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TENTH YEAR

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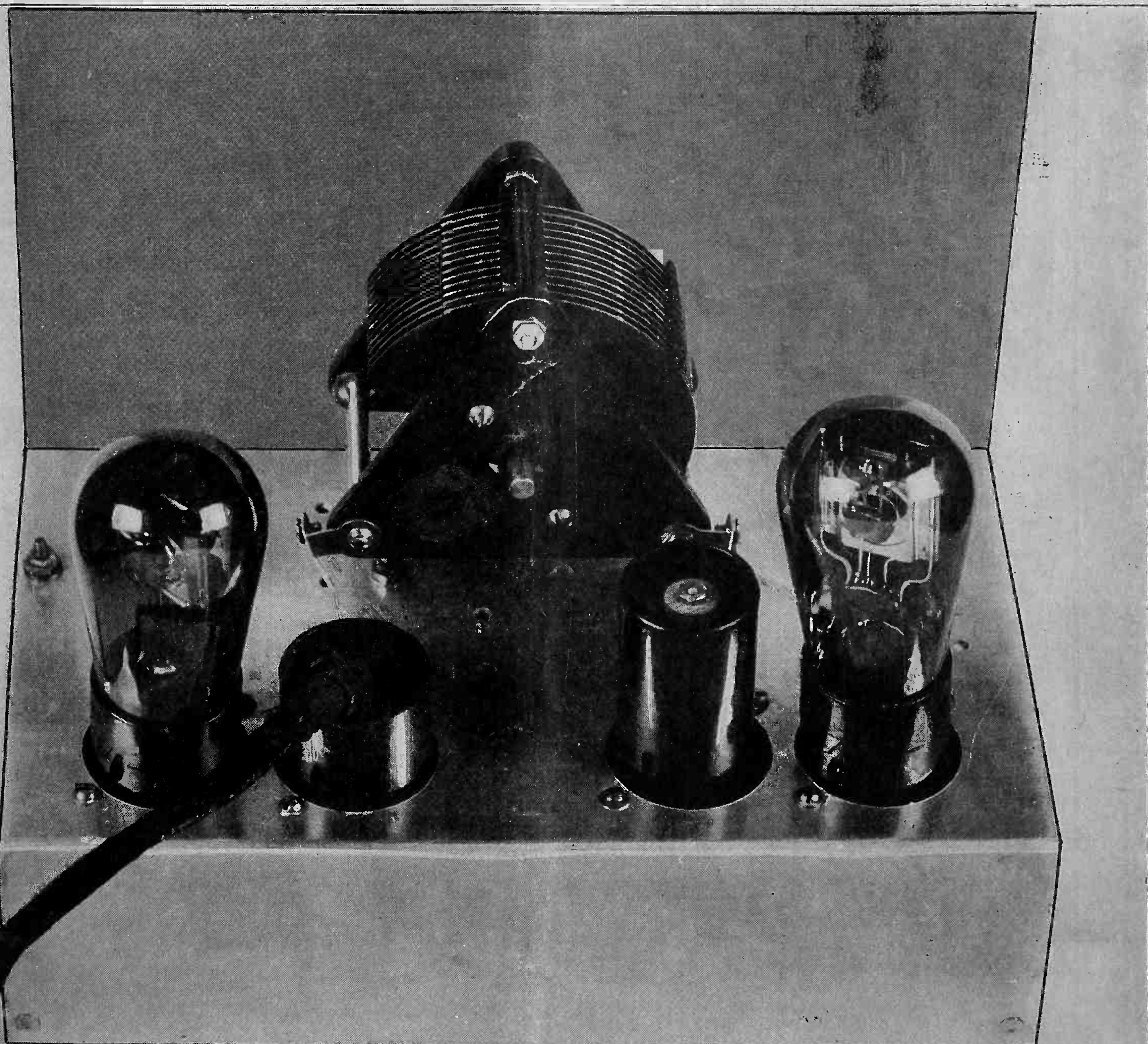

A Modulated-Unmodulated Oscillator, Broadcast and Intermediate Amplifier Frequencies. See page 6.

