Back view of the portable seven-tube portable superheterodyne.

FIG. 3
Bottom view of the seven-tube battery operated superheterodyne.

(*Continued from preceding page*)

trouble. It is only necessary to put the i-f in at the control grid of that tube during the peaking process, after having removed the grid clip from that tube.

That locates the trouble in the oscillator, and nearly all troubles in superheterodynes can be traced to this part. And that is logical for it is the heart of the receiver.

One trouble that is frequently met is blocking in the oscillator. It may be evidenced by an audible oscillation of almost any pitch, but the blocking may occur at such a high frequency that the resulting squeal is above audibility, and in that case the circuit is simply dead, or the output is badly mutilated.

Let us assume that there is blocking. It is due to insufficient leakage from the grid to the cathode, or to the filament. But whether or not a given leak is insufficient depends on the degree of oscillation, that is, on the tickler and on the plate voltage. A first test might be to reduce the applied plate voltage to see whether this stops the squeal. If nothing can be gained this way, the next step would be to use a lower value leak. In Fig. 1 is a typical oscillator which gave trouble of this nature, a weak squeal occurring at about 8,000 cycles. It was not practical to change the .voltage in this instance so the leak was varied. It was necessary to reduce the leak R4 to 10,000 ohms before the blocking would cease. This was considered too low, so a limiting resistance R3 was put in. Usually it is possible to make this 10,000 ohms and still have oscillation, with the grid leak at 100,000 ohms. But in this case the tube stopped oscillating and it was necessary to reduce the resistance R3 to 2,000 ohms. However, this permitted raising the leak to 30,000 ohms. This proved to be a satisfactory combination.

Still No Results

But this adjustment of the oscillator for stable and blocking-free oscillation was of little avail, for the circuit could still not be adjusted. Signals, and strong ones, could be brought in at spots, but there was no tracking throughout. In fact, the circuit was dead over most of the dial. Then with the aid of a calibrated oscillator the frequency was measured over the entire dial of the oscillator. It proved to go from 850 to 1,300 kc. This was with the oscillator trimmer condenser open as far as possible and the series condenser set at about half value. The range of the oscillator for this particular circuit should have been from 945 to 1,905 kc., for the intermediate frequency was 400 kc. and the range of the r-f tuner was 545 to 1,505 kc. which had previously been determined.

The calibration of the oscillator clearly pointed to the trouble. There was entirely too much distributed capacity in the oscillator circuit. Where did this capacity come from? Inspection of the wiring and comparison with other oscillators showed nothing which could account for any appreciable fraction of the undesired capacity. The pick-up coil added no appreciable capacity for this point was tested experimentally.

The oscillator coil was then taken out of the circuit and rewound. No change was made in the secondary, or tuned, winding, for this had been made to the exact inductance called for by careful computing. But the tickler was rewound. The spacing between the tickler and the tuned winding was very thin. It was made about three times thicker. The tickler and pick-up turns were replaced, without making any changes in the number.

How Circuit Was Padded

This changed coil was put back into the circuit and a calibration curve was again taken. This time the highest frequency was 1,800 kc. The low frequency did not change much, but it was not expected to change. This change in frequency made it possible to track the circuit by changing the intermediate frequency.

The intermediate frequency could not be changed a great deal. Hence the highest frequency of the oscillator was made as great as possible by opening the shunt trimmer condenser as far as it would make any difference in the frequency. A signal of 1,500 kc. was then put into the circuit from a modulated oscillator and the tuning condenser was set at minimum capacity. Then each of the four i-f tuned circuits was adjusted for maximum strength of the signal. It required to turn one of the trimmer condensers as tight as possible but a definite peak was reached on all of them. This adjustment of the intermediate frequency made all the high frequency stations come in with good strength. But the low frequency signals did not come through.

Next a signal of 550 kc. was put into the circuit and the tuning condenser set where the calibration curve indicated this frequency should come in. Then it was attempted to tune in the 550 kc. signal with the series padding condenser. Of course, it did not work for it was of such a value that nearly all of its capacity had to be used on 400 kc. intermediate. And the lower intermediate frequency was much lower now. A 250 mmfd. fixed condenser was put in parallel with the adjustable condenser and then it was possible to tune in the 550 kc. signal.

This done, the circuit should be trimmed with fairly good tracking throughout, and this on test proved to be the case. Of course, it was not perfect in the middle of the scale because the inductance in the oscillator was too low for the lower intermediate frequency. It had been made for 400 kc. At that, both the selectivity and the sensitivity were good.

Control of Volume

Obviously, the thing to have done was to rewind the tickler coil putting still more space between the tuned and the tickler windings. It would have required a reduction of the minimum capacity of only 6 mmfd. to reach 1,900 kc. The first reduction was 49 mmfd. A space of 1/16 of an inch between the two windings should have been sufficient.

The control of volume is always a problem in a battery operated set, unless we are willing to tamper with the filament voltage. In this circuit a 10,000 ohm potentiometer is used across the primary of the first r-f transformer. At first the slider was connected to the antenna, but this did not control the volume satisfactorily. Then the ground was connected to the slider as in Fig. 1. This proved satisfactory. There is another practical point in this connection. Most potentiometers are made so that the slider becomes grounded when the potentiometer is mounted on the metal chassis. This compels grounding the slider unless the instrument is insulated from the chassis. It is important to note that the volume control does not change the selectivity of the circuit. The entire resistance is across the primary at all settings of the slider. The improvement in selectivity at strong signals was very noticeable, as compared with other forms of volume control. There is also a rheostat Rh in the filament circuit by which the volume could be controlled completely.

Grid Bias Detection

Grid bias detection was ultimately used in both detectors. The first was changed to this when it was found it worked more satisfactorily with the particular method of coupling the oscillator to the detector. The bias was determined experimentally and it was found the 4.5 volts worked the best. This applied to the second detector as well. This bias could also be used on the first audio amplifier. Hence it was not necessary to bring out an extra lead for bias.

The resistance R2 in the screen circuit of the first detector was not used in the final circuit because much better sensitivity

(*Continued on next page*)

"Universal" Auto Receiver

Independent of D-C Polarity of Ground

By Charles R. Endicott

The following discussion concerns the Universal Auto Set (works on either A minus or A plus grounded), augmenting the article in last week's issue, dated May 7th.

THE voltage on the oscillator plate could well be 45 volts, but since we would need another lead in the cable for this, we give the oscillator plate 90 volts. It is not excessive in view of the fact that due to grid current the grid cannot go more than a fraction of a volt positive and therefore the plate current cannot be great.

The screen of the mixer tube is also given 90 volts. This, perhaps, is higher than the voltage that gives the best detection efficiency but it is a usually recommended value and it makes the detecting efficiency all right because the bias resistance automatically puts the operating point at the right value for the voltage combination used.

To apply 90 volts on the screen of the second detector would not be so good because it would reduce the detecting efficiency considerably. Hence it is desirable to put a resistance in the screen lead. In the one shown in Fig. 1 the resistance has a value of 0.5 megohm, a value often used. However, better results might be obtained in some instances with a lower value. Hence other values should be tried before the wiring is permanently concluded. The detecting efficiency will not be good unless a condenser is connected from the screen to the chassis, and it is recommended that it be made at least 0.25 mfd.

Coils and Condensers

Tuning coils and condensers in this circuit are exactly the same as in any other receiver of similar type. Thus condensers C1, C2, and C3 may be a gang of three 0.00035 mfd. condensers. T1 and T2 are two shielded midget type r-f transformers wound for this capacity. The primaries should be rather large in order to get sufficient sensitivity. As many as 90 turns could be used but 50 would be sufficient. This refers to a transformer wound on a one inch diameter and having 127 turns on the tuned winding. These coils are the same regardless of the intermediate frequency used in the circuit.

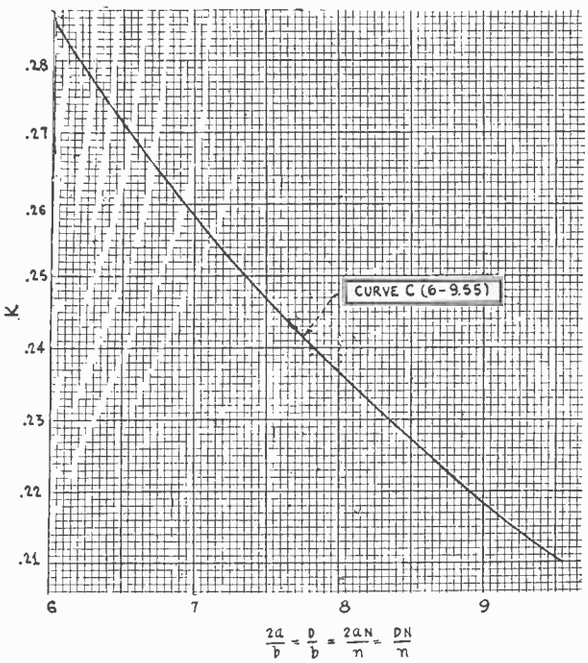
The oscillator coil T3 is available for a 0.00035 mfd. tuning capacity both for an intermediate frequency of 175 and 400 kc. T4 and T5 are the intermediate frequency transformers, which are also available both in 175 and 400 kc.

Cs, the series padding condenser, should cover a range of 700 to 1,000 mmfd. for a 175kc superheterodyne and from 350 to 450 for a 400 kc super. Both are available.

Padding and Adjustment

For a detailed discussion on how to pad the oscillator and for making essential circuit adjustments the reader is referred to an article in the April 16th issue of RADIO WORLD. It is recommended that this procedure be followed closely because any hit-or-miss method of adjustment is likelv to get the builder nowhere. By following the method closely the adjustment becomes a simple matter.

A word will not be amiss about the connections of the oscillator windings. The tickler and tuned winding terminals are marked P, B, G, and ground. Sometimes they are so arranged that if G is connected to the grid and ground to ground, B must be connected to the plate and P to B plus. In other words, the tickler connections must be the reverse from the indicated connections. This does not apply to all coils, but it should be remembered that if oscillation does not take place as the coils are connected first, the tickler winding should be reversed before any other source of trouble is looked for. The proper connection can be determined by inspection before the coil is put into the set. Remove the case and note how the tickler is connected to the terminals. If the two windings are in the same direction, which they will be if the coils are machine wound, then the plate and grid terminals should be at the extreme ends if we imagined that the tickler and tuned windings are pulled away from each other so that the other two terminals are adjacent to each other.



This curve gives the values of K in the Nagaoka inductance formula between 6 and 9.55 of the ratio of diameter to length of coil.

AN HARMONIC ANALYZER

WHAT IS an harmonic analyzer? On what principle does it operate? Does it have anything to do with the detection of harmonics in a superheterodyne? If so, can you suggest one that can be used in designing such receivers?—F. W. J., Bridgeport, Conn.

Every curve subject to certain conditions can be represented by a series of sine waves. The first term contains the fundamental, the second term, the second harmonic, and so on. The amplitudes of these terms vary according to the curve. Sometimes they may be entirely absent. An instrument by which the amplitudes of the various harmonics can be obtained is a harmonic analyzer. There are very many different such instruments. The analysis of a complex electric wave, that is, one that is very distorted from a simple, pure wave, can be performed by electric means, provided that we can put the wave in electric form. We may, for example, analyze the output of a vacuum tube to determine what percentage each harmonic is to the total current, or to the fundamental. A simple harmonic analyzer for this purpose was described in the issue of April 30th, last week. The principle of operation of this device was also explained.

(*Continued from preceding page*)

was obtained when nothing but the pick-up coil was in the screen lead.

The bias on the power tube was 13.5 volts, and for this a lead was used in the battery cable.

This seven-tube battery operated receiver was built for a portable to be used on a good ground and a fairly good antenna. It was not intended to be used without ground or antenna. For reproducer a magnetic speaker was used.

The power supply consisted of three 45-volt medium size B batteries, two small 7.5-volt grid batteries, and 4 No. 6 dry cells for filament supply. The total filament current is normally 0.62 ampere so that it would be better to use six No. 6 dry cells, connected in series parallel to give three volts. If six cells are used each cell will be called on to supply only about 0.20 ampere, but if four are used each cell will be called on for 0.31 ampere, which is a little higher than the rating of a cell. However, for portability light weight is important and frequent replacement of dry cells less so.

Besides the principal parts the following are needed:

Four binding posts.
Four grid clips.
One filament switch.
One seven-lead battery cable.
Six UX sockets.
One UY socket.
One vernier, or close adjustment, dial.
One aluminum chassis.
Suitable carrying case for chassis and the batteries.

Independent Tube with Two Equal Serves a

By J. E.

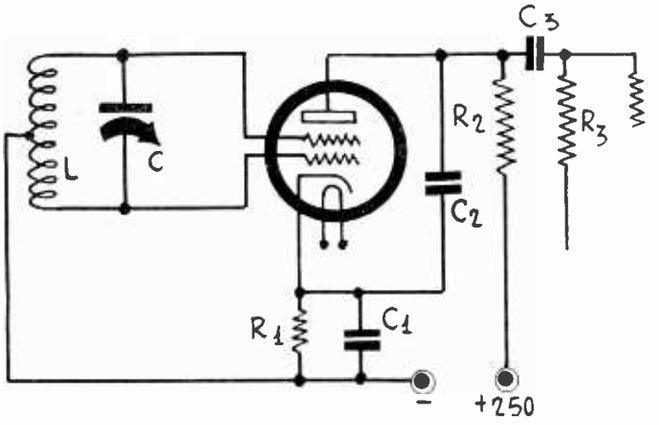


FIG. 1
This shows how the Wunderlich full-wave detector tube may be connected for grid bias detection.

IN THE April 30th issue we published the characteristics of five new tubes. But there is another new arrival in the large family of tubes, known as the Wunderlich tube, which is quite different from any of the others. It is primarily a detector or transrectifier but it has two equal grids instead of two or more different grids, and it functions as a full-wave transrectifier. One might be tempted to call it a push-pull detector, but the symmetry ceases at the grids because the tube has only one plate. It has a cathode, for it is designed to operate on alternating current and is of the indirectly heated type.

It is well known that if two detector tubes of equal characteristics are connected with the grids in push-pull and the plates tied together the circuit becomes a full-wave detector. The Wunderlich tube which is made by one independent, does exactly the same thing and combines the functions of two equal tubes when connected in that manner. It has only one plate and one cathode but two equal grids so placed with respect to the other two elements that each has exactly the same effect on the plate current. That is, the grids are equal and symmetrically placed with respect to the other two elements. The effect is very nearly the same as the effect would be with two equal tubes with their plates tied together, and also their cathodes, and using the two grids independently as in push-pull.

The Circuit for Wunderlich Tube

In Fig. 1 is a circuit diagram of a full-wave detector employing the Wunderlich tube. The symbols of the two grids do not conform with the actual case because of difficulty of representation. It suffices to say that each bears the same relation to the plate and the cathode. A tuned circuit is connected between the two grids and the midpoint of the coil is connected to ground. The total voltage across the tuned circuit is then divided equally between the two grids with respect to the cathode, or with respect to ground, but in opposite phase. Thus at any instant when one grid is one volt positive the other grid is one volt negative, and the voltage on one is increasing while that on the other is decreasing, the rate of increase and decrease being equal.

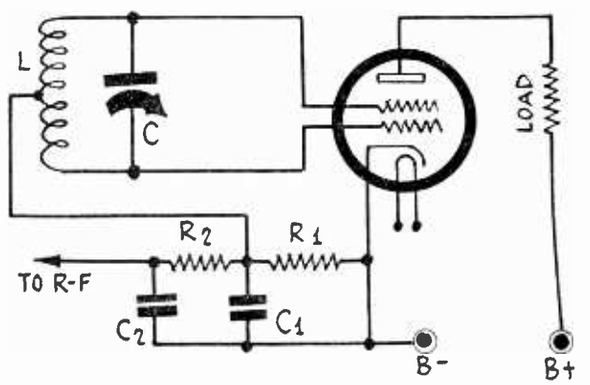


Fig. 2
The Wunderlich tube can also be used as a grid leak detector if connected in this manner. This also permits its use as an automatic volume control.

The tube is to be operated as a detector, and in the drawing grid bias detection is shown. The normal bias on both grids is the same, being the steady voltage drop across the bias resistance R1. Both grids are operated near the cut-off point on the grid voltage, plate current characteristic for each grid, or they are operated at a point where the bend is the most rapid.

Assuming that the grids are operated at a point where the bend is greatest, there is a certain minimum current flowing, and it is this plate current that establishes the grid bias.

Principle of Detection

Now let a radio frequency current be induced in the tuned circuit LC. A high alternating voltage will develop across the circuit. This is split equally between the two tubes in opposite phase. Consider an instant when the voltage on the upper grid is increasing. The plate current is then increasing by the action of the voltage on the upper grid. But it is decreasing by the action of the voltage on the lower grid. However, it is increasing more rapidly than it is decreasing so the net result is an increase in the plate current. The upper grid then contributes a current pulse during that half cycle when the upper grid is positive, measured with respect to the operating point. The grid voltage passes through zero in its cycle, and after it has passed through zero the lower grid predominates and during this half cycle it causes a current pulse. Thus in every cycle of the carrier voltage there are two current pulses in the plate current. The effect is similar to the effect of a full-wave rectifier like the 280, except that no current is drawn from the source of the voltage that causes the current pulses.

Smoothing Out

In the ordinary power rectifier we have a filter to smooth out the rectified pulses so as to get a steady flow of current. Likewise we need a filter in this circuit, not to smooth out all the fluctuations but only those due to the carrier voltage. We do not want to filter out the relatively slow fluctuations due to modulation. The filter in this case is the by-pass condenser C2 in the plate circuit. Of course, this condenser serves the same purposes exactly in the ordinary detector only we do not, as a rule, call attention to it. This condenser must be small so that it will be effective only at the carrier frequency and not at the modulation frequency.

If we did not have a filter condenser, C1, across the grid bias resistor, the current pulses in R1 would cause a pulsating voltage drop and this would become a variable bias. It would tend to limit the intensity of the current pulses. Hence we put C1 across R1 to eliminate this undesired effect. This is also done in the ordinary detector or in any amplifier, and for the same reason. C1 should preferably be large enough to make it effective at the lowest modulating frequency in order to make the detector sensitive.

Variation in Bias with Signal

It is well to call attention here to an effect often forgotten in connection with grid bias detection. When no signal is put on the grid the bias is determined solely by the steady current drop in R1. As a signal is impressed the mean value of the plate current is increased, and this has the effect of increasing the mean bias. This becomes greater the stronger the signal voltage. Therefore a detector of the self-biased type is not as sensitive on strong signals as it is on weak. This, in effect, acts as an automatic volume control to some degree. If this effect is to be minimized the bias resistance should be selected so that the steady bias is slightly less than the bias that gives greatest detecting efficiency. However, if we want to take advantage of the automatic volume control effect we should bias the tube so that greatest detecting efficiency occurs when a weak signal comes in. This would be the bias determined by static curves. What holds true of the half wave detector in this respect also holds true of a detector like that in Fig. 1.