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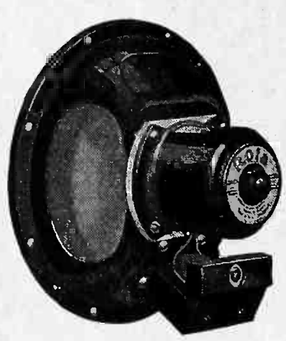

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A Continuity Tester

A Voltmeter Also Enables Resistance Measurement

By Herbert E. Hayden

A CONTINUITY tester is a convenient device to have around. There are many types, but in all cases there is a source of voltage and an indicating device. An ohmmeter is in effect a continuity tester. Sometimes a neon glow tube of small dimensions is used as the indicator, but in most instances a d-c voltmeter is used. A neon tube will indicate continuity all right if there is continuity and a sufficient voltage in the circuit to start the glow, but it will not indicate about what the resistance in the circuit is. It may, for example, give the same indication on short circuit as on one million ohms. A voltmeter gives an approximate indication of the value of the resistance in the continuity.

Suppose we have a 0—7.5 volt d-c voltmeter. If we connect one terminal of this meter to the proper terminal of a battery of suitable voltage, we have a good continuity tester. A meter of a different range would make just as good a tester, provided that we selected the proper voltage.

In Fig. 1 we have the circuit of such a tester composed of a dual range voltmeter and a battery. The voltmeter has three bindings posts, one common negative, which is connected to the negative terminal of the battery, one low potential positive, and one high potential positive terminal. In use, one of the positive terminals of the meter and the positive terminal of the battery are used for exploring the set or for testing for continuity.

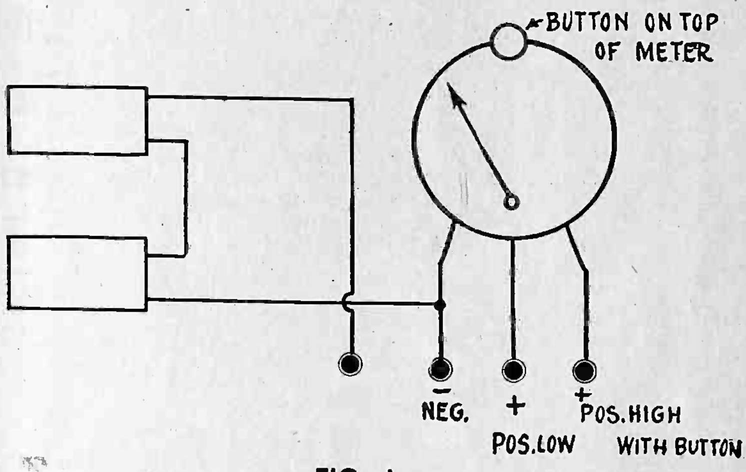

FIG. 1

The circuit of a simple continuity tester consisting of a battery and a double range voltmeter.

Double Range Meter

It is assumed that the battery voltage is so high that it gives full reading on short circuit when the high range of the voltmeter is used. There is a button on the voltmeter which must be pressed to make the meter read when the high range is used. This is a safeguard against blunders. Now it may be that the circuit indicates continuity but that the reading is so small that it is a mere flicker. In that case the low range may be used even if the applied voltage is so high as to cause full deflection on the higher range on short circuit. Using the lower range gives a larger deflection and gives a better indication of what the approximate resistance in the circuit is.

When tests of mere continuity of short circuits are to be made it makes no difference which scale of the meter is used provided that the voltage of the battery is such that it will not cause the deflection to be off the scale when a short is encountered. It is safe practice to use a low voltage and a high range meter when shorts are expected and to increase the voltage and lower the range only when conditions call for such change.

Measuring Resistance

An arrangement like this can be used for measuring resistances provided that the internal resistance of the meter is known. The method is based on the fact that when a resistance is connected in series with the battery and the voltmeter the deflection, or indicated voltage, is lowered by an amount which depends on the relative values of the external and internal resistances. If the internal resistance is not known the same method can also be used in determining it provided that one resistance of known value is available.

When the battery is connected directly across the voltmeter terminals the indicated voltage is the voltage of the battery, assuming that it is not old and nearly exhausted. When an external resistance is connected in series in addition the indicated voltage is lower. The voltage of the battery has not changed. Hence we know the drop in the external resistance, for it is the difference between the two voltage readings. For example, suppose we have a battery of 22.5 volts and connect this across the voltmeter. This reads a voltage of 22.5 volts. To make it general let us call this reading E. Now let us connect a resistance in series. We get another reading on the meter. Let us call it V. Then the drop in the external resistance is E—V. This is equal to the current through the meter multiplied by the resistance external to the meter. The current to use, of course, is that which causes a deflection of V on the meter.

Suppose we know the value of the external resistance. Then the current in question is (E—V)/R, where R is the known external resistance. Let us assume that the reading on the meter with 1,000 ohms externally is 17.5 volts. Then E—V is 5 volts. Hence the current through the meter when the reading is V is 0.005 ampere. The resistance in the meter can now be found because we know that the drop in it is 17.5 volts when the current is 0.005 ampere. Therefore the resistance is 3,500 ohms. We don't know yet what the resistance per volt is but in this case we don't need it. However, if the full scale reading is 30 volts, the ohms per volt is 116.5 ohms. These figures were just assumed and for that reason we got such an odd value.

Finding a Resistance Value

Now that we have found the total resistance in the meter we can find the value of any external resistance. Let the resistance of the voltmeter be r and let the value of the external resistance to be found be R. Let the battery voltage be E and let the reading on the meter with R in series be V. The current through the meter is directly proportional to the deflection, that is, to the indicated voltage. Let the current be I. Then by

(Continued on next page)

Views of Testing Outfits

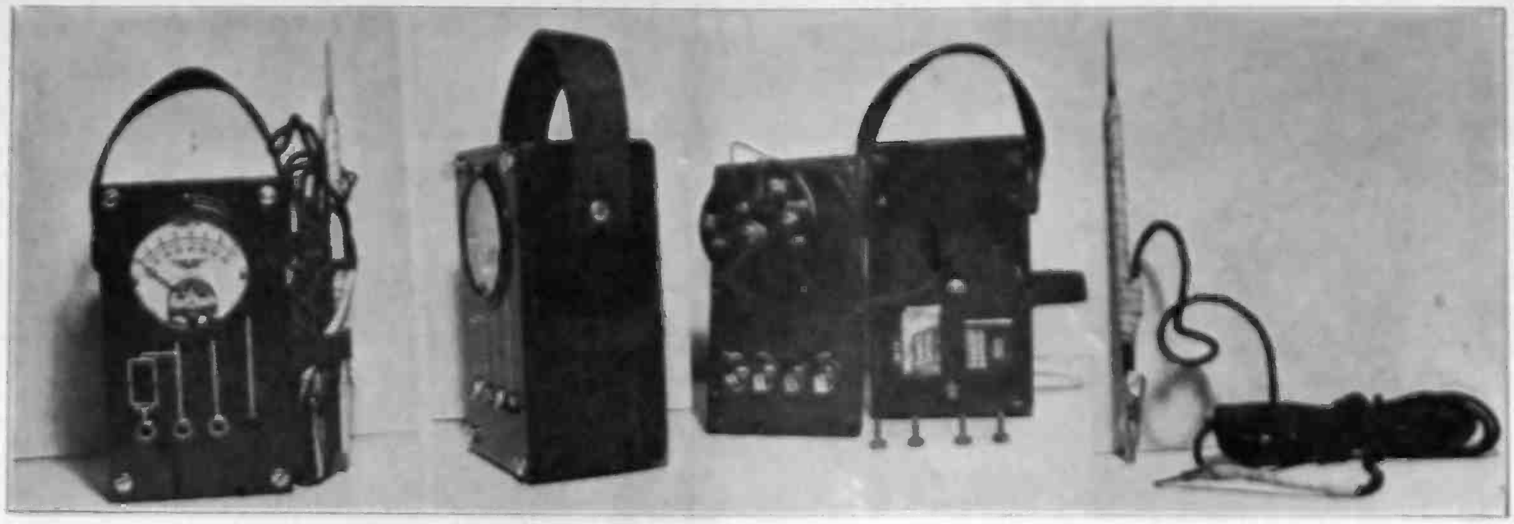

FIG. 2

Several views of the continuity tester and ohmmeter showing the construction and the layout of parts. A carrying handle and a set of special test leads make the device convenient.