It is not to be supposed that the full-wave detector is twice as sensitive as the half-wave detector. In the first place the voltage across the tuned circuit is divided by two. Thus cuts the current pulses in two, if we had straight line rectification.

Grids
s Full-Wave Detector, Either Type

Anderson

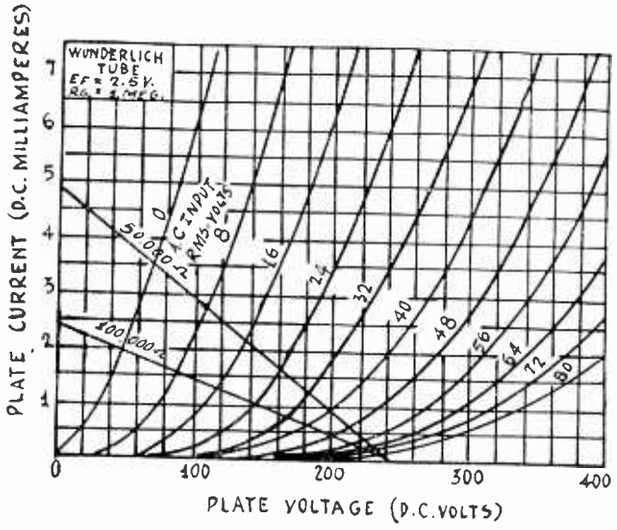


FIG. 3
A family of plate current plate voltage curves for various effective a-c values of grid voltage, together with two load lines.

But there are twice as many of them and the mean current, which determines the detecting efficiency, would be the same. So far neither loss nor gain. But we do not have straight line rectification, but more nearly square law rectification, and this is more nearly true when the voltage is split in two than when the whole voltage is impressed on the tube. On this basis the full-wave detector is only half as effective.

As the circuit is drawn in Fig. 1 the tuner is not suitable for radio frequency coupling between the amplifier and the detector, but it is for intermediate frequency coupling. The reason for this is that neither side of the tuning condenser is grounded. To make it applicable to radio frequency one could make C up of two equal condensers connected in series with the common rotors grounded. If LC is an intermediate frequency circuit no alteration is necessary.

It should be pointed out here that the tube may be used as a frequency changer in a superheterodyne by putting the signal into one grid and the oscillator voltage into the other. Undoubtedly, the tube will be applied to this as soon as it becomes available.

Grid Leak Detection

The tube can also be used as a grid leak detector if connected as in Fig. 2. Here R1 is the grid leak and C1 is the grid condenser. R2 and C2 may be disregarded for the moment.

In this case there will be considerable grid current, both grids taking current of equal amount but during different half-cycles. This current will be in such direction that the left end of R1 is negative with respect to the cathode.

Because of this polarity the voltage drop in the grid leak can be utilized for automatic volume control purposes. This is accomplished by connecting the cathode return of the controlled tubes to ground, as usual, and by connecting the grid returns of these tubes to the negative end of R1. However, this cannot be done directly because it is necessary to filter out the audio frequency component in R1 before utilizing the drop to control the grid bias. For this reason a filter consisting of a high resistance R2 anrd a large condenser C2 is used, being several times higher than the grid leak resistance in order to prevent lowering of the detecting efficiency. C2 should be so large that it acts virtually as a short circuit to all modulation frequencies, which in view of the high value of R2 may be from 0.1 to 1 mfd. A voltage as high as 15 volts may be developed across R1 for volume control purposes.

Characteristic Curves

In Fig. 3 is a family of plate current plate voltage curves of the Wunderlich tube. The various curves are for root mean square of the a-c input voltage rather than for various steady grid voltages. Thus they express the detecting efficiency of the

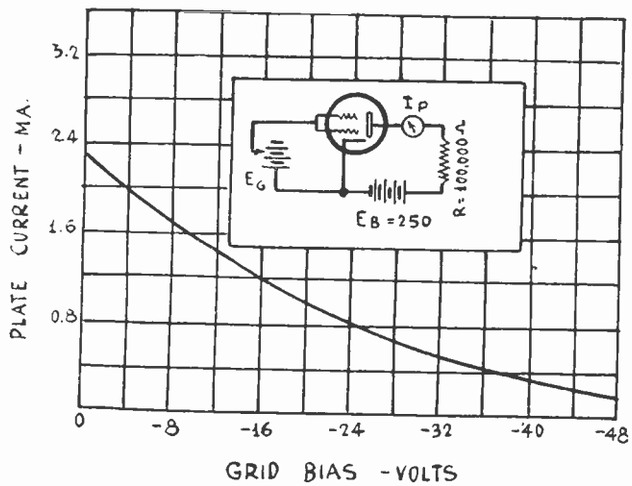


FIG. 4
A dynamic curve of the Wunderlich tube with the two grids tied together. The curves give d-c grid voltages against plate current through 100,000 ohms.

tube. Two load curves, one for 50,000 ohms and one for 100,000 ohms, are drawn across the curves, both for an applied plate voltage of 250 volts. In each case the grid leak is one megohm. Suppose the effective input voltage varies between zero and 40 volts. Then for a load of 50,000 ohms the plate current varies 3.5 and 0.9 milliamperes, or the variation is 2.6 milliamperes. The voltage variation from zero to 40 may be regarded as twice the amplitude of the modulation. Hence the amplitude of the modulation would be 20 volts. This causes a change in the plate current of 1.3 milliamperes. The corresponding output voltage would be 65 volts. That would be the output if the modulation were 100 per cent. A little higher efficiency is obtained when the load resistance is 100,000 ohms.

Fig. 4 shows a dynamic characteristic of the Wunderlich tube with a load resistance of 100,000 ohms, an applied plate voltage of 250 volts, and the two grids tied together. The insert shows the circuit with which the curve was taken.

The Wunderlich tube is made both for 2.5 and 6.3 volt service, and supplied with either 6-pin or 5-pin bases.

CHARACTERISTICS

A-C Type

Heater voltage, a-c	2.5
Heater current, amperes	1.0
Plate resistance, ohms	12,000
Mutual conductance, micromhos	1,200
Amplification factor	12
Plate current, milliamperes	2 to 5
Bulb, S-12 (automotive size)	
Base, red, 5-pin with cathode at top	
Base, red, 6-pin with cathode on the base	

Automotive Type

Heater voltage	6.3
Heater current, amperes	0.4
Other characteristics the same as the 2.5 volt tube	

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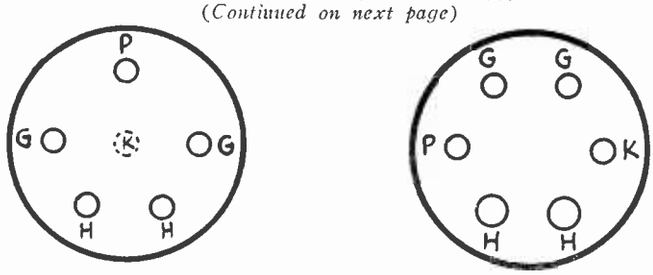

FIG. 5
The terminal arrangement of the base of the Wunderlich tube. There are two types of bases.

The Bedside Electric

A Five-Tube Regenerative Midget

By Charles Enris

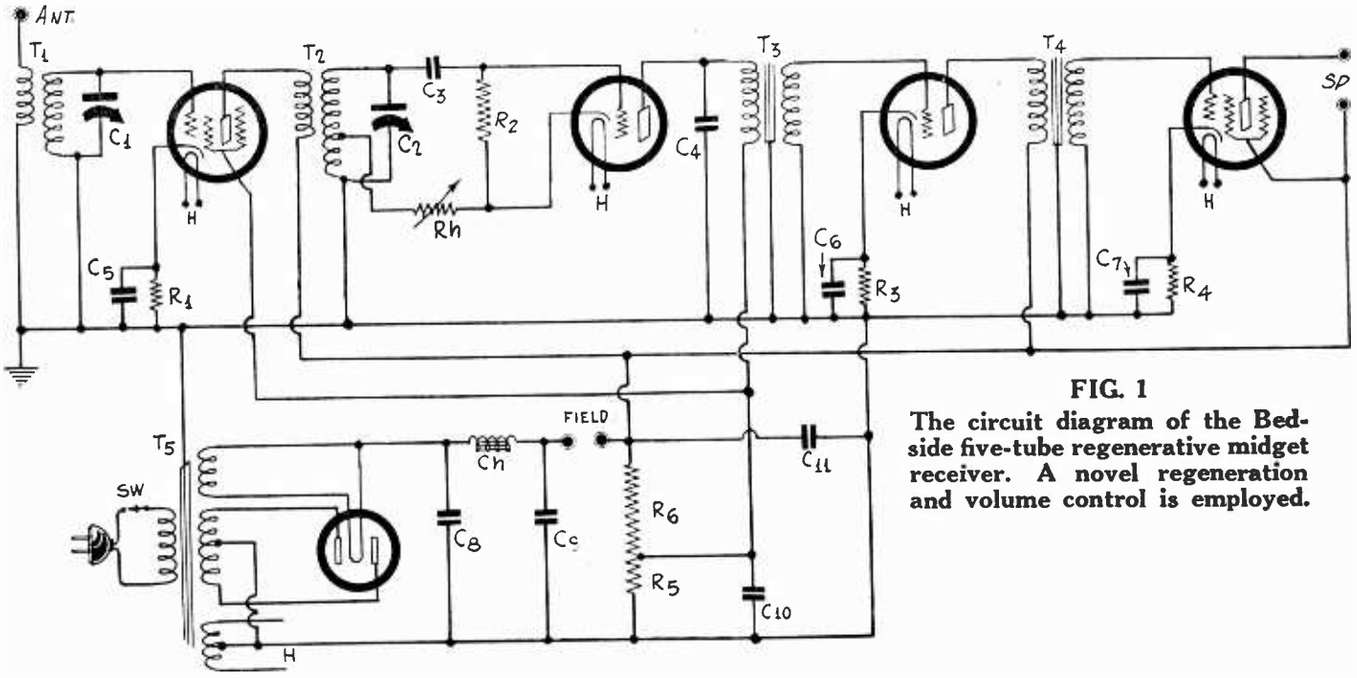

FIG. 1
The circuit diagram of the Bedside five-tube regenerative midget receiver. A novel regeneration and volume control is employed.

A RADIO receiver in every room may be desirable from the point of view of the trade, but a radio at the bedside is an expressed desire by many who already have radio sets in the living room. This desire springs from the wish to listen to radio programs early in the morning before rising and late at night after retirement. It may be that some lazy individuals have conceived the idea of participating in the morning setting-up exercises without leaving the bed. The reading of a favorite book to the accompaniment of bed-time music, no doubt, is a pleasant way of falling asleep. The trouble with that is that the set might be running all night, but even then it is not necessary to turn it on in the morning and the set will work as an alarm clock. The danger of letting the bedside set play all night is no greater than that of letting the living room set run all night. It is frequently done but that is no argument against a set.

The Bedside Receiver

In Fig. 1 we have a five-tube receiver quite suitable for the purpose. It does not take much power, so it will not run up the electric bill if it should be left on after it has ceased to entertain. Neither will it disturb the neighbors a great deal. If it is kept near the bed it will not be turned up to full volume, anyway.

It is quite sensitive although it is a midget set. Its sensitivity comes from the fact that the detector is regenerative and that two stages of audio are used. The regenerative feature is rather unique and is applicable only to a tube of the heater type. The circuit is first of all a Hartley oscillator. But, of course, it does not oscillate when it works as a detector. The regeneration is controlled by varying the effective plate voltage on the tube as well as by varying the resistance in the plate circuit. A high resistance rheostat Rh serves both these purposes. When Rh is zero the circuit is a Hartley oscillator and the tap on the coil is so placed that the circuit will just oscillate at the lowest signal frequency when the resistance is zero, or slightly more than zero. As the resistance is increased the drop in it is subtracted from the plate voltage and at the same time the resistance is put into the plate circuit. Not only does the resistance perform this function but it also divides the signal voltage between the grid leak and the rheostat. Thus the rheostat serves as a volume control aside from its control of the regeneration.

Details of Detector

The grid condenser C3 has the usual value of 0.00025 mfd. and the grid leak the usual value of 2 megohms. It may be, however, that in some instances there will be blocking of the grid with the high value, and this will be evidenced by a raucous squawk as the regeneration is advanced or by a high pitch squeal. If that should occur the leak should be reduced to one megohm. That should only be done if the blocking cannot be controlled with the rheostat. The bypass condenser C4 in the plate circuit of the tube should have a value of 0.0005 mfd. Note that this must be connected from the plate to ground, and not from the plate to the cathode. If it is connected to the cathode there will be no regeneration because the tickler portion of the tuning coil will be short-circuited for the radio frequency.

The value of Rh is not particularly critical but it should have a high value if it is to function properly. A suggested value is 50,000 ohms. This preferably should be of the smooth action type because if it is of the "wire-wound" type the current will be broken as the slider moves, and this will give rise to scratching noise. However, the noise is not so bad that it would interfere much and this type of variable resistance may be used.

The Tuning Coil

The tuning coil T2 is like any other r-f transformer with the exception that it has a tap on the tuned winding. This tap should be placed about one-third the way up from the ground terminal. That is, if the total number of turns is 75 the tap should be put at 25 turns up.

If the transformer is wound on a one-inch diameter with No. 31 enameled wire the tuned winding should contain 127 turns, assuming a tuning condenser of 350 mmfd. Therefore the tap should be put at the 42nd turn from the ground end of the winding. The primary should contain 50 turns of fine wire placed over the ground end of the tuned winding. No. 36 or No. 40 double silk covered wire is suitable. There should be

(*Continued on next page*)

CONNECTIONS FOR TUBE WITH TWO EQUAL GRIDS

(*Continued from preceding page*)

Fig 5 shows the arrangement of the terminals of the two types of base. At the left is the 5-pin base, looking at the bottom of the tube. The grids are actually brought out symmetrically with respect to the plate. The cathode, being brought out at the top, is represented by a central circle. At the right is the base of the 6-pin tube, also looking at the bottom of the tube. In this case the plate and the cathode occupy the same relative positions as in the 227, and the grids, taken together, occupy the position of the grid in the 227.

If we examine the characteristics of the 2.5 volt tube we note that it closely resembles the new series of tubes, that is, the 56, 57, and 58. It is of the same size and takes the same filament voltage and current.

LIST OF PARTS

Coils

T1—One radio frequency transformer as described
T-2—One three winding r-f transformer as described
T3, T4—Two audio frequency transformers, 3.5-to-1 ratio
T5—One power transformer as described
Ch—One 30-henry choke coil

Condensers

C1, C2—Two 350 mmfd. tuning condensers, with trimmer across C1 if they are ganged
C3—One 0.00025 mfd. grid condenser
C4—One 0.0005 mfd. condenser
C5—One 0.1 mfd. bypass condenser
C6, C7—Two one mfd. condensers
C8, C9, C11—Three 8 mfd. electrolytic condensers
C10—One 2 mfd. bypass condenser, or another 8 mfd. electrolytic

Resistors

R1—One 300 ohm bias resistor
R2—One 2 megohm grid leak
R3, R4—Two 2,000 ohm bias resistors
R5—One 3,000 ohm resistor
R6—One 4,500 ohm resistor
Rh—One 50,000 ohm variable resistor

Other Requirements

Sw—One line switch, may be mounted on Rh
Four UY sockets
One UX socket
One grid clip
One vernier dial
Four binding posts
One small dynamic loudspeaker
One midget chassis and cabinet

(*Continued from preceding page*)

an insulator layer about 1/32 inch thick between the windings, which may be built up by winding empire paper over the ground end of the tuned winding. In disposing of the leads to the terminals on the form the primary should be connected so that the plate terminal is next to the tap and so that the B plus terminal is next the ground end. This introduces some capacity coupling to boost the gain at the high frequencies and it also makes the first amplifier more stable. Of course, the regenerative coil should be put inside a metal shield, which should be not smaller than 2.5 inches high and 2 inches in diameter.

The r-f transformer T1 should be almost identical with T2 except that it should not have the tap. A difference in the number of primary turns may also be introduced. For high selectivity and moderate sensitivity 25 turns would be suitable. For low selectivity and high gain, as many as 75 turns could be used. Incidentally, due to the regenerative feature the selectivity of this circuit will be much greater than that of a two-tuner receiver without any regeneration.

Trimming Needed

Due to the difference between the two tuned circuits the tracking will not be good when the two tuning condensers are ganged. Best results will be obtained if two separate controls are used for tuning. But this is not very popular. The next best thing is to have a small trimmer across the first tuning condenser C1, one that is accessible from the panel. If this, too, is objectionable an ordinary trimmer can be put across C1 and adjusted at the high frequency end. In case there is a slight detuning at the low frequency end it will not be serious.

All the amplifier tubes in the circuit are self-biased, one resistor for each tube. The values of these resistors will depend on the tubes used, and we have not yet said anything about them. Preferably the tubes should be of the automotive type, the first a 239, the second a 237, the third a 237, and the final tube a 238. But a suitable filament or power transformer for these tubes is not available everywhere and in such cases the tubes may be a 235 and three 227. If the last tube is a 227, the screen in the drawing should be disregarded.

For automotive tubes the bias resistances should have the following values: R1, 300 ohms; R3, 2,000 ohms; and R4, 1,200 ohms. For the other type of tubes the resistors should have the following values: R1, 300 ohms; R3 and R4, 2,000 ohms each. The list of parts will assume that the 2.5 volt tubes are used.

The Power Supply

The power supply is a typical rectifier and filter employing a 280 tube. The transformer should have one 5-volt winding for the rectifier and one center-tapped high voltage winding with 350 volts each side of the center. It should also have one center-tapped filament winding. If automobile tubes are used the voltage of this winding should be 6.3 volts and if the other tubes are used it should have a 2.5 volts. It is a transformer with a 6.3 volts winding that is not easily obtainable.

Thorough filtering should be used because the circuit is regenerative and also because it contains two stages of audio; a 30-henry choke Ch and the field winding of a loudspeaker or else another 30-henry choke should be put in series with the line. The bypass condensers C8, C9, and C11 may be three 8 mfd. electrolytics. C10 could also be a condenser of this type and capacity but a 2 mfd. paper bypass condenser will do.

If the field is not used as a choke it would be desirable to put in a resistance in series with the second choke to drop the same voltage as the field coil would, that is, about 90 volts. But it is preferable to use the field as a choke for then the problem of obtaining the field power is solved.

The voltage applied to the screen of the first tube should be about 67 volts. This is also applied to the detector plate. Hence the drop in R5 should be 67 volts. Since the current to the plates is low and we need a high current for the field, we have to make the bleeder current high. The total plate current will be about 25 milliamperes and we need about 40 for the field. Hence the bleeder current should be at least 15 milliamperes. But we can use more for the field, say 50 milliamperes. Let us make the bleeder current 25 milliamperes. This requires that R5 be 2,680 ohms. If we select a bleeder current of 22 milliamperes we need a 3,000 ohm resistor. This is a convenient value and provides a satisfactory current for the field.