(Continued from preceding page)

Ohm's law we have $E=(R+r)I$, or $E=RI+rI$. Divide both sides of this equation by rI and we get $E/rI=(R/r)+1$. But rI is the voltage reading on the meter with R in series externally, that is, $rI=V$. Hence $E/V=1+R/r$. If we solve this for R we get $R=r(E-V)/V$. This is a simple expression for determining the value of any resistance in terms of two readings on a voltmeter the total internal resistance of which is known.

Let us apply this to a case. Suppose we have a voltmeter known to have an internal resistance of 100,000 ohms, the value of r in this case. When we connect this meter in series with a battery of 45 volts and an unknown resistance we get a reading of 6 volts. What is the value of the unknown resistance? E is 45, V is 6, and r is 100,000. Putting these values in the formula we just developed gives us $R=100{,}000\ (45-6)/6$, or 650,000 ohms. Again, suppose we have a meter the resistance of which is 10,000 ohms. When we connect this in series with an unknown resistance and a 45 volt battery we get 40 volts. What is the value of the unknown?

Resistance Examples

In this case r is 10,000 ohms, E is 45 volts, and V is 40 volts. Hence $R=10{,}000(45-40)/40$, or 1,250 ohms. The method is quite flexible if we have different voltage available and if, also, we have a dual range meter. It should be remembered that the total resistance of a meter is different for different ranges although the resistance per volt is the same. Thus if the ohms per volt is 1,000 and there are two ranges of the meter, one 0-10 and the other 0-100, the resistance of the meter when the first ranges is used is 10,000 ohms and when the second range is used the resistance is 100,000 ohms. The proper value should be used in computing the value of an external resistance. While this reference was made to a meter of high sensitivity, it is not necessary to use this as good results may be obtained with less expensive meters. For simple continuity almost any meter will do.

In Fig. 2 are shown several views of the continuity tester. At left is a front view showing the meter and the terminal jacks. The rectangular symbol from the extreme left terminal to the meter represents the battery built into the instrument. Since one side of this connects with the second terminal, it is clear that the voltmeter can be used as such without having the battery in the circuit. The other two terminals represent the two ranges of the instrument.

Use of Test Leads

At right center are shown two views of the interior of the tester, one displaying the meter and the terminal jacks and the other the battery. At the extreme right of Fig. 1 are shown the connecting leads. Three of the four terminals of the two leads are provided with phone tips which fit into the jacks. The remaining terminal is provided with a sharp point as well as with alligator jaw clips, these two representing continuity.

The box containing the instrument is provided with a convenient handle for carrying. On the side there is also a loop for holding the terminal leads.