If we allow 180 volts on the plate of all the tubes except the detector, we need about 4,500 ohms for R6. If the maximum voltage after the field coil is greatly in excess of 180 volts, it is advisable to put in a resistance in series with the field to cut down the excess. However, if the total voltage across C11 is not more than 200 volts it is not necessary to use the resistance.

Short Waves to Be Sent from Saxonburg Plant

Pittsburgh.

The short waves of Westinghouse station W8XK, relay of KDKA, are about to be sent from the ultra-modern plant at Saxonburg, Pa., approximately 30 miles from here. The standard wave transmission from KDKA has been made Saxonburg since the plant was first opened, August 31st, 1930.

New transmitting sets are being installed at the Saxonburg plant for the short-wave frequencies of 15,210 kilocycles and 21,540 kilocycles, their respective wavelengths being 19.72 meters and 13.35 meters. The most advanced equipment is now being installed, the Westinghouse engineers utilizing the latest scientific knowledge of radio to insure that the short-wave facilities are the height of modernity. Other short-wave frequencies to be sent from Saxonburg are 6,140 kc. or 48.83 meters, and 11,870 kc. or 25.2 meters.

International Voice in 1923

Walter C. Evans, manager of radio operations for the Westinghouse Electric and Manufacturing Co., is supervising the installation of the short-wave equipment at the Saxonburg station.

The achievements of W8XK are known throughout the world. It has carried the National Broadcasting Company programs originating in the KDKA studios to the far corners of the earth. Not only have these short-wave programs of W8XK been received direct on short-wave sets but millions have tuned in on them after the waves had been picked up and re-broadcast on broadcast waves.

In November, 1923, when radio broadcasting was much in its infancy, the short-wave unit carried a KDKA program to England. So important had the short-wave unit become that in the same month of that year Westinghouse Station KFKX, then at Hastings, Neb., rebroadcast a program on the standard wave band after having picked it up on the short wave.

On December 31st, 1923, the first rebroadcasting of an international program was achieved.

Go to All Parts of Earth

On that occasion the short-wave unit transmitted a program that was picked up by a station at Manchester, England, which sent it out on the standard wave. This achievement began a long series of international broadcasts in which the short-wave programs encircled the world.

Today the short waves of W8XK carry KDKA programs to all parts of the earth. In addition to this, special broadcasts are sent out each Saturday night bearing messages to explorers, missionaries and others in remote places where they are far beyond the ordinary means of communication.

An innovation in use of short-wave broadcasting is being performed each Sunday evening in the Westinghouse Personalities program. These broadcasts are for both the English and the Spanish speaking people.

The music of the programs is sent out on both the short and the standard waves of KDKA and W8XK. Ralph Leavenworth, Westinghouse general advertising manager, then speaks in English and his talk is sent out only by KDKA. At the same time a Spanish talk is delivered on W8XK. At the conclusion of the two addresses the short and standard wave units are connected to the same microphone for the musical part of the program.

A Self-Biased Receiver

Economical Four-Tuber for Battery Operation

By Ora G. Fretz

IN DESIGNING a-c receivers we do not have to worry about the current consumption of the tubes, but in designing battery sets this is an important factor. There is a large number of battery sets in non-electrified territories standing idle because of run-down batteries and because of the expense and inconvenience of replacing or recharging these batteries.

In order to conserve the batteries as much as possible and at the same time have constant use of the radio receiver it is important that there should be as few tubes as possible and that these should be of as low current consumption as is consistent with good reception.

Of the low current tubes we have the 222, 199, 120, 232, 230, 234, and the 233. The last four are of the two-volt type while the first are of the three-volt type. With either type a good four-tube regenerative receiver can be built that is comparatively inexpensive to keep in operating condition. The circuit which I am about to describe uses the three-volt tubes because I had these available. The first is a 222 screen grid tube, the second a 199, used as a regenerative detector, the third is also a 199, and the fourth is a 120 power tube. Transformer coupling is used in the audio amplifier because it was desired to get as much sensitivity as possible with the four tubes.

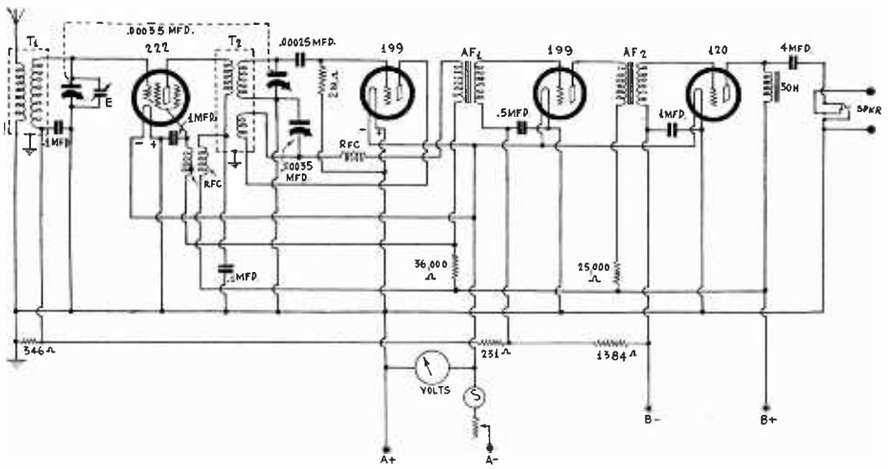

FIG. 1

The circuit of a four-tube battery operated regenerative receiver using 3 volt tubes. Flexibility in regards to filament supply and self-bias are features.

As this circuit was adjusted, the current drain from the 6 volt storage battery was only three-eighths of an ampere, which is so low that a charge of a medium size battery will last a long time. Moreover, it is so low that dry cells can be used for heating the filaments during times when the battery is on charge or when it becomes exhausted during critical moments. In view of the fact that a rheostat is used for cutting down the excess voltage of the storage battery, the circuit can be operated on four No. 6 dry cells connected in series-parallel when dry cell operation becomes desirable. While the voltage given by two dry cells connected in series is slightly low, it is high enough for emergency operation. Or the set can be operated on a six-volt dry cell battery, which should contain six cells connected in series-parallel. That is, three would be connected in series and two such groups would be connected in parallel. Another way is to use a four-volt storage battery. Thus the circuit is quite flexible in regards to filament supply.

Plate Voltages

The maximum effective plate voltage, with 135 volts applied, is about 113 volts, since nearly 22.5 volts are taken for the bias on the power tube. Under these conditions the total plate current is only about twelve milliamperes. Thus the drain on the B battery is comparatively low and dry cell B batteries should last a long time.

The maximum voltage is applied to the plates of the first and the fourth tubes. The voltage on the plate of the 199 audio tube should not exceed 90 volts and therefore it is dropped to about this value by a 25,000 ohm resistance in the plate return lead of this tube. The voltage required on the plate of the detector and on the screen of the first tube should be considerably less than 90 volts and hence it is dropped by a 36,000 ohm resistor.

Considerably greater output will be obtained if the voltage is raised so that the effective value is 135 volts or slightly more. To make it 135 volts the applied voltage could be boosted by a 22.5 volt B battery, or it could be raised to about 157 volts by adding a 45 volt battery. If the voltage is raised above that first specified it is necessary to use different resistances in the bias voltage divider because the total plate current would be raised considerably. The resistances would have to be lowered.

How Bias Is Obtained

The bias is obtained by connecting a resistance between minus B and the filaments and then returning the grids to suitable points along the resistance. The power tube requires the greatest bias, so its grid is returned to B minus and the total value of the biasing resistance is adjusted to give the desired effective bias. The grids of the other tubes requiring less bias are returned to points on the resistance farther away from the negative terminal of the B battery. The resistors are indicated, one of 346 ohms, another of 231 ohms, and still another of 1,384 ohms. Thus the total is 1,961 ohms.

A peculiarity should be noted in the circuit. The bias resistance is connected to the positive end of the filament circuit. Thus if the grids were returned to ground the grids would be positive by the amount of drop in the filaments, since bias is measured with respect to the negative end of the filament. Hence the bias resistances must be high enough to offset the bucking effect of the filament battery. In effect the B minus

(*Continued on next page*)

LIST OF PARTS

Coils

T1—One shielded r-f transformer as described
T2—One shielded three-winding r-f transformer as described
AF1, AF2—Two audio frequency transformers
One 30 henry choke coil
Three 85 millihenry choke coils

Condensers

Three 0.00035 mfd. tuning condensers, two of them ganged
Three 0.1 mfd. condensers, in one case
One 0.00025 mfd. grid condenser
One 0.5 mfd. bypass condenser
One 1 mfd. bypass condenser
One 4 mfd. condenser

Resistors

One 2 megohm grid leak
One 36,000 ohm resistor
One 25,000 ohm resistor
One 346 ohm, one 231 ohm, and one 1,384 ohm resistors
One 10 or 20 ohm rheostat

Other Requirements

Four 4-contact sockets
One grid clip
Eight binding posts
One low-range voltmeter (optional)
One 1.25 volt pilot light (optional)
One single circuit jack
One vernier dial for tuning condensers
One knob for regeneration control

(*Continued from preceding page*)

is connected to A plus and the filament voltage is added to the plate voltage.

The odd values of bias resistances are not absolutely necessary because a considerable variation is allowable in the grid bias, and the nearest commercial values can be used. However, it is all right to use a single resistor strip having the required total resistance, provided this is of the type that can be tapped at any desired points. This will permit close adjustment of the bias in any case and it is not necessary to obtain a new set of bias resistors when the plate voltage is changed.

Coils

The coils were wound on 1.75 inch tubing. The secondaries contained 80 turns of No. 29 enameled wire, which is approximately the correct number just to cover the broadcast band with a 350 mmfd. tuning condenser. The computed inductance is slightly too large but the effective inductance is reduced a little by the shield. If the reduction is not enough to bring the effective inductance down to the proper value, as judged by the coverage, a turn or two may be removed until 550 kc comes in just below 100 on the dial.

The primary of the antenna coil contained 40 turns of very fine wire and the turns were bunched within a space of about ⅛ inch. Lacquer was used for holding the turns together. A space of ⅛ inch was left between the primary and secondary windings.

The interstage coil was just like the antenna coil except that it had 50 primary turns and that it had the tickler. The tickler contained 35 turns of very fine wire. This was wound in a single layer at the ground end of the tuned winding. Some adjustment may be necessary of the tickler turns because if there are too few the circuit may not oscillate and if there are too many it may not be possible to control the oscillation. With the regeneration control condenser set at nearly maximum and the tuner set at 550 kc, there should be just enough turns to make the circuit oscillate. It should be possible to stop oscillation at all settings with the tickler control condenser, and it should also be possible to start oscillation at all settings of the tuning condenser. The required turns also depend on the thoroughness of the shielding and on the filtering of the circuit. If the shielding fits too snugly over the interstage coil the circuit may not oscillate with the specified number of tickler turns. There is no harm in using a large shield, but there is in using a small one. The shields used were 2⅞ inches in diameter and 3.75 inches long.

Filtering

Filtering is done rather more thoroughly than is customary in sets of this type. At first we have a 0.1 mfd. condenser across the bias for the first tube. Then there is a 0.1 mfd. condenser from the screen of this tube to ground, and a radio frequency choke in series with the screen lead. This may have an inductance of 85 millihenries or so. A similar choke and condenser filter is put in the plate circuit. Then there is a similar choke in the plate lead of the detector, which in conjunction with the regeneration control condenser serves as a filter. In the audio end there is a 0.5 mfd. condenser across the bias for the 199 and a one microfarad condenser across the bias for the power tube. In the output of the power tube is a 4 mfd. condenser and a 30 henry choke. Note that the speaker returns to ground. This reduces audio feedback.

The method of voltage division used also helps to isolate the audio circuits so as to minimize feedback. The 25,000 ohm resistor in the first audio tube and the 36,000 ohm resistor in the detector tube plate circuit help in this particular.

The two 0.00035 mfd. tuning condensers are ganged to simplify tuning. But to offset any possible lack of tracking an adjustable midget is connected across the first section of the gang.

Filament Control

An inexpensive voltmeter is connected across the filaments as an aid in adjusting the filament voltage. Of course, this is not an essential, but it will tell when the fllament battery is getting low and it will also tell at all times what the operating voltage is. S in the negative side of the filament supply line is a small pilot light. Of course, it must be such that it will carry ⅜ ampere. Its chief purpose is to drop the excess voltage when a 6 volt source is used. Its use is optional. The rheostat below it, however, must be used. Its resistance should be such that it will cut the excess voltage no matter what battery voltage is used. Since the current normally is ⅜ ampere there should be 8/3 ohms for every excess volt. Thus, if the battery voltage is 6 volts and the excess is 3 volts, the rheostat should be 8 ohms. That is the minimum value. It may be 10 to 20 ohms.

Using Two-Volt Tubes

If two volt tubes are used, the first bias resistance should be 363 ohms, the second 111 ohms, and the third 1,333 ohms. This is on the assumption that the first tube is a 232, the second a 230, the third also a 230, and the power tube a 231. Of course, as before, the nearest commercial values may be used. The applied voltage in this case should be 157.5 volts.

The 232 tube requires a higher screen voltage than the 222. Therefore the 36,000 ohm resistor should be replaced by a 10,000 ohm resistor and a 25,000 ohm resistor should be connected in series with the plate return to the detector. This is equivalent to using a 35,000 ohm resistor for the 36,000 ohm resistor and connecting the screen to tap 10,000 ohms from the B plus end of the resistor. The aim should be to get about 45 volts on the plate of the detector and 67 volts on the screen. This cannot be measured with an ordinary voltmeter, even a 1,000 ohms per volt meter giving low values. It is best to measure the currents and determine the voltages on the basis of drop and the voltage of the battery. However, the voltages are not critical.

Inductance Offers Several Problems

Inductance is quite a problem in radio construction, especially in regard to short waves. But it must not be assumed that there are no problems of this nature remaining in regard to broadcast coils.

Any one desiring to build a radio set of any kind may check up on commercial coils or on coils he wound himself by comparing the resultant frequency or frequencies. Suppose a simple broadcast set is to be built, using three coils. If the tuning condenser is 350 mmfd. then the secondaries will be 245 microhenries or thereabout, or at least should be.

In the commercial manufacture of coils the same type and diameter of tubing are used, and the same number of turns of the same kind of wire put on the secondaries. This might seem to guarantee identical inductance, but does not. The wire thickness will vary, also spacing between turns, even though so-called close winding was intended, and the very material on which the coils are wound may be a bit different, resulting in inductance difference.

Coil manufacturers commonly "spin" the last part of the winding, whereby the axial length of the winding is kept the same to solve one of the problems.

Tolerance Is Established

The inductance depends of course on the axial length of the winding, more so when the coil is short, little when the coil is long, as can be verified by putting 10 more turns on a secondary that has 127 turns on a 1-inch diameter, and noting the small inductance increase. However, when it is known in advance that all coils will have the same length because an extra space is provided near one end, this space may be relatively moved during the machine-winding of the coil, and the axial length will be the same.

However, even with this precaution, for other reasons stated, the inductances will not be identical, whereupon the coil manufacturer will measure the inductance of all the coils and assort the products into groups, so that three-coil kits will not differ in inductance more than the standard. One manufacturer has a tolerance of 0.6 microhenry for broadcast coils.

Another coil manufacturer found that by using standard phenolic composition, common for winding coils, the forms would affect the inductance, so that if the moulding was done during wet weather the inductance would be considerably less than if the moulding were done in dry weather. He reported extreme examples of difference in inductance amounting to 20 per cent. Diverse coils could be segregated in almost identical groups, but he preferred some method that avoided the weakness of the cause itself and therefore selected a specially treated winding form where mica was impregnated so that the form would not absorb moisture (non-hydroscopic). The same material required fewer turns for the tickler, too, therefore indicating low losses.

Short-Wave Coils

So, when any coils are to be put into a set, it is well to test them by hooking them into an oscillating circuit and using a small capacity for establishing resonance. A test oscillator is required and the frequency is read. It is preferable to use a frequency that falls on a curve showing differences of 10 kc., which usually requires that a small capacity be used. The frequency may be so high as to be out of the band actually to be covered by the set, but that makes no difference.

The dissimilarity, if any, will show up in the difference in frequency reading. If all coils read the same frequency exactly, then the coils may be regarded as being matched.

On short waves the same general situation obtains, until one reaches the smallest coil, or winding for the highest frequencies to be tuned in, when the distributed capacities and the differences in capacities in ganged circuits become of such vast importance that the inductance may be deemed incidental. In fact, for very small inductance there is no formula for very accurately determining just how many turns are needed (5% error must be expected) and of course distributed inductance and capacity of the circuit are not known. So the small coils should be made by the cut and try method, tested for identity of inductance, by putting one coil after another in the same capacity circuit, an ordinary oscillator, and then checking up on the circuits in which the coils are to be used, so that trimmers in these circuits are adjusted on the basis of an unmolested frequency from the test oscillator.