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Short Wave Shielding

How to Effect Stability Without Sacrifice

By Fred Worth

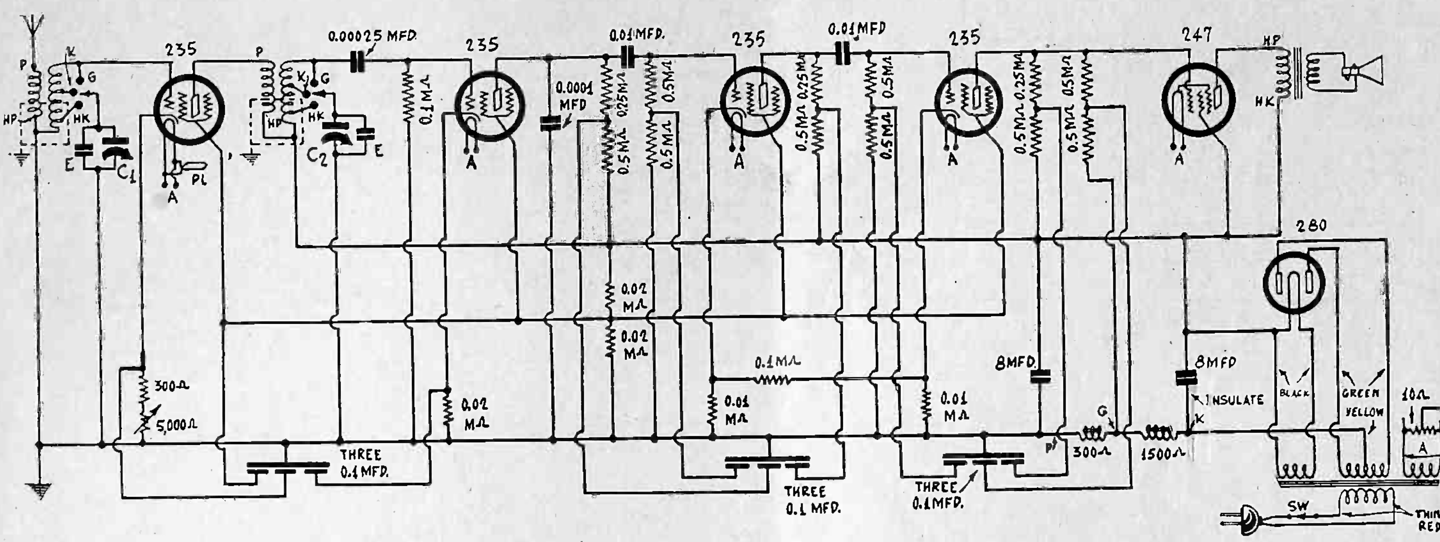

FIG. 1

A simplified short wave set, which can be adapted to use of plug-in coils for wave band shifting, or for use of tapped coils so front panel switch will change the wave bands. Short leads result even with switching, and the coils may be fairly close together. The speaker plug and power transformer connections are identified.

FOR short wave work complete shielding may incur too severe losses, where there are one stage of tuned radio frequency and a detector. In that case the shielding is sufficient if only the lower part of the coil is "covered." The problem has been worked out experimentally in a given instance, aluminum tube shields being cut down until just the right height remained.

The problem usually arises when the coils are relatively close together, as they may have to be for certain chassis layouts, or for switching. But when the circuit is stabilized the results are as good as by any other way.

It is easy to kill the sensitivity, or not to reduce it enough and leave objectionable and almost uncontrollable oscillation. Therefore the shield was cut down ¼ inch in height at a time until the correct height obtained. The solution herewith presented is one applying to the dimensions given, including the number of turns on the primary in the plate circuit of the r-f tube. The larger this number of turns, the more shielding is necessary, whereas the antenna primary works in the opposite direction. However, the limiting factor in the antenna circuit is selectivity. One desires that the selectivity shall be serviceable, hence an extremely large primary very closely coupled to the secondary would not do.

Leave Some Feedback

Some little feedback may remain, and it is desirable. Every one who has experimented with squealing circuits knows that the trouble is you can not find just the right point and hold it, the control being unmanageably critical. But if the feedback is reduced suitably, then the control is easy to work. Hence the volume control in the circuit, Fig. 1, a rheostat in the cathode leg of the r-f tube, controls the feedback in that tube. The height of the shield determines the degree of stability. A 1¼ inch height, open top, proved satisfactory.

In the audio channel there is another question of stability. There are three stages of resistance coupling, using screen grid tubes throughout, for of course the 247 pentode is a screen grid tube, too. It was found that the 235 as audio amplifier afforded far better stability than the 224, and as each plate and grid circuit is filtered to check positive feedback, therefore the circuit is tamed for 224 tubes as well. It is not practical to omit these filters. They consist of the resistors in the lower section of the grid and plate circuits, with a condenser from the juncture to ground.

The audio circuit is stable at high as well as low audio frequencies, and no bypass condenser is necessary across the 0.01 meg. (10,000 ohm) biasing resistors of the first and second audio tubes.

Option of Coil Use

Plug-in coils are used, although not necessary to change the wave band. If it is desired to use different coils for different bands they may be wound on a total of six UY plug bases, affording three sets of coils, 15 to 200 meters. In that case the

(*Continued on next page*)

LIST OF PARTS

Coils

For wave band changing by plugging in, three sets of coils, two coils to a set, total six coils, as described in text.
For switching, one set of coils, (total, two coils), tapped, as described in text.
[*Note: B supply choke coil is field coil of dynamic speaker, which speaker also has output transformer built in. Speaker specified later.*]
One power transformer to work four heater tubes, one pentode 247 and 280 rectifier.

Condensers

One 0.00025 mfd. fixed condenser.
One two gang 0.00035 mfd. condenser, with equalizers.
One 20-100 mmfd. equalizer, used at full capacity as detector plate bypass condenser.
Three 0.01 mfd. mica fixed condensers.
Two 8 mfd. electrolytic condensers, one with two insulating washers and connecting lug.
Three shielded blocks, three 0.1 mfd. condensers in each block. (Black, common, grounded; reds interchangeable).

Resistors

One 10 ohm center tapped resistor.
One 150 ohm pigtail resistor.
One 5,000 ohm potentiometer with a-c switch attached.
Two 0.1 meg. pigtail resistors (100,000 ohms).
Three 0.25 meg. pigtail resistors (250,000 ohms).
Six 0.5 meg. pigtail resistors (500,000 ohms).
Three 0.02 meg. pigtail resistors (20,000 ohms).
Two 0.01 meg. pigtail resistors (10,000 ohms).

Miscellaneous Other Parts and Accessories

One dynamic speaker, with 1,800 ohm field coil, tapped at 300 ohms, and pentode output transformer built in.
One vernier dial, ghost type, with escutchen, scale, pilot lamp.
One three point, double throw rotary selector switch, shaft insulated from everything (for use with tapped coils for switching wave bands); keyed knob.
One chassis, 13.5 x 7.75 x 3 inches, with seven socket holes; extra socket is for speaker plug.
Three 235 sockets, one 224 socket, one 247 socket, one 280 socket and one speaker socket.
One midget cabinet to fit (not suitable if plug-in coils are used for wave shifting).
One knob to match keyed knob of wave band switch.
One dial knob.
Six tube shields and bases, two shields to be cut down for use as coil shields as directed.
Four grid clips.
One roll of hookup wire.
Two dozen 6/32 machine screws and nuts.
[*Note: If plug-in coils are used, the potentiometer has no switch, a separate shaft type a-c switch is used, and two separate matched knobs are needed.*]

Views of Testing Outfits

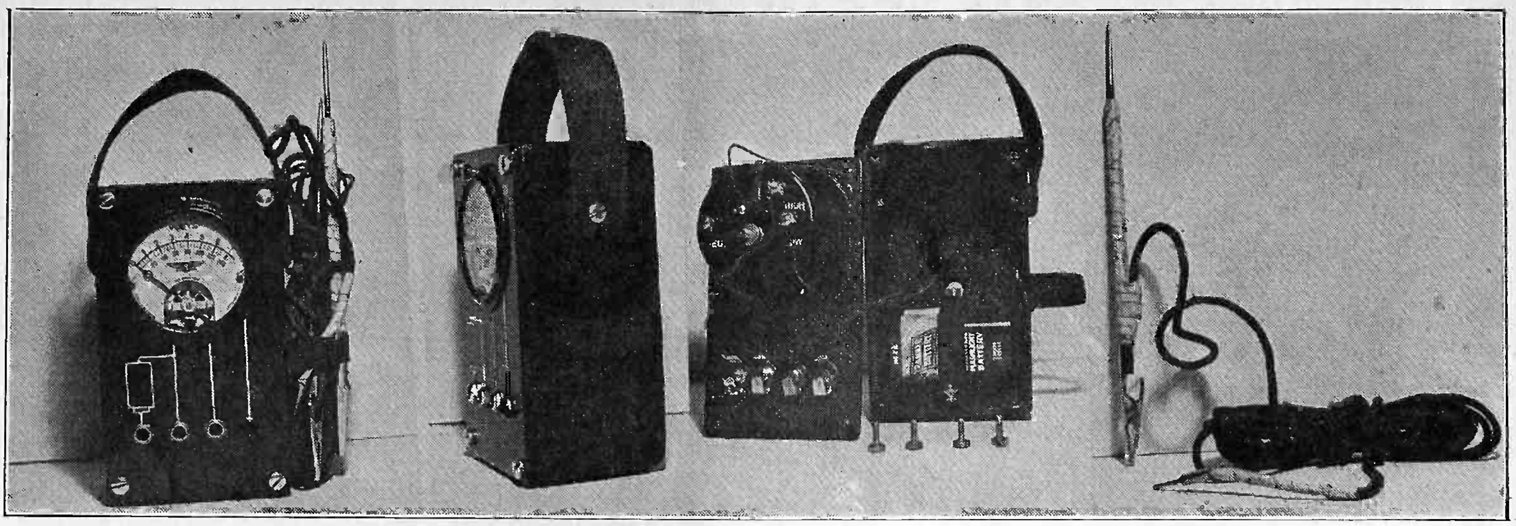

FIG. 2
Several views of the continuity tester and ohmmeter showing the construction and the layout of parts. A carrying handle and a set of special test leads make the device convenient.