DETECTORS AND AMPLIFIERS IN NUMERICAL ORDER

Type Number	Purpose	Base	Type Cathode	Rating: Filament (or heater) Volts	Filament (or heater) Amperes	Filament (or heater) Supply	Plate Max. Volts	Screen Max. Volts	Plate Supply Volts	Negative Grid Bias Volts: D C on Fil.	Negative Grid Bias Volts: A C on Fil.	Screen Volts ( ) = Current ma	Plate Current Milliamp.	A.C. Plate Resistance Ohms	Mutual Conductance Micromhos	Voltage Amplification Factor
11	Detector* or Amplifier	WD-11	Filament	1.1	0.25	D C	135	...	90 135	4.5 10.5	... ...	... ...	2.5 3.0	15,500 15,000	425 440	6.6 6.6
12	Detector* or Amplifier	UX	Filament	1.1	0.25	D C	135	...	90 135	4.5 10.5	... ...	... ...	2.5 3.0	15,500 15,000	425 440	6.6 6.6
56	Detector* or Amplifier	UY	Heater	2.5	1.0	A C or D C	250§§	...	250	13.5	13.5	...	5	9,500	1,450	13.8
56	Biased Detector	UY	Heater	2.5	1.0	A C or D C	250§§	...	250	20	20	...	Plate current to be adjusted to 0.2 ma. with no input signal		...	...
57	Radio Freq. Amplifier	6-pin	Heater	2.5	1.0	A C or D C	250	100	250	3**	3	100 (1.0)	2.0	11.5 meg.	1,225	+1,500
57	Biased Detector	6-pin	Heater	2.5	1.0	A C or D C	250†	100	250	6	6	100	Plate current to be adjusted to 0.1 ma. with no input signal		...	...
58	Radio Freq. Amplifier**	6-pin	Heater	2.5	1.0	A C or D C	250	100	250	3	3	100 (3.0)	8.2	800,000	1,600	1,280
112-A	Detector* or Amplifier	UX	Filament	5.0	0.25	D C	180	...	90 135	4.5 9.0	... ...	... ...	5.2 6.2	5,600 5,300	1,500 1,600	8.5 8.5
V-199	Detector* or Amplifier	UV-199	Filament	3.3	0.063	D C	90	...	90	4.5	...	...	2.5	15,500	425	6.6
X-199	Detector* or Amplifier	UX	Filament	3.3	0.06	D C	90	...	90	4.5	...	...	2.5	15,500	425	6.6
200-A	Detector	UX	Filament	5.0	0.25	D C	45	...	45	Grid Return to (—) Filament		...	1.5	30,000	666	20
201-A	Detector* or Amplifier	UX	Filament	5.0	0.25	D C	135	...	90 135	4.5 9.0	... ...	... ...	1.5 3.0	11,000 10,000	725 800	8.0 8.0
222	Radio Freq. Amplifier	UX	Filament	3.3	0.132	D C	135 135	67.5	135 135	1.5* 1.5	... ...	45 67.5	1.5 3.3	850,000 600,000	350 480	300 290
222	Audio Freq. Amplifier	UX	Filament	3.3	0.132	D C	135	67.5	180†	1.5	...	22.5	0.3	2,000,000	175	350
224	Radio Freq. Amplifier	UY	Heater	2.5	1.75	A C or D C	275	90	180 180 250	1.5 3.0 3.0	1.5 3.0 3.0	75 90 90	4.0 4.0 4.0	400,000 400,000 400,000	1,050 1,000 1,025	420 400 615
224	Biased Detector	UY	Heater	2.5	1.75	A C or D C	275	90	275‡	5 approx.	5 approx.	20 to 45	Plate current to be adjusted to 0.1 ma. with no input signal		...	...
224	Audio Freq. Amplifier	UY	Heater	2.5	1.75	A C or D C	275	90	250*	1.0	1.0	25	0.5	2,000,000	500	1,000
226	Amplifier	UX	Filament	1.5	1.05	A C or D C	180	...	90 135 180	5.0 8.0 12.5	6.0 9.0 13.5	... ...	3.8 6.3 6.3	8,600 7,200 7,000	955 1,135 1,170	8.2 8.2 8.2
227	Detector* or Amplifier	UY	Heater	2.5	1.75	A C or D C	275	...	90 135 180 250	6.0 9.0 13.5 21.0	6.0 9.0 13.5 21.0	... ...	2.7 4.5 5.0 5.2	11,000 9,000 9,000 9,250	820 1,000 1,000 975	9.0 9.0 9.0 9.0
227	Biased Detector	UY	Heater	2.5	1.75	A C or D C	275§	...	275	30.0	30.0	...	Plate current to be adjusted to 0.2 ma. with no input signal		...	...
230	Detector* or Amplifier	UX	Filament	2.0	0.06	D C	90	...	90	4.5	...	...	1.8	13,000	700	9.3
232	Radio Freq. Amplifier	UX	Filament	2.0	0.06	D C	150	67.5	135	3.0	...	67.5	1.4	1,150,000	505	580
232	Biased Detector	UX	Filament	2.0	0.06	D C	120	67.5	175	6 approx.	...	6.75	Plate current to be adjusted to 0.2 ma. with no input signal		...	...
232	Audio Freq. Amplifier	UX	Filament	2.0	0.06	D C	150	67.5	180†	22.5	0.25	...	..	....	...	...
234	Radio Freq. Amplifier**	UX	Filament	2.0	0.06	D C	180	67.5	180 135 90 67.5	3** 3 3 3	... ...	67.5 67.5 6.75 67.5 (1.0)	2.7 2.7 2.8 2.8	200,000 500,000 600,000 1.0 meg.	560 580 600 600	224 290 360 620
235	Radio Freq. Amplifier**	UY	Heater	2.5	1.75	A C or D C	275	90	180 250	1.5 3.0	1.5 3.0	75 90	5.8 6.5	350,000 350,000	1,100 1,050	385 370
236	Radio Freq. Amplifier	UY	Heater	6.3	0.3	D C	180	90	90 135 180	1.5 1.5 2.5	... ...	55 67.5 90	1.8 2.8 3.5	450,000 450,000 450,000	825 1,025 1,075	370 460 485
237	Detector* or Amplifier	UY	Heater	6.3	0.3	D C	180	90	90 135 180	6 9 13.5	... ...	... ...	2.6 4.3 4.7	11,500 10,000 10,600	780 900 900	9.0 9.0 9.0
239	Radio Freq. Amplifier**	UY	Heater	6.3	0.3	D C	180	90	90 135 180	3** 3** 3**	... ...	90(1.3) 90(1.3) 90(1.2)	4.4 4.4 4.5	375,000 540,000 750,000	960 980 1,000	360 530 750
240	Voltage Amplifier	UX	Filament	5.0	0.25	D C	180	...	135† 180†	1.5 3.0	... ...	... ...	0.2 0.2	150,000 150,000	200 200	30 30

*For grid-leak detection—plate volts 45, grid return to + filament or to cathode.
†Applied through plate coupling resistor of 250,000 ohms.
*Applied through plate coupling resistor of 200,000 ohms.
**Minimum negative bias given. Usually adjustable. First detector in superheterodynes at 10 volts negative bias or adjustable.
§§Applied through a plate coupling resistor of 50,000 to 100,000 ohms. Bias resistor 100,000 to 150,000 ohms.
§Applied through plate coupling resistor of 50,000 ohms.
‡Applied through plate coupling resistor of 250,000 ohms or 500 henry choke shunted by 0.25 megohm resistor.
✚Applied through plate coupling resistor of 100,000 ohms.

POWER AMPLIFIERS IN NUMERICAL ORDER

Type Number	Purpose	Base	Type Cathode	Rating: Filament (or heater) Volts	Filament Amperes	Filament Supply	Plate Max. Volts	Screen Max. Volts	Plate Supply Volts	Negative Grid Bias Volts: DC on Fil.	AC on Fil.	Screen Volts = ( ) = Current	Plate Current Milliamp.	AC Plate Resistance Ohms	Mutual Conductance Micromhos	Voltage Amplification Factor	Ohms Load for Stated Power Output	Power Output Milliwatts
46	Power Amplifier †Class A	UY	Filament	2.5	1.75	A C or D C	250	...	250	31.5	33	...	20	2380	2350	5.6	6400	1250
46	Power Amplifier ††Class B	UX	Filament	2.5	1.75	A C or D C	400	...	400	0	...	...	200 peak				1300 per tube	
112-A	Power Amplifier	UX	Filemtnt	5.0	0.25	A C or D C	180	...	135 180	9.0 13.5	11.5 16.0	... ...	6.2 7.6	5300 5000	1600 1700	8.5 8.5	8700 10800	115 260
120	Power Amplifier	UX	Filament	3.3	0.132	D C	135	...	90 135	16.5 22.5	... ...	... ...	3.0 6.5	8000 6300	415 525	3.3 3.3	9600 6500	45 110
171-A	Power Amplifier	UX	Filament	5.0	0.25	A C or D C	180	...	90 135 180	16.5 27.0 40.5	19.0 29.2 43.0	... ...	12.0 17.5 20.0	2250 1960 1850	1330 1520 1620	3.0 3.0 3.0	3200 3500 5350	125 370 700
210	Power Amplifier	UX	Filament	7.5	1.25	A C or D C	425	.	250 350 425	19.8 27.0 35.0	22.0.. 31.0 39.0	... ...	10.0 16.0 18.0	6000 5150 5000	1330 1550 1600	8.0 8.0 8.0	13000 11000 10200	400 900 1600
231	Power Amplifier	UX	Filament	2.0	0.130	D C	135	...	135	22.5	...	...	6.8	4950	760	3.8	9000	150
233	Power Amplifier	UY	Filament	2.0	0.26	D C	135	...	135	13.5	...	135(3.5)	14.5	50000	1350	70	7000	650
238	Power Amplifier	UY	Filament	6.3	0.3	D C	135	135	135	13.5	...	135(2.5)	9.0	102000	975	100	13500	525
245	Power Amplifier	UX	Filament	2.5	1.5	A C or D C	275	...	180 250 275	33.0 48.5 54.5	34.5 50.0 56.0	... ...	27.0 34.0 36.0	1900 1750 1670	1850 2000 2100	3.5 3.5 3.5	3500 3900 4600	780 1600 2000
247	Power Amplifier	UY	Filament	2.5	1 75	A C or D C	250	250	250	15.0	16.5	250(7.5)	32.0	35000	2500	90	7000	2500
250	Power Amplifier	UX	Filament	7.5	1.25	A C or D C	450	...	250 350 400 450	41.0 59.0 66.0 80.0	45.0 63.0 70.0 84.0	... ...	28.0 45.0 55.0 55.0	2100 1900 1800 1800	1800 2000 2100 2100	3.8 3.8 3.8 3.8	4300 4100 3670 4350	1000 2400 3400 4600
841	Power Amplifier Class A	UX	Filament	7.5	1.25	A C or D C	* 425	... ...	425 1000	5.8 9.2	... ...	... ...	0.7 2.2	63000 40000	450 750	24 26	250000 250000	... ...

†Grid adjacent to plate tied to plate. ††Both grids tied together (socket G and K). Class B is a form of push-pull. Maximum continuous power output, two tubes, 16 to 20 watts. *Supply voltage may exceed 425 by the voltage drop in the plate load. **1,000 volts applied; 575 volts dropped in plate load, so effective plate voltage will be 425.

RECTIFIERS IN NUMERICAL ORDER

280	Full-Wave Rectifier	UX	Filament	5.0	22.0	A C	1 { A C Voltage per Plate (Volts RMS).....350 { D C Output Current Maximum MA).....125 2 { A C Voltage per Plate (Maximum Volts RMS....400 { D C Current (Maximum MA).....110 3 { A C Voltage per Plate (Maximum Volts RMS)....550 { D C Output Current (Maximum MA).....135 This rating is permissible only with filter having an input choke of at least 20 henries.
281	Half-Wave Rectifier	UX	Filament	7.5	1.25	A C	A C Plate Voltage (Maximum RMS).....700 D C Output Current (Maximum MA)..... 85
282	Full-Wave Mureury Vapor Rectifier	UX	Filament	2.5	3.0	A C	A C Plate Voltage (Maximum Volts RMS).....500 D C Output Current (Maximum MA).....125 Approx. tube voltage drop, 15 volts.

REGULATORS IN NUMERICAL ORDER

874	Voltage Regulator	Designed to keep output voltage of B-Eliminators constant when different values of "B" current are supplied.	Operating Voltage.....90 Volts D C Starting Voltage.....125 Volts D C Operating Current.....10-50 Milliamperes
876	Current Regulator (Ballast Tube)	Designed to insure constant input to power operated radio receivers despite fluctuations in line voltage.	Operating Current.....1.7 Amperes Voltage Range.....40-60 Volts..
886	Current Regulator (Ballast Tube)	Designed to insure constant input to power operated radio receivers despite fluctuations in line voltage.	Operating Current.....2.05 Amperes Voltage Range.....40-60 Volts

TYPES FOR AMATEUR AND EXPERIMENTAL RADIO USES, IN NUMERICAL ORDER

Type Number	Purpose	Base	Type Cathode	Filament: Volts	Amps.	Supply	Normal Plate Volts	Voltage Amplification Factor	Negative Grid Bias: Class B Approximate Volts	Class C Approximate Volts	Screen Voltage: Class B Approximate Volts	Class C Approximate Volts	Plate Current: Class B Maximum Ma.	Class C Maximum Ma.	Plate Dissipation: Class B Maximum Watts	Class C Maximum Watts	Power Output: Class B Peak Watts	Class C Carrier Watts	Class C Watts
841	Oscillator of RF Amplifier	UX	Filament	7.5	1.25	AC or DC	250 350 450	30 30 30	... 5.1 5.1	20 25 30	... ...	... ...	... 50 50	60 60 60	15 15 15	15 15 15	... 12 16	... 3 4	6 10 13
RCA-852	Oscillator or RF Amplifier	UX	Filament	10.0	3.25	AC	2000	12	150	250	...	...	85	100	100	100	120	30	100
RCA-865	Oscillator or RF Amplifier	UX	Filament	7.5	2.0	AC	500	500	40	75	125	...	30	60	15	15	7.5	1.9	7.5
RCA-866	Half-Wave Rectifier	UX	Filament	2.5	5.0	AC							Maximum Peak Voltage—7500 Volts Maximum Peak Plate Current 0.6 Amperes Approximate Tube Voltage Drop—15 Volts						

SUPER-REGENERATION REDUC SYSTEM USED IN T

By Herman

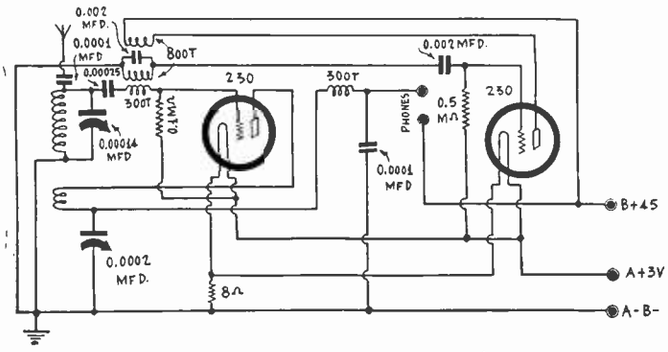

FIG. 1
A battery-operated tuner, using super-regeneration.

AS super-regeneration is the subject of renewed experiments now, the object being to attain simple, stable receivers of short waves, it is proposed that circuits be tried wherein the two different oscillation frequencies are generated in separate tubes.

Last week (issue of May 7th) a method was outlined for using a single tube to perform the dual function, but somewhat better results are obtained with separate tubes. Readers should experiment with both methods to compare results. Designers of commercial receivers of this type are leaning toward the separate-tube method.

Better Tuning Stability

An earphone receiver is shown in battery-operated and a-c models. Fig. 1 is the battery circuit. The signal frequency tube is hooked up in detector fashion, and the usual plug-in coils may be employed. It is advisable to have a control to limit the feedback in this tube, to provide a sensitivity control. A variable plate bypass condenser will do it.

The first tube is hooked up thus as a tuned grid oscillator, but the oscillation itself is prevented by the introduction of a low frequency oscillation from the second tube. It can be seen that the second tube is circuited much as is the first, and that grid coupling is established inductively, a 300-turn honeycomb being in the grid circuit of the first tube and inductively related to the grid coil in the second tube.

The circuit was tried both with and without the auxiliary oscillation frequency. It was found critical when worked alone, and anything but critical when the low frequency oscillation was introduced. The sensitivity seemed at least as great the second way as it was the first. It is hard to measure sensitivity on short waves for various reasons, one being that circuit noises are not distinguished from the signal by the measuring device.

The Low Frequency Coil

The aerial is connected to one side of a series condenser of 0.0001 mfd. capacity, while ground is connected to the return side of the grid winding. If oscillation is absent when the first tube is tried alone, reverse the external connections to the plate or grid winding, it makes no difference which.

Worked alone, the first tube will spill over with the usual squawk. This is a very irritating sound and gives the ear a shock. So any system that prevents spillover is advantageous. The super-regenerative method will do this nicely.

The second tube does not have to be hooked up in detector fashion, and the 0.5 meg. grid leak may be returned to negative filament instead of to positive filament. Performance was approximately the same.

Coil Information

The three honeycomb coils are wound on ⅜ inch dowels, occupy about 1 inch diameter, and are commercial products. The two 800-turn windings may be separated about ⅝ inch, which situation obtains when a common screw through the core holds them together. These coils should face the same way, whereupon their terminals are connected so that the second tube oscillates. Reverse the connections to either grid or plate coil if regeneration fails. A wetted finger put to grid of the second tube will denote oscillation by the distinct plop. The frequency is usually too high, in this case, for a circuit tone to be heard.

The pickup winding may be connected in either direction. It is the 300-turn honeycomb, held by the same screw, and tightly coupled to the secondary honeycomb.

Place the 300-turn winding with the short end of the dowel toward the secondary coil, or, for greater pickup, saw off the ½ inch dowel extension, so that the two coils are not more than ¼ inch apart.

It is not necessary to tune the plate winding.

Check-up On Operation

The fact that the system is working properly may be verified in several ways. One will be stated, as it is as good as any other. The crucial test is that there should not be the terrific squawking characteristic of spillover. The tube is regenerating, but should not be oscillating, as the auxiliary frequency of oscillation breaks down the oscillation of the tuner.

A circuit noise may be heard when the set is working at highest sensitivity. Therefore the feedback control is advisable, as it permits reducing the sensitivity so that the noise level is avoided. It is therefore clear that with a single tube it is possible to get down to the noise level. This condition is distinctly audible as introducing a racket as great as the intensity of the signal, or even greater. Sometimes the sensitivity will seem almost to disappear. This is due to too little capacity of the feedback condenser (0.0002 mfd.) being in circuit, so that feedback is totally removed, which is not desired.

Tuner Plug-in Coils

For those who want to wind their own coils the following data, applicable to the tube base diameter (approximately 1.25 inches) are given, comprising five coils, 200 to 15 meters, although with precision wound commercial coils the span can be covered with four coils:

Grid Coil No. Turns, Enamel	*Plate Coil No. Turns, Enamel*	*Range, Meters*
60 of No. 32	32 of No. 32	200+ to 118
33 of No. 24	15 of No. 32	118+ to 69
20 of No. 18	10 of No. 32	69+ to 40
10 of No. 18	10 of No. 32	40+ to 24
4 of No. 18	7 of No. 28	24+ to 15

When the higher frequencies are to be tuned in the super-regenerative feature will prove very valuable. In general, the lower the frequency, the less the contribution of the auxiliary oscillator to the performance of the circuit. It can be said, therefore, that the circuit has a distinctively rising characteristic. By suitable range of the regeneration control in the tuner, as provided, the sensitivity is lifted considerably at the low frequency end. Yet in some cases the circuit will be dead for the last few degrees of the dial, due to the low ratio of inductance to capacity or too long an aerial or other equivalent resistance causes. This can not be helped very well, so the coil data were given so as to provide considerable overlap.

A-C Model Tuner

The a-c model tuner, Fig. 2, is, if anything, simpler. The grid leak in the receiver circuit (0.25 meg.) is returned to cathode, to stabilize the grid voltage as much as possible. The variable resistor in the cathode leg is the feedback control. No matter how much or little of this resistance is in circuit, the grid bias is always about the same, as the grid is returned to cathode.

Due to grid current flow there will be a slight negative bias, and as the grid current rises the bias becomes more negative and thus tends to check the flow of grid current, or hold it and the bias relatively constant. All that the variable resistor does is to control the amount of plate current and reduce feedback. No bypass condenser is required.

The 5,000-ohm value given is maximum. Smaller values may be used, even to 400 ohms, in which case the grid leak may be reduced if desired, because the control is reduced.

A tuned grid oscillator is used in the signal detector circuit, but in the low frequency oscillator a modified Hartley oscillator is shown. This is an extremely simple and infallible oscillator, but it has the disadvantage of not standing any considerable load on its grid circuit. A small extra winding could be included for pickup, but, due to its smallness, and despite the much greater voltage in the grid circuit, it is no more advantageous than to take off the oscillation at the plate cir-

ES CRITICAL TUNING; WO TUNERS AND CONVERTER

Bernard

cuit. Then the resistance of the tubes is between the grid circuits of both tubes.

How Frequencies Are Combined

For detection a plate bypass condenser is necessary, otherwise sensitivity would be low indeed. This condenser may be 0.00035 mfd. It is a fixed one, whereas in the battery model it was variable. Values from 0.0001 mfd. to 0.0005 mfd. may be used, but the higher the value the greater should be the total resistance of the feedback control resistor.

This bypass condenser is large enough virtually to short the high frequencies from the plate circuit of the auxiliary oscillator, hence from the 'phones. However, this does no harm, since the same condenser is not of much effect on the low frequency oscillation. The high frequency oscillation is present in the tickler winding of the tuner circuit, we have seen that the low frequency oscillation is present there, also, hence the two oscillation frequencies are combined.

The grid coil of the auxiliary oscillator consists of two 800-turn honeycomb coils of the same small type as previously discussed. They are held together by a screw through the core, and if it is a machine screw a nut is put at one end and tightened down. If the coils face each other, with lugs parallel, one lug of one coil should be connected diagonally to one lug of the other coil, this joint to cathode, other extremes interchangeably to grid and grounded B minus.

25,000-Cycle Oscillator

The coils are separated by the length of the dowel extensions, whatever it is, normally around 1 inch, and since there is some inductive coupling between the two halves of the total winding, the diagonal connection was stressed so the coils would be in series aiding. This keeps the inductance up to the desired value, about 20 millihenries, which, with 0.002 mfd., will give a suitable frequency of oscillation, around 25,000 cycles (approximately 12,000 meters). Children and birds can hear 20,000 cycles. Most adults can not.

The B voltage is shown as 45 volts. Results were obtained on as little as 16 volts. When the voltage was increased very considerably beyond 45 volts there was somewhat more volume on some stations, but other stations formerly heard did not come in, and the grid current was too high.

The 16 volts were applied to the detector tuner, but it is advisable to have the plate voltage higher, at least 45 volts, on the low frequency oscillator. The reason is that this circuit, due to the low frequency, is not as ready an oscillator as the other, and an easy way of making it oscillate infallibly is to have the plate voltage around 45 volts or even higher. If much higher plate voltage is used it is advisable to put in a cathode resistor of around 2,000 ohms and bypass it by a condenser of 0.1 mfd. or higher capacity. The grid leak still could go to the cathode, and the 2,000-ohm resistor would not affect the bias but rather reduce the plate current.

Quiet Reception

One fact in favor of a low voltage on the tuner detector is that the reception is very quiet. When the plate voltage is high here there is more sensitivity but considerable noise. Since one of the complaints has been that there is too much noise in short-wave devices, the voltage apportionment can be as stated,

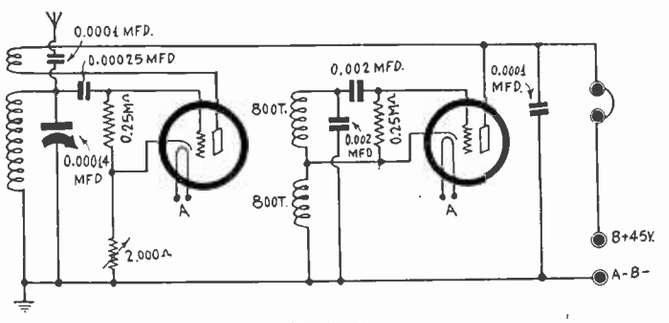

FIG. 2

A-C tubes are used in this equivalent model of a super-regenerative tuner. The auxiliary oscillator is of the Hartley type and plate coupling is used.

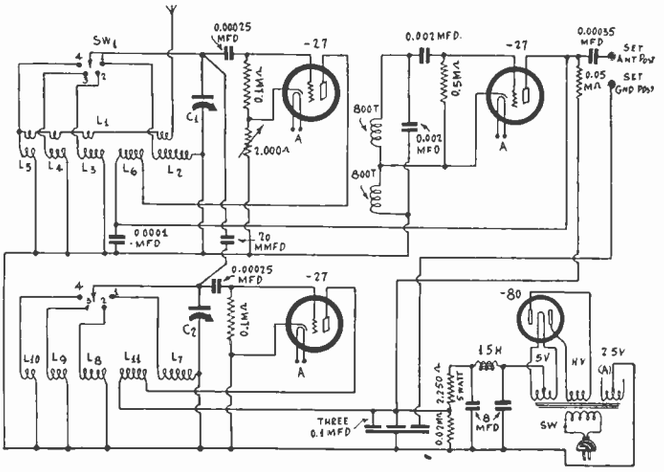

FIG. 3

A short-wave converter using the super-regenerative principle in the modulator.

and the extra gain in the audio channel relied on for building up the sensitivity without introducing such a high noise ratio.

Circuits concerning super-regeneration must be regarded as experimental, and there is no doubt a great deal yet to be learned about this system. Instead of working it for all the sensitivity that it can develop, it is suggested that it be used simply to retain as high a sensitivity as would be present without it, but to reduce the noise level. It does not seem logical that such a result actually is accomplished, since noise level is associated strictly with too much sensitivity and the two considerations are expected to go hand in hand. Yet the circuit was tried, the sensitivity was higher than without the auxiliary oscillator, and the noise was inconsiderable when the plate voltage on the tuner detector was low.

Principle Applied to a Converter

Besides use in a receiver super-regeneration has its merits also in a short-wave converter. A diagram of such a converter is shown in Fig. 3. The modulator has the auxiliary frequency introduced. A B supply is included.

The converter follows the same general principle as discussed in the a-c model tuner. It is provided with a switch for band shifting, to pick up the respective secondaries. In the case of the antenna coil the primary couples to each of the secondaries because it runs through the inside of the form, the windings being smaller when opposite smaller secondaries.

If the two condensers are not ganged in the tuning, then the coils may have the same number of turns for modulator and oscillator, provided the modulator condenser has about twice the capacity of the oscillator condenser. Suitable values would be 0.00025 mfd. for modulator, 0.00014 mfd. for oscillator. Hardly any separation exists between windings.

The winding on 1 inch diameter may be 50 turns of No. 28 enamel, 25 turns of No. 28 enamel, 13 turns of No. 18 enamel and 6 turns of No. 18 enamel for the secondaries. In the instances of the antenna coil, the primary is wound on ½ inch diameter, consisting of 25 turns opposite the larger secondary, then 20 turns, 15 turns and 10 turns. The tickler winding for the oscillator consists of 25 turns of No. 28 enamel or finer wire, on the same form as the secondaries, positioned literally as in Fig. 3.

Oscillators are often of low stability, due to large capacity resulting from grid current flow, and indeed changing values of capacity due to rise and fall of the amount of grid current. A corrective may be applied in the form of a leak and condenser, as in detection, even though the oscillator is hooked up in amplifier fashion, with a biasing resistor. The grid current through the leak causes a voltage drop, and the greater the drop the greater the negative bias, and the less the grid current, so the leak-condenser combination acts as a corrective. This is another way of stating that the d-c resistance of the grid circuit should be high.

Too tight inductive coupling of a pickup winding will introduce an unexpectedly high capacity, and also will coil switches now generally used in short-wave devices for public use.

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

To obtain a membership in Radio World's University Club for one year, send $6 for one year's subscription (52 issues of Radio World) and you will get a University number. Put this number at top of letter (not envelope) containing questions. Address, Radio World, 145 West 45th Street, New York, N. Y.

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

Resistance Push-pull

WILL YOU KINDLY publish a circuit of a diode rectifier feeding a push-pull power stage? I understand that this is possible. It does not matter what tubes are used as I have complete sets of all of them.—V. J. D., New Orleans, La.

In Fig. 1,007 is such a circuit, using a 227 as rectifier and two 247 as power tubes. No guaranty that this will work can be given but the principle of the hook-up is correct. A very strong signal must be impressed on the detector tube in order to load up the power tubes. The following values may be tried: R2, R3, 50,000 ohms each; C2, C3, 0.1 mfd.; R1, 10,000 ohms; C1, 0.00025 mfd. This circuit requires that the rectifier be a cathode type tube or a filament type tube with a separate filament supply. The capacity between ground and cathode or filament, should be as low as possible.

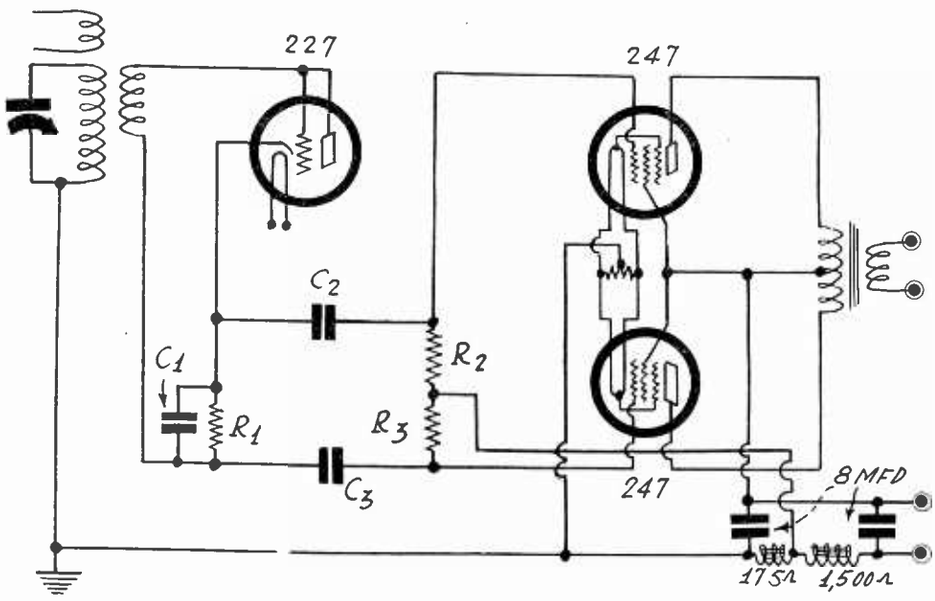

FIG. 1,007
Circuit of a diode detector feeding a stage of push-pull audio amplification. The coupling is effected by means of resistances and capacities.

* * *

Measuring Mu of a Tube

WILL YOU kindly suggest a simple way of measuring the mu of a tube? I have voltmeters, voltage dividers, a milliammeter of several ranges, and other parts. Can the mu be measured with these devices if they are wired into the proper circuit?—R. B. B., Cleveland, Ohio.

You have all the parts you need, assuming also that you have the necessary batteries for the tube. Put the milliammeter in the plate circuit and adjust the grid and plate voltages to the proper values. Change the grid bias by a small amount in one direction. Alter the plate voltage until the plate current is the same as it was before the change. Divide the change in the plate voltage by the change in the grid bias, and the result is the mu of the tube. For example, suppose the plate current is 10 milliamperes when the grid bias is 3 volts and the plate voltage is 135 volts. Change the grid bias to 4.5 volts. The plate current will go down but raise it to 10 milliamperes by adding voltage in the plate circuit. Suppose we have to add 13.5 volts. The change in the grid bias is then 1.5 volts and the change in the plate voltage is 13.5 volts. Hence the mu of the tube is 13.5/1.5, or 9. It is important that the current in the plate circuit be the same at both adjustments, for the mu of the tube is defined "at constant current."

* * *

Transconductance

WHAT IS the meaning of transconductance as applied to vacuum tubes? This seems to be a new characteristic not contained in tube references. Please give a definition of it.—M. M. A., Lincoln, Neb.

The transconductance is just another term for mutual conductance. It is a measure of the change in plate current for changes in the grid bias. When the mutual conductance is given as 2,000 micromhos the meaning is that the plate current changes by 2,000 microamperes for a change of one volt in the grid bias, the plate voltage being held constant. Transconductance is a more logical term.

* * *

Effectiveness of R-F Chokes

EVERY R-F CHOKE has a certain self-capacity. What effect does this have on the value of the coil as a choke? I realize that at the natural frequency of resonance the impedance changes from that of a coil to that of a condenser, but what is the impedance at frequencies above? How can it be computed? I would prefer a method of computing the impedance at all frequencies in terms of the minimum capacity and the inductance.—F. T. W., San Francisco, Calif.

The impedance is reduced by the capacity. At frequencies below the natural frequency the impedance can be taken as the reactance of the coil alone as if the self-capacity were not present. For frequencies above, the impedance may be taken as the reactance of the self-capacity alone. In the immediate vicinity of the natural frequency it may be taken as L/RC, in which L is the inductance in henries, R the resistance of the coil in ohms, and C is the capacity of the condenser in farads. One r-f coil is rated at 2.5 millihenries, 1 mmfd. self-capacity, and 50 ohms resistance. At the natural frequency this coil would have an impedance of 50 megohms. At 1,000 kc the impedance would be 15,700 ohms. At 10,000 kc the impedance would be 15,900 ohms. The natural frequency would be 3,180 kc. The impedances stated are approximate but very near the actual values.

* * *

Connecting Heaters in Series Parallel

WHICH IS the best way of connecting automobile type tubes in a receiver in which the tubes are heated by a 12-volt source? Sometimes the set will be operated on a 12-volt storage battery and sometimes on a generator putting out 12 volts.—F. R. R., Mineola, L. I., N. Y.

The best way is to connect them in series-parallel. Connect two in series and all such combinations in parallel. In case there is an odd number of tubes in the set use a resistance in one of the parallel branches and make this equal to the resistance of a tube. The resistance of one of these tubes is approximately 21 ohms, but of course, a 20 ohm resistor can be used. A seven tube set of this kind would take the same current as an eight tube set, and the total current would be 1.2 amperes. The wattage required for heating the tubes would be 14.4 watts.

* * *

Connecting a Hartley Oscillator

IS THERE any danger of connecting a Hartley oscillator so that the circuit will not work? Of course, I refer only to the coil. Does it matter which terminal of the coils is connected to the grid?—T. C. R., New Haven, Conn.

There is little chance of making the connection wrong because there are only three to make, and the tap on the coil should be connected toward the cathode or the filament. The terminals should be connected toward the plate and the grid. The preposition "toward" is used advisedly because there may be devices between the coil and the elements of the tube, such as stopping condensers, load resistors or batteries. The Hartley oscillator is very dependable and will function if the tap to the cathode is somewhere near the middle of the winding. The best point for the tap is a little nearer the plate than the grid.

50-CYCLE RULE SOON IN FORCE; WARNING GIVEN

Washington.

On Wednesday, June 22d, the new rule of the Federal Radio Commission, requiring broadcasting stations to stay within 50 cycles of their assigned frequencies, of which rule the stations will have had a full year's notice, goes into effect, and compliance is absolutely imperative. For failure to comply the station will be refused permission to operate, and there will be no exceptions; neither will any excuse of whatsoever nature be accepted. It is the most stringent rule, and the only absolutely unexceptional one.

The position in regard to the rule was given in a statement issued by the Commission. In this statement pleasure was expressed over the fact that more than two-thirds of the stations have installed frequency control equipment that will enable them to comply with the regulation.

Will Reduce Interference

Conformity is not difficult, but costs the stations some money, as a specially accurate monitor is required.

The new 50-cycle rule will confine beat notes between stations assigned to the same wave to a maximum of 100 cycles, a tone inaudible in most receivers, as the audio amplifier and speaker give virtually no response at this frequency. Stations on adjoining channels should not interfere at all, as to carriers mixing, because 9,900 kc. apart, but the modulation envelope might cause a beat when the modulation of both stations happens to be an exceptionally high audio frequency. At least, all forms of interference, due to wave-sharing and adjacent channel occupation, should be greatly reduced.

The present allowable deviation is 500 cycles, permitting a 1,000-cycle note and resulting in considerable waxing and waning groans and moans, particularly at the higher frequencies of the broadcast spectrum.

Gratification Expressed

The statement follows in full:

"The Federal Radio Commission is much gratified to report that approximately two-thirds of the broadcast stations now have installed frequency control equipment that has the capability of maintaining the operating frequency within 50 cycles of the assigned frequency, as required by rule 144 which becomes effective June 22, 1932. In conjunction with this equipment, an approved frequency monitor must be employed.

"Three frequency monitors have been approved to date and others are now being tested at the Bureau of Standards. All stations must have in operation by June 22, 1932, an approved monitor to be operated in conjunction with the transmitter so as to determine that the station is operating within the rigid frequency deviation tolerance specified. The monitors are considered necessary to maintain the close frequency requirements and are required by Rule 145.

Increased Service Area Expected

"Under the present rules, broadcast stations are required to maintain their operating frequency within only 500 cycles of the assigned frequency. Such operation subjects duplicated channel stations to severe mutual interference in the form of whistles and heterodynes. The new rule entirely eliminates these whistles and heterodynes, thereby increasing the service area of all stations that are now thus so limited in service.

"It is the hope and expectation of the Commission that when the new rule goes into effect all stations will be equipped with frequency control and frequency monitors so as to observe the new rigid frequency deviation tolerance.

Why Rule Is Inflexible

"It is the intention of the Commission to enforce rigidly the new rule and no stations will be allowed to operate which can not meet the requirements. No exceptions will be granted in this regard for any causes whatsoever.

"The value of the improvement, both to the broadcasters and the listeners, depends upon strict compliance. The failure of one station on a channel to maintain the tolerance limits may destroy the advantages to several other stations which maintain the required accuracy.

Chief Beneficiaries

"The chief beneficiaries of the new rule will be those listeners located fairly close to a station, but now unable to receive it satisfactorily due to interference from other stations on the channel. By the new rule this interference will be materially reduced and thereby the stations will serve larger areas. All stations that are now suffering from heterodyne interference will have their service areas increased. It is estimated that this increase in service area will be from 25 to 100 per cent for all duplicated channel stations now suffering heterodyne interference."

Lookers Asked to State Results

Lafayette, Ind.

W9XG, using 60-hole scanning, is asking lookers to report reception results. Particular evidence of double image reception is sought. The station operates on the 2,800 kc. band.

It is believed that the double images are caused by the prior arrival of the ground wave, which traverses the ether near the earth, as compared to the sky wave that takes the longer route to the Kennelly-Heaviside layer and is reflected back to earth. This same phenomenon is associated with fading in sound reception.

NEW BUILDING NAMED FOR RCA

Rockefeller Center's largest building, rising seventy stories from the center of Radio City and dominating the entire project, will be known as the RCA building.

The tower and twelve-story extension in the rear will contain the executive offices of the Radio Corporation of America. RCA executive offices will occupy the fifty-third and fifty-fifth floors of the tower. Executive offices of NBC will occupy the seventh floor of the tower, with the NBC studios immediately in the rear covering nearly 380,000 feet of floor space on nine floors of the extension.

The CA Building, which will have more floor area than any other office building in the world, will extend from Sixth Avenue eastward 535 feet toward Fifth Avenue, in the block between Forty-ninth and Fiftieth Streets.

SCHUETTE TOPS BROADCASTERS' COPYRIGHT WAR

Washington.