(*Continued from preceding page*)
Ohm's law we have $E=(R+r)I$, or $E=RI+rI$. Divide both sides of this equation by rI and we get $E/rI=(R/r)+1$. But rI is the voltage reading on the meter with R in series externally, that is, $rI=V$. Hence $E/V=1+R/r$. If we solve this for R we get $R=r(E-V)/V$. This is a simple expression for determining the value of any resistance in terms of two readings on a voltmeter the total internal resistance of which is known.

Let us apply this to a case. Suppose we have a voltmeter known to have an internal resistance of 100,000 ohms, the value of r in this case. When we connect this meter in series with a battery of 45 volts and an unknown resistance we get a reading of 6 volts. What is the value of the unknown resistance? E is 45, V is 6, and r is 100,000. Putting these values in the formula we just developed gives us $R=100{,}000\ (45-6)/6$, or 650,000 ohms. Again, suppose we have a meter the resistance of which is 10,000 ohms. When we connect this in series with an unknown resistance and a 45 volt battery we get 40 volts. What is the value of the unknown?

Resistance Examples

In this case r is 10,000 ohms, E is 45 volts, and V is 40 volts. Hence $R=10{,}000(45-40)/40$, or 1,250 ohms. The method is quite flexible if we have different voltage available and if, also, we have a dual range meter. It should be remembered that the total resistance of a meter is different for different ranges although the resistance per volt is the same. Thus if the ohms per volt is 1,000 and there are two ranges of the meter, one 0-10 and the other 0-100, the resistance of the meter when the first ranges is used is 10,000 ohms and when the second range is used the resistance is 100,000 ohms. The proper value should be used in computing the value of an external resistance. While this reference was made to a meter of high sensitivity, it is not necessary to use this as good results may be obtained with less expensive meters. For simple continuity almost any meter will do.

In Fig. 2 are shown several views of the continuity tester. At left is a front view showing the meter and the terminal jacks. The rectangular symbol from the extreme left terminal to the meter represents the battery built into the instrument. Since one side of this connects with the second terminal, it is clear that the voltmeter can be used as such without having the battery in the circuit. The other two terminals represent the two ranges of the instrument.

Use of Test Leads

At right center are shown two views of the interior of the tester, one displaying the meter and the terminal jacks and the other the battery. At the extreme right of Fig. 1 are shown the connecting leads. Three of the four terminals of the two leads are provided with phone tips which fit into the jacks. The remaining terminal is provided with a sharp point as well as with alligator jaw clips, these two representing continuity.

The box containing the instrument is provided with a convenient handle for carrying. On the side there is also a loop for holding the terminal leads.

Short Wave Club

THE following is a list of some of the new members of the Short Wave Club. Virtually every week new names are published. There are no repetitions.