That the broadcasters mean to put up a stiff fight against what they consider any "impositions" by music interests was indicated in the retainer of Oswald F. Schuette as director of copyright activities on behalf of the National Association of Broadcasters.

While prose and poetry are also subjects of interest in regard to copyrights, music furnishes the principal worry, as the music fees paid under copyrights now amount to about $1,000,000 a year, and the American Society of Authors, Composers and Publishers is asking an increase of $3,000,000 a year.

Schuette will operate out of Washington and he is expected to be the official representative of the association in arguing before legislative and other bodies on behalf of the broadcasters.

Schuette Led Fight on RCA

For several years efforts have been made to amend the copyright law so that it will be more favorable to the broadcasters, as the largest users of copyright music, while also some concessions to authors and composers are under consideration, although not of a nature to make large fee collections easier.

Schuette was the leader of the fight when independent set and tube manufacturers tried to have the Radio Corporation of America prosecuted as a trust. He was particularly active in the fight the tube manufacturers waged successfully against an RCA contract clause that foreclosed independents from the sale of tubes to licensed set manufacturers for initial equipment of sets. The anti-trust suit is now under way.

While Schuette is fighting on behalf of his new clients for a better break for the broadcasters he will be fighting for his old enemy, the Radio Corporation of America, which wholly owns the National Broadcasting Company. With subsidiaries RCA owns or controls seventeen stations, while RCA itself actually owns eight stations and leases four.

Association Gives Wide Authority

"Mr. Schuette has been given wide authority to represent the broadcasting industry as such and will give immediate attention to the study of the field of music," the association announced. "He will also supervise personally the legislative fight in Congress to secure just protection for the broadcaster as a major user of music."

While he will be concerned also with the situation between the broadcasters and the society, the actual negotiations on the subject of music fees, now going on, are in others' hands. The negotiations are being conducted in New York City. The music men agreed to postpone the effective date of new rates from June 1st to September 1st. The broadcasters have said they simply can not afford to pay the increases demanded, and negotiations are being conducted in an effort to reach an agreement.

ASSIGNMENTS

Apco Electric Corp., selling electrical merchandise, 1164 Sixth Ave., New York City, to Joseph A. Caprio, 154 Nassau St., New York City.

PETITION IN BANKRUPTCY

Pyramid Electric Contracting Co., Inc., 228 East 41st St., New York City—By Williamsburg Electric Supply Corp., for $729; Atlantic Electrical Distributors, Inc., $275; The Okonite Co., $3,169. The petition states the liabilities are $44,753.

A THOUGHT FOR THE WEEK

A subscriber writes us and wants to know whether he should "fall for" (so he puts it) a stock salesman who is trying to sell him some shares in a new television company. Well, Mr. W. J. L., there's your banker; but, remember—it won't do you any good to ask him about a deal after you've made it. In the meantime, watch your step!

RADIO WORLD

The First and Only National Radio Weekly

Eleventh 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; J. Murray Barron, advertising manager.

Once Worthless, Now Precious

THE coming season probably will be attended by considerable activity on the part of amateurs and experimenters in the ultra frequency region. At present amateurs are conducting short-distance 'phone work on the 56 to 60 megacycle bands, and also they are authorized to use 400 to 401 megacycles, although so far as can be learned there is nothing doing yet in that remote region. Some television stations are trying out the lower ultra frequencies, with the expectation of giving public service in this region some time or other.

In nearly all the work being done on the ultra frequencies an oscillator is needed, and of course the frequency stability must be of the best. Therefore the more conventional types of oscillators do not serve the purpose, for if they oscillate at all they do not stay put. Some means of stabilizing the frequency against the effect of voltage supply changes have come to light in recent months, notably the use of non-reactive components in various parts of the tube circuit, especially grid and plate stabilization, while another method is to use the fourth element of a screen grid tube, whereby the coupling is by electrons only, and therefore not by the usual methods of resistance, capacity and inductance.

There will be so-called 5-meter receivers on the market before the Fall arrives, and one can expect that a great deal of technical information will come to light as the result of actual operation of and experimenting with such hookups, with perhaps a rush to the ultra frequencies that were once considered of no value whatever.

Sinning with Solder

A GREAT deal of mischief results from using a soldering iron that does not get quite hot enough. There are a great many 50-watt irons in use by experimenters, and while these serve for merely joining some wires or other small jobs, many other joints are attempted with underpowered irons, and the solder just sticks enough to fool you.

Some chasses are made of a zinc composition that takes solder well, only the metal is cold indeed, and a very hot iron is necessary, or, rather, the work has to be raised to the required temperature. Thus the solder will seem to stick to the chassis, if a "cold" joint is made, but experience will prove the alliance of scant lasting.

It is a good plan indeed to tug at a joint you have made and be sure not only that it is secure, but also that it has not jeoparded any other connection or introduced a short. Poor joints are still a source of seemingly inexplicable trouble, including underperformance or utter silence, although the builder "followed the diagram exactly as printed and checked up several times."

There's more fun in radio when the soldering's done right.

When in doubt about the service the iron will render for a particular piece of work, heat the work with the iron and apply stiff solder to the work, instead of to the iron. If the work is not hot enough you can't melt the solder, whereas by the other method you can melt the solder and still not make the joint.

Need for More Patents

ABOUT a century ago the Commissioner of Patents, United States Patent Office, recommended that the office be closed, as everything of value had been invented. The supreme satisfaction encompassed by that recommendation is hardly enjoyed by any one in any commercial undertaking today, certainly not in radio. There is always some new demand for a solution, and the problems tax the most ingenious experimenters. Not a week goes by without a bevy of radio patents being issued, and when all the patents in all lines are put together they make a fairly fat volume each week.

Patents are highly important in radio, and it is even the regret of some manufacturers that they can scarcely turn a stroke without having to use some patented circuit or device. So an effort is being made to establish a patent pool, in which RCA and associates also are co-operating for the first time, and the industry hopes that stabilization of patents in this manner will be achieved.

Stations Donate Time for Salvation Army

Radio stars and broadcasting company executives who take part in the Salvation Army United Appeal for $1,090,000 will work with Alfred J. McCosker, director and general manager of WOR, Newark, N. J. Mr. McCosker will be associated in this work with Major Edward Bowes, managing director of the Capitol Theatre, New York, and known to millions of radio listeners as the head of the "Capitol Family." Major Bowes is acting as chairman of the amusement section in the United Appeal.

As the money asked for in the united appeal will enable the Salvation Army to continue its emergency relief work and to carry on its institutional welfare work, the broadcasting companies are cooperating by donating time on the air. Through the courtesy of the broadcasters Salvation Army officers will be heard weekly over WEAF, WABC, WOR, WNYC, WOV, WFOX, WMIL and WBBC.

The Salvation Army officers are telling of the work the Army is doing. As a result some unusually interesting human interest stories are being "aired" for the first time.

MANUFACTURE AND SALES COMBINED

F. A. D. Andrea, Inc., announces a change in the firm name to be known as Fada Radio and Electric Corporation. The address is Jackson Ave., Orchard and Queens Sts., Long Island City, N. Y. Both manufacturing and sales organizations will operate as a single unit under the new name, handling Fada radio and other Fada electrical products.

Read 'Em and Weep

Five new tubes add something to what we must know against our will. We don't want to learn any more. Teaching is much pleasanter, though loafing's best.

* * *

The new tubes are principally for a-c operation. This gives folk with other or no line power in the house something else to kick about and run the depression a close second.

* * *

The numbers of the new tubes are 46, 56, 57, 58 and 82, which may mean something to numerologists, but leaves an astrologer cold.

* * *

It seems that the 46 is a parlor magician type tube that can be any kind of a power tube you want it to be. All things to all men. That doesn't leave the 46 with any kind of a reputation the home folk will admire.

* * *

The 56 is much like the —27, but if it is very much like some of the —27's we've burned out lately by voltage misconnections, they'd better compare it to the Mazda lamp or something.

* * *

The 57 you'd expect would be more like the —27, because sevens are sevens the world over, but that doesn't go for tubes. Sixes and sevens are about what tubes are at, judging by present low prices. So the 56 is like the —27, while the 57 is like the —24. It looks as if we've completed the 57 varieties of tubes.

* * *

But no. There's the 58. So '58, famous as the natal year of all 74-year-olds, now becomes doubly famous as denoting a tube that doesn't cross-modulate or do any other wicked things.

* * *

The 58 is like the —35 and other variable mu tubes, but it's more fashionable to call the vari-mus "super control" tubes, because then the other fellow isn't so sure of knowing what you mean, and the tube science becomes more closely held.

* * *

When everybody knows the inside dope on vacuum tubes there won't be much left for engineers to talk about at those monthly gatherings.

* * *

Every month now there's a "paper" on this and a "paper" on that, and if the spread of knowledge keeps up the audience will be able to ask intelligent questions. That will put the speakers on their guard so much that they won't show up for the cross-examination.

* * *

However, with two of the tubes having six pins on the base, and besides a grid cap at top, our eyes will enjoy the novel sight. It's become tedious to look at vacuum tubes that are so much alike.

* * *

The dome-shaped top of the 57 and 58 gives one a thrill, and maybe there's magic underneath the odd appearance. We've always been keen about the association of magic with radio and would like to find at last some reason for this.

* * *

All told, the new amplifier tubes are so sensitive that it is dangerous to say anything against them in their presence, lest they feel hurt, and explode!

STATION SPARKS

By Alice Remsen

A Love Song

FOR LANNY ROSS

WABC, Mondays, Wednesdays, Fridays, 7:15 P. M.

If only you were here, my dear, tonight!
The golden moon, arrested in her flight,
Hangs by a thread,
The grass is spread
With witching pattern woven from her light.

Like sentinels the pine trees boldly stand;
The murmur of the surf upon the strand
Is all I hear;
But, O, my dear,
I spurn these beauties with disdainful hand.

For moonlight bears no charm when you are gone.
And in my ears the ocean's lovely song
Shall be a dirge,
Till you emerge
And let me hear the voice for which I long.

—A. R.

* * *

NO ONE ELSE CAN SING LOVE SONGS JUST LIKE LANNY ROSS. He has a softly sweet way of putting them over, in a class all by itself. Please, Lanny, don't change your style and lose that marvelous personal appeal you now possess. If you become a robust tenor, you'll be just another tenor, whereas now you are different!

* * *

NEWS OF THE STUDIOS

WOR

A quartet of Hemstreet Singers, known on the air as the Dream Singers, are meeting with much success over WOR every Monday evening at 9:30 p.m. These young ladies, Adeline Bradley, Evelyn Lowman, Genevieve Taliaferro and Rhea Leddy, are accomplished soloists and were assembled and coached daily by Frank Hemstreet, both for radio and stage. They have a refined yet snappy routine for clubs and conventions. Their repertory includes classics, semi-classics, madrigals, ballads, negro dialect songs and spirituals, songs of every nation and popular tunes of the day, with many special arrangements. The Dream Singers are not only lovely on the air but pleasing to the eye and Frank Hemstreet is to be congratulated upon this, his latest ensemble success.

* * *

Bob Wilder of WOR recently became a proud papa. He insists that his new state requires a knowledge of chemistry. He spent two hours concocting formulas in the kitchen the other morning and just as he filled his young son and heir's milk bottle the bottom fell out of it. The baby had to wait until the nurse arrived before he could be fed and poor Bob was kept busy walking up and down in the usual manner.

* * *

Phil Brae and Bill Scholtz join together every Friday night at 7:00 p.m. over WOR in a program of comedy and song entitled "The Jolly Jugglers." Phil Brae came direct to radio as a pioneer from vaudeville. He was the original "Mr." of "Mr. and Mrs.", did "Broadway" in the Checker Cab program and has appeared in many commercials over all the local New York stations. Brae's partner, Bill Scholtz, received his experience with the American Opera Company.

* * *

NBC

S. L. Rothafel, "Roxy," out-Roxeyed himself on Saturday, April 30th, when he brought to the microphone a special "Roxy's Gang" of stage and radio over WEAF and WJZ for a feature, "Radio City Program." It was Roxy's parting gesture before leaving for Europe on May 4th with Martin Beck, with whom he will travel over the European continent in the interests of Radio City.

* * *

Jacques D'Avrey, NBC's French tenor, is hard at work translating a French play into English. He is working with Donald Blackwell, who wrote some of the skits for "Three's a Crowd" and the "Third Little Show." The play in process of translation is "Les Ailes Brisees," or, in English, "Broken Wings."

* * *

WABC

Believing that somewhere in the radio audience there is an unknown composer capable of writing a world-winning tune worthy of adoption as the official song of "A Century of Progress" in Chicago in 1933, Paul Specht, internationally famous exponent of symphonic jazz, has set himself to the task of finding that person.

In his Friday night broadcasts over WABC and the Columbia network he will outline details of the plan that has drawn endorsements from the "Century of Progress" officials, Mayor Cermak and the Chicago Chamber of Commerce. Manuscripts must be mailed direct to Paul Specht, at the Pla-more Cafe. Chicago, complete orchestration must be included, and no lyrics will be considered without the accompanying music. Music and radio critics will be invited to act as judges.

* * *

WMCA

With the acquisition of full air time, WMCA takes its place among the ranks of quality stations in and around the local area of New York. Donald Flamm, its president, will immediately start building up the station and is prepared to spend $150,000 on developing programs and purchasing new station equipment and promises some interesting news in the near future.

* * *

Sidelights

"DINNY" DINSDALE, production man for the Ziegfeld Radio Show, is English. Was the editor of a television journal in Britain, came to America to direct a scientific publication and later joined up with Columbia. He is tall, good-looking, rather reticent, but knows his business. . . . WILLARD AMISON, Bath Club vocalist, was chosen the outstanding tenor of Providence, R. I., when he was only seventeen years old. . . . MARIAN CARLEY, Columbia staff pianist, was a finalist in the New York City tennis tournament played in Central Park last year. . . . THE BOSWELL SISTERS' full names are: CONNIE FOORE BOSWELL, HELVETIA GEORGE BOSWELL, and MARTHA MELDANIA BOSWELL. . . DAVID ROSS is convinced that the Venus de Milo was the inspiration for Hemingway's "Farewell to Arms". . . FRANK BLACK has written many vocal works that have never been published. . . ARTHUR FIELDS, NBC singer, made his first phonograph record in 1910 and he's been doing it regularly ever since; doesn't that constitute some sort of record? . . . RACHEL MORTON, NBC concert singer, has been made a trustee of the Manor Woods Association, a civic group in Hartsdale, N. Y., where she makes her home. . . NELLIE REVELL, in her recent all-announcer broadcast, brought to light the astounding fact that although PAT KELLY, NBC supervisor of announcers, has been wrecked three times on three different oceans, he is not Shipwreck Kelly. . . SHIRLEY BELL, Orphan Annie in the Chicago NBC broadcast, keeps up a constant correspondence with Harold Gray, author of the "Orphan Annie" comic strip. . . LOU RADERMAN, ace violinist with many radio hours, including WABC'S "Evening in Paris" and NBC'S "Gypsies," recently returned from a trip to Cuba; he brought back plenty of Rhumba music and Cuban ideas.

BiographicalBrevities

ABOUT DON VOORHEES

For the best part of a year I've been trying to get some data on the dapper Don Voorhees, without success, but now my chief scout at the Columbia studios submits the following: Don Voorhees, born in Allentown, Pa., on July 26th, 1903. . . The only professional musician in the Voorhees family annals. . . Talent inherited from his mother, accomplished as an amateur pianist and singer. . . Father in the railroad business. . . Musical education started at the age of five with violin lessons, to which piano lessons were added a year later. . . Dr. J. Fred Wolle, one of the foremost living exponents of Bach, gave him his general musical education. . . Was a child prodigy, playing piano, violin and pipe-organ professionally in his home town at the age of twelve, and in New York at the age of fifteen. . . Although still well under thirty, has more than five years of radio experience behind him. . . At the age of twelve he was playing in the orchestra of a theatre. He led his own orchestra for dancing and hotel engagements, and filled a position as organist and choir-master at an Allentown church.

When he graduated from high school at the age of fifteen he took advantage of an opportunity offered him to leave Allentown for New York, where he started his theatrical career as concert-master for Rudolph Friml's operetta, "Sometime". . . At the conclusion of that engagement he became the conductor and musical director for Bert Williams, which position he filled until the old-time comedian's death in 1921. . . Then he directed such productions as George White's "Scandals," "Spice of 1922," and other Winter Garden revues. Then came "The Right Girl," Gershwin's "Sweet Little Devil," "The Florida Girl," "Rain or Shine," "Americana" and from the second through to the sixth edition of Earl Carroll's "Vanities". . . While at the Carroll Theatre he again formed an orchestra of his own and started broadcasting over a radio network. . . When the Columbia Broadcasting System was formed, Don and his musicians were engaged for a year as the "house" orchestra, and on Sunday, September 18th, 1927, he conducted the first program over the newly formed chain. . . In the course of his radio career, Don has conducted a large number of the air's outstanding sponsored programs over both NBC networks and the Columbia chain. . . He is tall, youthful looking and very handsome. . . Is an only child. . . A vigorous conductor. Serious about his music. . . Has few other interests except for an occasional game of golf. . . Does no composing, but much arranging. . . Arranges all of the music for his radio program. Likes music of any sort that is melodious and pleasing. . . Dislikes poses and false attitudes, especially in music. . . Is quiet and studious looking in demeanor. . . An unruly lock of brown hair is usually falling over one eye. . . Is now conducting for one of my favorite male singers, Lanny Ross, on the Maxwell House Tune Blenders, Monday, Wednesday and Friday, WABC, 7:15 p.m. . . Listen in! . . . It's a good program.

* * *

(If you would like to know something of your favorite radio artists, drop a card to the conductor of this page. Address Miss Alice Remsen, care RADIO WORLD, *145 West 45th St., New York, N.Y.)*

WMCA WINS ITS WAVE FIGHT AS WNYC IS MOVED

Washington.

A tentative decision was announced by the Federal Radio Commission whereby WMCA and WHAP will share the 570 kc. channel formerly occupied by WMCA and WNYC, the New York City municipal station, while the present wave of WHAP, 810 kc., will be assigned to WNYC. The WMCA-WHAP operation on the 570 kc. channel would be unlimited, while that of WNYC on 810 kc. would be all day, until sunset.

WMCA is owned by the Knickerbocker Broadcasting Company, and the license of WHAP is held by the Eastern Broadcasting Company, but the Knickerbocker concern controls the other. It was intimated at the Commission that the Knickerbocker concern intends to take WHAP off the air, and operate WMCA full time, since there is no object in having two different call letters when the same channel is used by two stations. When the stations were on separate waves the advantage lay in simultaneous operation.

Board Reversed Examiner

WMCA and WNYC have been disputing ever since they were assigned to the same wave, several years ago, and on some occasions the dispute became so acute that the two transmitters were on the air for a brief period at the same time, although both are New York City stations. WNYC's transmitter and studio are on the twenty-fifth floor of the Municipal Building, near the City Hall, while WMCA's transmitter is in Jersey City, N. J., and its studio on Manhattan Island.

The Commission rendered a tentative decision because it desires to formulate the state of facts and the findings thereunder, for release with a final decision. It is said that this situation results from the original recommendation of Chief Examiner Ellis B. Yost being just the opposite to what the Commission found.

Two protracted hearings were held before the examiner, who reported that the people of the City of New York were more in need of the educational and civic type of programs offered by WNYC than of the enlargement of the mainly entertainment type offered by WMCA, which has been a steady night-club broadcaster. He therefore favored continuing both WNYC and WMCA on the same wave, increasing the time allotment to WNYC and taking time from WMCA to enable this. The status of WHAP would not have been changed.

Types of Programs Differ

The Commission did not give any explicit reasons for its tentative findings, but it is believed that these reasons will be set forth fully in the statement that is to be issued. The Commission itself had held a hearing on the dispute, because of the strenuous objections of WMCA to the recommendations of the examiner. At this hearing counsel for the city opposed further extension to the commercial station and said 810 kc. was a graveyard channel so far as WNYC was concerned.

WMCA's strongest argument was that, although a regional station, it was spending more money than any other in this group, and has the highest type of directors, operators, announcers and artists. WNYC features educational talks by members of the faculty of the College of the City of New York, Commissioners and deputies of various departments, as well as singing and orchestral music by departmental organizations that put a great deal of enthusiasm in their work.

Commissioner Starbuck dissented from the Board's tentative finding.

WMCA to Build New Transmitter

WMCA's present transmitter is at Jersey City, but work will be begun on a new transmitter on a five-acre lot on Jamaica Bay in the New York City limits, as soon as a license is issued for the operation of WMCA and WHAP on full time on 570 kc., it was announced by the Knickerbocker Broadcasting Company.

Donald Flamm, president of the company and director of the station, said that the Commission's ruling will result in a more advantageous position for all three stations, and in view of his having gotten all he asked for he was quite charitably inclined toward the municipal station with which he had been at odds for so long.

The municipal station is under the jurisdiction of the Department of Plant and Structures, of which Albert Goldman is Commissioner.

"WNYC will find little difficulty in making any change that is required," said Commissioner Goldman.

He would not comment on the decision of the Commission.

Kirbery Extends Those 5 Minutes

After having been a nightly singer at WEAF for many months, Ralph Kirbery has been moved into a sponsored program, being heard on the Enna Jettick Melodies at 9 p. m. (EDST) Sundays over the NBC-WJZ network.

Kirberry has an excellent tenor voice, fine diction and a flair for romantic singing. He has been known as the Dream Singer. His "hour" each night has amounted to exactly five minutes, starting at midnight, and no sooner did he get started than he was finished. Now he'll be having considerable more time. Two vocal quartets will be heard on the weekly program, as well as Enna Jettick Songbird, a soprano.

SCHOOL SEEKS VISION PERMIT

Washington.

A former member of the Federal Radio Commission is a prominent stockholder in a company seeking a television license, but so far this company has met with no luck.

The former board member is Sam Pickard, stockholder in the First National Television Corporation, of Kansas City, Kan. Besides, Mr. Pickard is a vice-president of the Columbia Broadcasting System.

First National conducts a radio correspondence school and seeks a license to send vision on the 2200-2300 kc channel, using 500 watts. R. H. Hyde, examiner, has recommended that the application be denied for lack of a definite plan of operation, and also because of danger of interference with Canada.

Arthur Church, manager of KMBC, Kansas City, also is a stockholder in the First National corporation.

SYNCHRONIZED TEST SUCCEEDS AT WBZ-WBZA

Washington.

When WBZ, Boston, Mass., and WBZA, Springfield, Mass., owned by Westinghouse Electric & Manufacturing Company, make their report to the Federal Radio Commission it is expected that it will be favorable to synchronization. These stations have had experience in matched crystal simultaneous operation, as well as in synchronization by control of the two carriers, having started on these endeavors in 1925. Not much success attended matched crystal operation, but the two stations have been on the same wave with improved synchronization since 1927.

Reports on the results of all stations using either method are to be in the hands of the Commission by Monday (May 16th).

The synchronization plans tried included piezo oscillator, tuning fork and master oscillator. Research is being conducted in an effort to reduce the amount of equipment and also to improve the synchronization results. The synchronizing frequency is sent over the land wires that formerly carried the program of one station to the transmitter of the other when the stations used different waves.

Both stations are now listed as transmitting from Willis Township, Mass., with studios in Boston.

Improved Operation in Amateur 'Phone

Washington.

Improved operating conditions in amateur radiotelephony are noticed as a result of the new rules of the Federal Radio Commission. One modification widens the principal amateur radiotelephone band, reduces two other 'phone bands, and restricts telephone operation in general to amateur operators demonstrating special technical qualifications.

The 50 kilocycle sub-band beginning at 3500 kc., which previously contained the great bulk of amateur radiotelephone operation, was doubled in width and located at the upper end of the amateur 3500-4000 kc region, or 3900-4000 kc. Operation on this band, together with that on the 14,150-14,250 long-distance 'phone territory (half the previous band), is restricted to those amateurs holding special licenses from the Department of Commerce, certifying special ability in radiotelephony.

Unrestricted amateur 'phone operation is thereby confined to two amateur bands, one being the region from 1875 to 2000 kc, or half of the "160 meter band" in which beginners' and short-distance operation is carried on, and the other comprising the entire amateur 56,000 to 60,000 kc band at "five meters," on which a great deal of purely local work is done.

The regulations comprise in detail a previous proposal made by the board of directors of the American Radio Relay League, the national amateur organization.

ADDS NEW LINE

Wholesale Radio & Equipment Co., 902 Broadway, distributors for the Bosch radio and Cunningham tubes, is now distributing the Buckeye Refrigerators.

RETAIL SALES INCREASE 54%; AUTO SETS OFF

Washington.

Following the report of the wholesale situation, showing sales increase of 30.47 per cent. during the last quarter of 1931, the Department of Commerce made public figures on retail sales, showing an increase of 54 per cent. over the previous quarter.

In both the wholesale and retail instances inventories were lower. While the wholesale situation showed 42.01 per cent. decrease in inventory, the retail report was of an 18 per cent. decrease.

Reports were received from 6,750 identical retail dealers, who reported sales of $12,533,336 for the quarter, an increase of $4,401,966 over the $8,151,350 figure for the previous quarter. The stocks of these dealers were valued at $5,741,175, a decrease of $1,295,799 under the $7,036,974 figure of the previous quarter.

There was a rise in the inventory of television sets, the only rise reported, the decreases being from 30.83 per cent. maximum for screen grid tubes to 4.18 minimum for accessories and parts.

Trends Indicated

Automobile sets and television sets showed lower sales than other items, all the rest increasing. Auto sets were 21.24 and television sets 43.53 per cent. off, whereas advances were, minimum, 6.89 for speakers and, maximum, 89.0 for automatic radio-phonograph combinations.

The figures, as applying both to wholesalers and retailers, are not for total sales, since only a relatively few dealers and jobbers send in reports, but they do indicate trends.

For instance, the Christmas season buying, as part of the best radio season, is reflected in the increased sales. The freak figures regarding slow-moving numbers, such as television sets and radio-phonograph automatic combinations, have no particular significance, since a very few sales, more or less, make an enormous difference in percentage.

Greater Auto Set Sales Expected

The drop in auto set sales may be ascribed to the last quarter being an off-season for auto sets, for in warm weather the auto set is a considerable factor, and even the report for the first quarter of 1932 should reflect an increase in the sales of this growing number.

Inventory of television sets rose because of the same reason, small turnover, and a large upset in percentage if only a few less sets are sold than anticipated, out of a negligible absolute total.

Westinghouse Orders Increase Nearly 50%

News of orders for the first quarter of 1932, compared to the same period of last year, as reported by several companies doing electrical and radio business shows increases, and now Westinghouse Electric & Manufacturing Co. adds to the favorable news by reporting an increase of almost 50 per cent.

The figures are $30,100,410 compared to $20,388,658. The comparison of unfilled orders is as follows for the same quarters: 1932, $37,999,565; 1931, $36,598,246.

Tradiograms

By J. Murray Barron

Solar Manufacturing Co., 599 Broadway, N. Y. City, manufacturer of electrolytic and mica condensers, announces the appointment of Leroy Kischner as district sales manager for the Chicago territory, with offices at 9 South Clinton Street.

* * *

Edward J. Cohen has formed World-Wide Radio Corp., with headquarters at 47 Murray Street, N. Y. City, to serve dealers, servicemen and experimenters.

* * *

The Airex Company has moved its offices and mail order departments to 78 Cortlandt Street, N. Y. City, where additional floor space provides for greater stock of radio goods.

* * *

Ferry Sound Service, 14 Bleecker St., Newark, N. J., will install replacement and small parts departments. Dealers, servicemen and experimenters will be catered to in all standard radio merchandise.

* * *

Premier Sales Corp., 1646 W. Adams St., Los Angeles, California, has been appointed representative for California for Solar electrolytic and mica condensers. Russell Hines will guide the sales activities.

* * *

Motor Car Devices Co., 1455 Venice Blvd., Los Angeles, Cal., announces the Aut-O-Bee, an eliminator to take the place of the B and C batteries. It is for installation on boat, car or aircraft for radio receivers. It is planned to market it through radio shops, ship stores and automobile accessory stores.

Former Movie House Now a Radio Fair

What was formerly a motion picture house at 85 Cortlandt Street, N. Y. City, has been taken over by Try-Mo Radio Corporation and will be known as Try-Mo Radio Fair. The long entrance has been fitted with modern window space, giving elaborate display. On the inside the auditorium is approached through aisles flanked with counters and handsome displays of radio merchandise.

In the main body of the structure, offices, test rooms and private booths are to the left. To the right is a large center counter with passage ways, with more counters surrounding these. In the rear is the tube department with accurate tube testing board. The entire inside store has a large mezzanine on three sides, reached by an open grill staircase. Sets, speakers, replacement parts and other radio merchandise will be carried in many departments.

New Incorporations

Roadiola, New York City, radio. Attys., White & Stillman, 8 West 40th St., New York City.

Old Dominion Broadcasting Co., Wilmington, Del., broadcasting stations, television stations. Attys., Corporation Trust Co., Wilmington, Del.

American Radio Exchange, Inc., Camden, N. J. Atty., Meyer L. Sakin, Camden, N. J.

P. S. Radio Service Corp., New York City. Attorneys are Albany Service Co., 315 Broadway, New York City.

Philco Radio and Television Corp., Philadelphia, Penna. Attys., United States Corporation Co.

C. & R. Refrigerator Company, Brooklyn, N. Y. Attys., Canter & Pines, 290 Broadway, New York City.

Empire State Refrigeration Co., Brooklyn, N. Y. Atty., H. Jaffe, 61 Delancey St., New York City.

Pastor-Angel Co., Yonkers, N. Y., electrical appliances. Atty., C. P. Pinto, National Bank Bldg., Brooklyn, N. Y.

A. Electric Co., Brooklyn, N. Y. Atty., A. Dunaif, 399 Stone Ave., Brooklyn, N. Y.

Sunbeam Lighting Wares, Queens, N. Y., electrical supplies.—Attys., Brownstein & Brownstein, Jamaica, L. I., N. Y.

ASKED TO QUIT, JUDGE IN EARL CASE REFUSES

Newark, N. J.

A letter has been written to Vice-Chancellor Alonzo Church by Chancellor Walker, asking that the Vice-Chancellor resign from the bench, and that the letter of resignation be "without any attempted explanation, in the usual terse form," but the Vice-Chancellor replied that he could not comply either in justice to the court or to himself, as there would be an implication that the court had had a member who was corrupt, and constitute a confession of charges "that are absolutely false."

These charges have to do with the appointment by Church of Harry G. Hendricks, an acquaintance of long standing, as receiver in the bankruptcy case of the Earl Radio Corporation.

On a charge that the accounts of the referee were more than $175,000 short Vice-Chancellor Backes removed Hendricks as receiver and sentenced him to three years in State prison for contempt of court. Hendricks is out on $30,000 bail pending appeal.

Hendricks was a chauffeur for the Essex County Park Commission when Church was secretary of the Commission. It is said Hendricks obtained many appointments as receiver in bankruptcy from Church as Vice-Chancellor, at one time holding seventeen of them. An allowance of $45,000 to counsel and receivers in the Earl case was objected to in court and led finally to the action against Hendricks and the request for Church's resignation.

UNIVERSITY SEEKS LICENSE

Washington.

An application in the name of Neil H. Williams, head of the physics department, has been made to the Federal Radio Commission on behalf of the University of Michigan for a license to transmit on 28,000 and 100,000 kc (10.71 and 2.998 meters). Many other colleges have similar experimental licenses.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

Edward Keyser, 2113 Sidney Ave., Baltimore, Md.

Georges Henri Dufour, 51-4eme Pur, Limoilou, Quebec, Canada.

Kurt R. Zumhagen, 3609A, No. 17th St., Milwaukee, Wisc.

Wm. F. Sydallis, 89 Parkway, Oshkosh, Wisc.

Woodrow Wroblewski, 309 Davis Terrace, Schenectady, N. Y.

Rafael Palacios, Jf., Commission Merchant, 14 Tetuan St., San Juan, Porto Rico.

W. O. Pierce (pho-attach., short wave and add. systems) Route 1, Box 64, Hampton, Ark.

Herbert E. Hall, P. O. Box 482, Gainesville, Texas.

Charles Fishkind, Chief Engineer, Television Radio Service Co., 299 Broadway, New York City.

Darold N. Peters, 2162 S. 62nd St., West Allis, Wisc.

George Nowobilski, Box 107, Stowe, Penna.

Louis Dietrich, 39 Jordan Drive, Grand Rapids, Mich.

Herbert F. Harris, 20 Harrison Ave., Lakewood, R. I.

Wm. E. Huddleston, 409 E. Moses St., Cushing, Okla.

L. D. Thomas, Green Mountain, N. C.

Paul S. Sullivant, 34 East Third St., Oklahoma City, Okla.

Forum

I HAVE READ the article announcing the five new tubes in the April 30th issue with a great deal of interest. Two of these tubes look good to an amateur for C-W work on high frequencies.

We have obtained very good results in a low-power rig on the amateur 7,000 kc. band utilizing two '47 tubes in push-pull. The screen of the tube was connected directly to the high voltage, the same as applied to the plate. A single '45 will put out three or four watts as an oscillator in a low-power circuit, but two of the '45s with 350 volts on their plates in push-pull will deliver 8 to 10 watts. Two of the '47s were tried in this same circuit and an output of almost 20 watts was obtained by tying the screen and plate together.

Performance equal to that of a single 210 tube with 500 volts on its plate was obtained by designing a circuit analogous to the push-pull utilizing a single type '47 tube. The plate was used for one side and the screen for the other, a sort of a push-pull effect.

The value of such experimenting can readily be seen because of the price of tubes and power supplies. Two 510 (15 watt oscillators) cost $11 or $12 while two of the '47s cost around $2. The cost of a power supply delivering 600 volts pure d-c and sufficient current for two 510s is around $30, including two '81 rectifiers, while the cost of one delivering 350 or 400 volts is around $6 or $8 complete, if you build them yourself.

As soon as the 46, 57 and 58 tubes are available experiments will be conducted with them.

THOS. R. STERLING,
(W5AJU) Somerville, Texas.

Personnel Changes in NBC Pacific Division

Howard I. Milholland, manager of the program department of the Pacific Division of NBC, and for several years prior to that maanger of KGO, Oakland, Calif., is now manager of KGA, Spokane. This station is part of the Northwest Broadcasting System, control of which passed to the National Broadcasting Company last Summer.

Thomas H. Hutchinson, NBC production department, becomes program manager of the Pacific Division and Lewis S. Frost production manager in Hutchinson's place.

Rochelle Salts Used in Tiny Set's Speaker

A tiny new radio set, with diminutive tubes and a loudspeaker unit made out of Rochelle salts, was demonstrated in New York City recently. A. J. Cappicotto, who has been in charge of recent research on this new type of set, explained its features at that time. He is chief tube engineer for the Radio Products Company, of Newark, N. J.

Station Changes

Changes in the list of stations by frequencies, made since the publication of the list in the March 26th issue, follow:

630 kc, WOS, Jefferson City, Mo. Change owner to Missouri State Marketing Bureau.

860 kc, KMO, change frequency to 1330 kc, and power to 250 w.

1010 kc, KGGF, new location, Coffeyville, Kans. (Instead of South Coffeyville, Okla.)

1010 kc, WORK, York, Pa., York Broadcasting Co. 1KW. New Station.

1120 kc, KRKD, new location, Los Angeles, Calif. (Instead of Inglewood, Calif.)

1200 kc, WABI. Change owner to Universalist Society of Bangor.

1130 kc, WJJD. Change owner to WJJD, Inc.

1230 kc, KFQD, Change power to 250 w.

1310 kc, Delete WFDV. See 1500 kc below.

1310 kc, KRMD, Shreveport, La. Change owner to Radio Station KRMD, Inc.

1310 kc, WEBR, Buffalo, N. Y. Change power to 250W. (*) Max. day power.

1330 kc, Insert KMO, Tacoma, Wash. KMO, Inc. 250 w.

1360 kc, WCSC, Charleston, S. C. Change ownership to South Carolina B'dc'g Co., Inc.

1420 kc, KGKX, Sandpoint, Idaho. Change owner to Sandpoint B'dc'g Co.

1420 kc, KFXY, Change location to Yuma, Ariz.

1500 kc, WFDV, Rome Ga., Rome Broadcasting Corp., 100 w. Frequency changed from 1310 to 1500 kc.

1500 kc, WSYB, Change power to 250 w. (daytime).

Goelet's Son Asks Station for Estate

Washington.

An application for a construction permit to erect a broadcasting station at the Goelet estate at Chester, Orange County, N. Y., has been filed by Peter Goelet, son of Robert Goelet, New York banker. The applicant asked permission to broadcast on 1,210 kc during specified hours with a power of 50 watts. This channel is now used by WMRJ, Jamaica, N. Y., and three other stations.

At one time the applicant operated a similar station at Chester without a license, being under the impression that the low power he used did not interfere with stations in other states. He stopped operation when notified by the Federal Radio Commission.

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RADIO WORLD AND POPULAR MECHANICS MAGAZINE—Radio World is $6.00 a year, and Popular Mechanics Magazine is $2.50 a year. Popular Mechanics Magazine does not cut rates, but Radio World will send both publications to you for one year for $7.00. Radio World, 145 West 45th St., New York City.

"HOW TO WRITE FOR RADIO," by Seymour and Martin. $3.00. Radio World, 145 W. 45th St., N. Y. C.

"FORD MODEL—'A' Car and 'AA' Truck,' by Page. $2.50. Radio World, 145 W. 45th St., N. Y. C.

Dynamic Speaker Replacements

We can supply cone and voice coil replacement assemblies for dynamic speakers, as listed below, at stated prices. Besides, we can supply replacement cone and voice coil assemblies for non-listed speakers, prices furnished on request, if you will supply the following information: inside diameter of voice coil, extreme diameter of cone, including floating ring, depth of cone.

Make of Speaker	*Size*	*Price*	*Make of Speaker*	*Size*	*Price*
Peerless (1-turn)	7"	$1.60	Victor (RE 32, RE 45)		$1.35
Peerless (1-turn)	9"	1.95	R.C.A. (No. 106)		1.95
Peerless (1-turn)	11"	2.10	R.C.A. (No. 105)		1.95
Peerless (1-turn)	15"	2.85	R.C.A. (No. 104)		1.95
Peerless (1-turn)			Jensen (D7 concert)		2.25
Peerless (wire-wound)	7"	1.45	Colonial (No. 33)		2.25
Peerless (wire-wound)	9"	1.65	Symington	9"	1.90
Peerless (wire-wound)	15"	2.75	Symington	11"	2.25
Farrand (Induct. Dynam.)	7"	2.25	Zenith (No. 52)		2.25
Farrand (Induct. Dynam.)	11"	1.35	Eveready	9"	1.90
			Eveready	11"	2.25
			Newcomb-Hawley	7"	2.25
			Magnavox	7"	2.25
			Sterling	7"	2.25

DIRECT RADIO CO.
145 WEST 45th STREET
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LOOKING FOR FINE GOODS AT BARGAIN PRICES? HERE THEY ARE!

WE carry a complete line of Rola dynamic speakers, all sizes, all purposes, as well as the exclusive Farrand inductor speaker for push-pull pentode output that requires no output transformer.

The Rola speakers are very popular in midget sets, both of the broadcast and short-wave type, as well as for all-wave coverage, and are used also to great advantage in automobiles.

The Rola speakers for home receivers are obtainable with field coils that may be used also as the B supply choke coil, and which field coil has a tap, so that bias for a pentode may be obtained from the field coil itslf. This method introduces audio regeneration, which improves tone and sensitivity. The tapped coils have a total resistance of 1,800 ohms and the tap is at 300 ohms from the ground end. The grid return of the power stage is connected to the tap. This is the method used in all our a-c circuits.

Rola dynamic speaker, 1,800 ohm field coil, tapped at 300 ohms. Output transformer matched to single pentode is built in. Diameter of cone is 7 inches. Cat. RO-18 @ $4.50

Same as above, except that cone diameter is 10.5 inches. Cat. RO-18-10 @ $5.85

Same as above, except that cone diameter is 12 inches. Cat. RO-18-12 @ $7.25

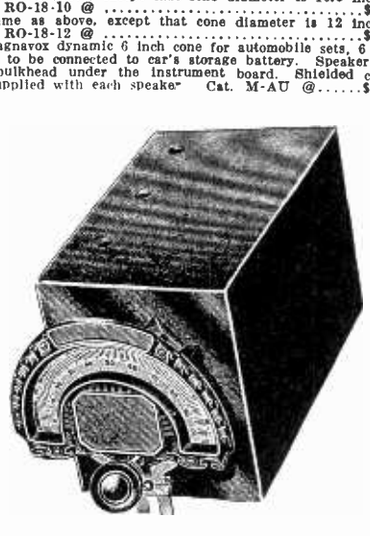
Magnavox dynamic 6 inch cone for automobile sets, 6 volt field to be connected to car's storage battery. Speaker fits on bulkhead under the instrument board. Shielded cable is supplied with each speaker Cat. M-AU @.....$4.95

TAPPED COILS FOR BAND SHIFTING

For 80-600 meters, for use with 0.00035 mfd. three gang, order Cat. M-35-C (three coils, three shields at this price) @ $2.45

For 0.00046 mfd. order Cat. M-46-C MSSC @.....$2.45

For 0.0005 mfd. order Cat. M-05-C @.....$2.45



MATCHED COMBINATION TUNING UNIT, to cover from 80 to 600 meters, using a coil system including a single tap on each secondary, and serving as the tuning adjunct in superheterodynes with an intermediate frequency of 175 kc. The tap need not be used if only the broadcast band is desired. The oscillator circuit is accurately padded for that intermediate frequency. The matched tuning unit includes a three gang, brass-plate, steel-frame condenser, with stator shields built in, the entirely shielded again, with extra partitions built inside to serve as rotor shields (illustrated). Low vibration factor to avoid grunting of some types of superheterodyne condenser construction. Three trimmers are built in. The three shielded coils, of the same general appearance as the one illustrated at upper position on this page, and dial are supplied. The oscillator coil is already padded. Order Cat. CMTU @....$6.85

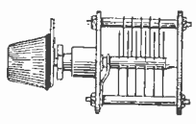
Set of three shielded coils, padded for 0.00035 mfd., for use with 175 kc. intermediate amplifier. Tap is included. Cat. SUC-35 @ $3.10

Same as above (set of coils) except for 0.00046 mfd. Cat. SUC-46 @.....$3.10

Same as above, except for 0.0005 mfd. Cat. SUC-5 @ $3.10

MIDGET CONDENSER

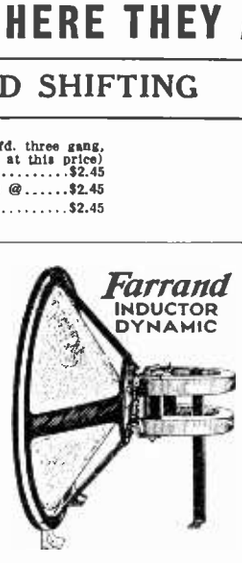
The rotor has no end stop and therefore precision calibration of oscillators and tuners is not upset by dial-jarring.



A MIDGET condenser for high frequency work, equipped with knob and pointer, and including a milled bushing that can be attached for taking ¼ inch dial hub. This condenser may be used either as a trimmer for a main condenser or alone for tuning in the high frequencies. Particularly valuable for amateur wave reception, short wave converters and short wave sets generally, where wide dial spread is highly desired, and five coils are used for coverage of 200 to 15 meters. The capacity is 0.000045 mfd. (45 mmfd.). Cat. CHMG-45 @.....$0.69

The same model condenser also is obtainable in 0.000055 mfd. (55 mmfd.) capacity. Order Cat. CHMG-55 @ ..... .59

Guaranty Radio Goods Co.
145 West 45th Street New York City



FARRAND inductor dynamic, for pentode push-pull requiring no output transformer. Simply conneet the two tipped leads to the plates of the pentodes and connect the untipped (yellow) lead to the maximum B plus voltage. By this method no plate current flows through the winding, only signal current so there is no danger of burnout or premature saturation, and the tone quality is superb.

This speaker has one of the best audio curves of any ever produced, but it is not quite so sensitive as other type dynamic speakers, and therefore should be used on high powered sets. It is suggested therefore that it be used on a-c sets having no fewer than six tubes or battery sets having fewer than seven tubes. It is strongly recommended, however, that the speaker be used on all high powered sets using push-pull pentode output. These pentode speakers are not generally obtainable. We're privileged to have a source of supply that enables us to fill the needs of those most discriminating as to tonal values. Order Cat. FAR-PENT @ $8.75

"DYKE'S AUTOMOBILE AND GASOLINE ENGINE ENCYCLOPEDIA," by A. L. Dyke. New 16th Edition, covering all the latest developments. A complete training in every part of automotive work, and for easy study is divided into a series of 85 simple instructions. 1,339 pages, 4,400 illustrations and diagrams. 6½ x 9¼. Cloth, $6.00, Flexible, $7.50.

Anderson's Auto Set

In an automobile set what you need and must have is **SENSITIVITY.** You read about high-powered home receivers having a sensitivity of 10 microvolts per meter. Here is an 8-tube auto set, chassis 7 x 11½ x 2¾ inches, that has jnst such sensitivity. It brings in DX through 50,000 watt locals 10 kc. removed. Did you ever hear of that before in an auto set? Volume is high, without distortion. Push-pull pentode output. This circuit was designed and engineered by J. E. Anderson and is by far the best auto set we've ever heard. Variable mu, pentode r-f tubes.

Complete kit of **parts, including** remote tuning control, running board aerial, speaker, battery box, everything but tubes which are: two 236, two 237, two 238 and two 239 (automotive 6-volt series). Order Cat. JE-631 @.....$35.00

Set of tubes for car receiver (Cat. 630-TUK), @.....$10.76

SHORT WAVE SWITCHES

SWITCHES of special precision, positive contact, non-shorting, are needed for short waves. These rotary selector switches are suitable for moving the stator connections of tuning condensers to taps or to separate coils. Single knob actuates multiple circuits. Knob can't slip on shaft and switch can't slip on panel.

Single circuit, 4 taps and index. Cat. 4-1-SW @ $1.05

Two circuits, 4 taps and index for each. Cat. 4-2-SW @ $1.87

Three circuits, 4 taps and index for each (fewer taps may be used). Cat. 4-3-SW @ $2.28

These switches may be used for any purpose where single, double or triple circuits are to be worked, up to four different positions, and are suitable for all wave switching because the shafts are totally insulated. These are anti-capacity switches of the precision type.

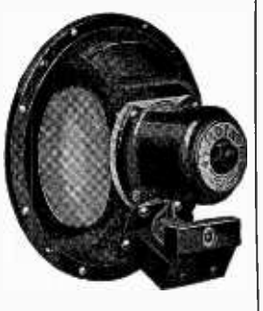
INTERMEDIATE FREQUENCY TRANSFORMERS

FOR short wave superheterodyne work 1,600 kc. is the popular intermediate frequency, because you can tune to below 9 meters without interlocking of modulator and oscillator circuits, due to the high intermediate frequency. Our 1,600 kc. shielded transformers have large diameter wire, loose coupling for selectivity and stability, and Hammarlund's new superheterodyne condensers built in, accessible to a screwdriver. Both plate and grid circuits are tuned. Shield is 2⅛ inch diameter, 2⅞ inches high. For variable mu tubes. Order Cat. FF-1600 @.....$1.65

Doubly tuned fixed-frequency transformer, 1 to 1 ratio, 175 kilocycles. Band pass filter characteristic. Hammarlund 20-100 mfd. equalizers across primary and secondary accessible. Aluminum shield (must be grounded) 2¼ inches diameter, 2½ inches high, removable bottom. For variable mu tubes. Order Cat. FF-175 @.....$1.50

Same as directly above, for 400 kc. Order Cat. FF-400 @.....$1.50

ROLA DYNAMIC SPEAKERS



Series F, Rola dynamic speakers for single pentode output, with 1,800 ohm field coil tapped at 300 ohms. Field coil may be used as B supply choke, with 300 ohm section for 247 bias, if field is put in negative rectifier leg. Output transformer built in. 7" cone. Cat. RO-18 @ $4.50

Same as above, except that cone diameter is 10.5 inches. Cat. RO-18-10 @ $5.85

Same as above, except that cone diameter is 12 inches. Cat. RO-18-12 @ $6.95

Magnavox dynamic 6-inch cone for automobile sets, 6 volt field to be connected to car's storage battery. Speaker fits on fireboard under the instrument board. Shielded cable is supplied with each speaker. Cat. MG-AU @.....$4.95

BROADCAST COILS WITH 80-METER TAP

The shielded 80-550 meter coils have a side lug (shown at left) and four identified lugs at bottom. The side lug is for grid return. The ground symbol lug is the 80-meter tap. P and B go to antenna and ground or plate and B plus. For oscillation B goes to plate and P to B plus.

TAPPED coils are proving very popular, as they make for economy of room and also afford good results. The Roland coils are obtainable for broadcast coverage, 200 to 550 meters, with tap for going down to 80 meters, so television, airplane talks, amateur and other interesting transmission may be heard. An insulated three-deck two-tap long switch is needed for front panel band shifting. See illustration at right. These coils are wound on 1⅛ inch diameter and are attached at the factory to aluminum screw bases, with four identified lugs protruding at bottom and a fifth lug at side. An aluminum cover (not illustrated) screws over the base.

The primary is wound over the secondary, with insulating fabric between, and the inductance is kept exactly equal for all coils by keeping the axial length of the winding identical, as well as the number of turns. Therefore at top (what looks like a separate winding), a space is "spun," as well as at bottom, to insure such identical inductance.

For 80-550 meters, for use with 0.00035 mfd. three gang, order Cat. M-35-C (three coils, three shields at this price) @ $2.45

For 0.0005 mfd. order Cat. M-05-C @ $2.45

175 kc tuning unit: 3-gang condenser, trimmers, r-f and modulator coil, and special oscillator coil with 700-1000 mmfd. padding condenser and 0.6 mmfd. grid-to-grid coupling condenser. Padding directions supplied, (Cat. 175-TU) @ $6.03

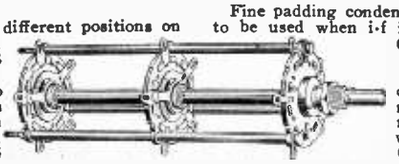
LONG SWITCHES

Three decks, four different positions on each deck. Cat. LSW-4-3 @ $2.95

Three decks, two different positions on each deck (used in 627 circuit). Cat. LSW-2-3 @ $2.65

SUPER CONDENSERS

Fine padding condenser, 700-1,000 mmfd. to be used when i-f is 175 kc. Cat. PC-710 @..$ .50



Coupling condenser, oscillator grid to modulator grid, 0.6 mmfd., no pickup winding needed. Cat. C-6T @ .....$ .18

Battery Set 15 to 200 Meters

A SHORT-WAVE receiver, using two 230 (2-volt) tubes, requiring 3 volts filament battery source and 90 volts of B battery. The circuit is detector and one transformer coupled audio stage. This "detector and one step" has been standard for ten years. With this circuit reception the world over has been enjoyed and the elated users number into the teeming thousands. Ranges 15 to 200 meters, using five plug-in coils. Old-timers know this circuit well. Persons who have had no experience with short-waves will find this a most appropriate circuit for a thrilling beginning. The circuit can be wired in 1½ hours.

PARTS REQUIRED: 4 plug-in coils, $1.50; Hammarlund 0.00014 mfd. tuning cond., $1.20; Hammarlund 0.0002 tuning cond., $1.35; three UX sockets, 30c; audio trans., 70c; 50,000 ohm leak, 10c; 300 turn honeycomb, 30c; 0.00025 mfd., clips, 15c; 6.5 ohm limiting resistor for filament circuit, 15c; 20-ohm rheostat, 40c; 20-100 mmfd. equalizer, 20c; battery switch, 20c; 6 bind. posts, 30c; bind. post strip, 10c; vernier dial, 50c; two knobs, 10c; 7 x 10 bakelite panel, $1.25; 7 x 18 baseboard, 25c.

Designed by Jack Tully.

Complete parts, with blueprint, less tubes, (Cat. SW-DAF), @ $9.10

Two 230 tubes @ total of.....$1.92

NATIONAL DRUM DIAL

National Velvet Vernier drum dial, type H, for ¼" shaft. An automatic spring take-up assures positive drive at all times. Numbers are projected on a ground glass. Rainbow wheel changes colors in tuning. Order Cat. ND-H @ $3.13.

Precision Parts

800 TURN HONEYCOMB coil, total diameter 1¼ inches; will tune to 175 kc. with 0.0001 mfd. (or 20-100 mmfd equalizer). Cat. HC-800 @.....$ .50

300 TURN HONEYCOMB coil, same style, tunes to 400 kc. with 0.0001 mfd. Also may be used without condenser as antenna input coil, screen and plate choking, or two used inductively coupled for evening the amplification of t-r-f sets, in untuned stage feeding detector. Cat. HC-300 (each) @.....$ .30

50 TURN HONEYCOMB coil, ¼ millihenry, for all short wave purposes. Cat. HC-50 @.....$ .25

1 WATT PIGTAIL RESISTORS, all resistance values. Mention Cat. PGTR and state resistance in ohms thereafter. Price .....$ .15

5 WATT 2,250 OHM resistor to drop maximum B to B plus 180 volts for plates of r-f tubes in any t-r-f set. Cat. 5-W-2 @.....$ .45

POTENTIOMETERS: 400 ohms at 27c; 5,000 ohms @ 95c; 25,000 ohms @ $1.25; 50,000 ohms @ $1.25: 100,000 ohms @ $1.25; 500,000 ohms @ $1.25.

POTENTIOMETER with a-c switch attached. 10,000 ohms, for variable mu grid bias as volume control. Cat. POT-5-SW @ $1.55

WALNUT FINISH, EITHER DORSET OR STANTON CABINET for midget sets, cut for 7-inch cone. Cat. MDCB @ $4.90

TWO GANG 0.00035 MFD. straight frequency line condenser, brass plates; long ¼ inch shaft; nickeled frame. Shielded. Cat. DJA-35 @.....$1.85

KELFORD 30 henry choke; stands up to 100 ma; in black shield case. Cat. KEL-30 @.....$1.75

KELFORD 15 henry B supply choke; 60 ma; unshielded. Cat. KEL-15 @.....$ .95

2.5 VOLT center tapped fil. trans., 8 amperes (will stand up to five heater tubes, when voltage is 2.25 v). Cat. FLT @ $1.62

HAMMARLUND 0.0002 mfd. variable condenser, junior midline; rotation is within 2-inch diameter; for short waves. Cat. H-20 @.....$1.35

HAMMARLUND 60 mmfd. manual trimming condenser. Cat. H-60 @.....$ .79

HAMMARLUND 20-100 MMFD. EQUALIZERS: adjusting screw works in a threaded brass stud, so excess force cannot damage the unit. Cat. 3-EQ-100 (price is for three) .....$ .60

CHASSIS for midget, fits in Roland cabinet; chassis is 13½ inches wide, 7½ inches front to back; flaps front and back 3 inches high; drilled for sockets and speaker plug and for volume control and switch at front. Cat. 5-TCH @ $1.75

CHASSIS for 6 tube midget. Cat. 6-TCH @.....$1.75

TWO GANG 0.00035 MFD. straight frequency line condenser, brass plates; long ¼ inch shaft; nickeled frame. Cat. DJA-35 @.....$1.85

THREE 0.1 MFD. condensers in one shield case; black lead is common; three red leads go interchangeably to destination; mounting screw built in. Cat. 31 @....$ .57

MIDGET POWER TRANSFORMER, for five-tube set, to handle three heater tubes, one 247 and one 280. Cat. MPT-5 @ $3.15

MIDGET POWER TRANSFORMER for six-tube set, to handle four heater tubes, one 247 and one 280. Cat. MPT-6 @ $3.55

8 MFD. WET ELECTROLYTIC condenser, for inverted mounting; washer and extra lug provides insulation from chassis for circuits with B choke in negative leg. Cat. LCT-8 @ .....$ .62

TELEVISION KIT, 80-100 meters, using two stages 235-r-f, 224 power detector, 224 first a-f, 247 output, 280 rectifier. R-f coils have right-angle honeycomb chokes with 4-turn pickup windings. Designed by Edwin Stannard. Dorset cabinet and Rola speaker included. 110 v., 50-60 c. Order Cat. TK @ $18.95

GUARANTY RADIO GOODS CO., 145 West 45th St., NEW YORK, N. Y.