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Short Wave Shielding

How to Effect Stability Without Sacrifice

By Fred Worth

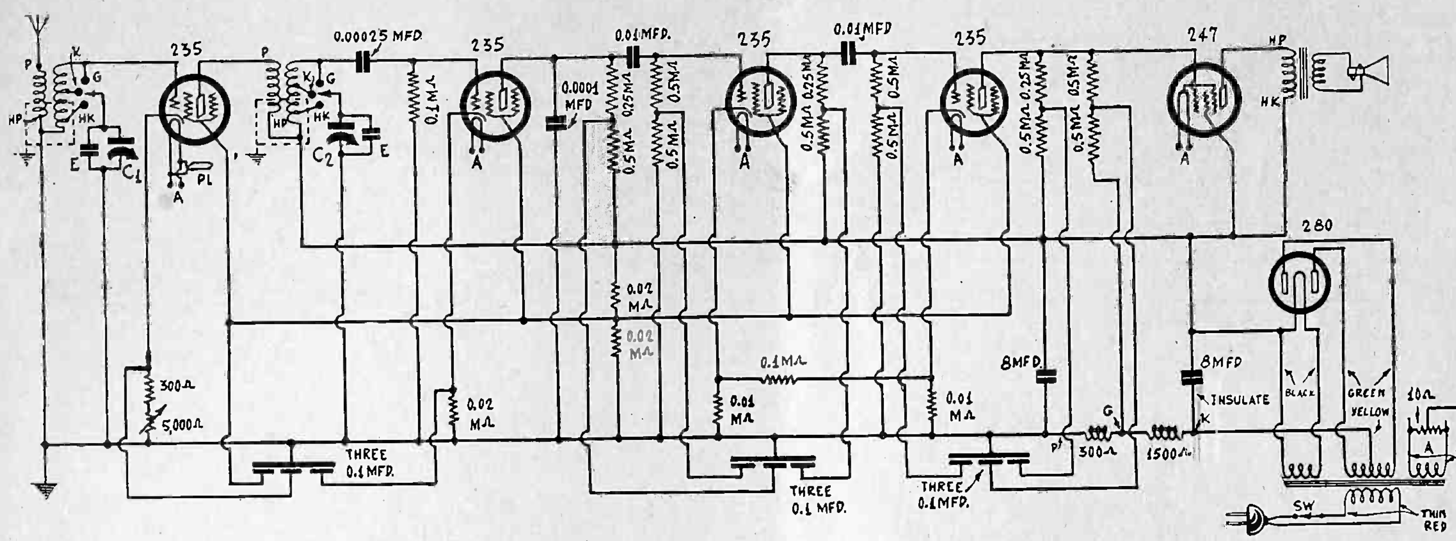

FIG. 1

A simplified short wave set, which can be adapted to use of plug-in coils for wave band shifting, or for use of tapped coils so front panel switch will change the wave bands. Short leads result even with switching, and the coils may be fairly close together. The speaker plug and power transformer connections are identified.

FOR short wave work complete shielding may incur too severe losses, where there are one stage of tuned radio frequency and a detector. In that case the shielding is sufficient if only the lower part of the coil is "covered." The problem has been worked out experimentally in a given instance, aluminum tube shields being cut down until just the right height remained.

The problem usually arises when the coils are relatively close together, as they may have to be for certain chassis layouts, or for switching. But when the circuit is stabilized the results are as good as by any other way.

It is easy to kill the sensitivity, or not to reduce it enough and leave objectionable and almost uncontrollable oscillation. Therefore the shield was cut down ¼ inch in height at a time until the correct height obtained. The solution herewith presented is one applying to the dimensions given, including the number of turns on the primary in the plate circuit of the r-f tube. The larger this number of turns, the more shielding is necessary, whereas the antenna primary works in the opposite direction. However, the limiting factor in the antenna circuit is selectivity. One desires that the selectivity shall be serviceable, hence an extremely large primary very closely coupled to the secondary would not do.

Leave Some Feedback

Some little feedback may remain, and it is desirable. Every one who has experimented with squealing circuits knows that the trouble is you can not find just the right point and hold it, the control being unmanageably critical. But if the feedback is reduced suitably, then the control is easy to work. Hence the volume control in the circuit, Fig. 1, a rheostat in the cathode leg of the r-f tube, controls the feedback in that tube. The height of the shield determines the degree of stability. A 1¼ inch height, open top, proved satisfactory.

In the audio channel there is another question of stability. There are three stages of resistance coupling, using screen grid tubes throughout, for of course the 247 pentode is a screen grid tube, too. It was found that the 235 as audio amplifier afforded far better stability than the 224, and as each plate and grid circuit is filtered to check positive feedback, therefore the circuit is tamed for 224 tubes as well. It is not practical to omit these filters. They consist of the resistors in the lower section of the grid and plate circuits, with a condenser from the juncture to ground.

The audio circuit is stable at high as well as low audio frequencies, and no bypass condenser is necessary across the 0.01 meg. (10,000 ohm) biasing resistors of the first and second audio tubes.

Option of Coil Use

Plug-in coils are used, although not necessary to change the wave band. If it is desired to use different coils for different bands they may be wound on a total of six UY plug bases, affording three sets of coils, 15 to 200 meters. In that case the

(*Continued on next page*)

LIST OF PARTS

Coils

For wave band changing by plugging in, three sets of coils, two coils to a set, total six coils, as described in text.

For switching, one set of coils, (total, two coils), tapped, as described in text.

[Note: B supply choke coil is field coil of dynamic speaker, which speaker also has output transformer built in. Speaker specified later.]

One power transformer to work four heater tubes, one pentode 247 and 280 rectifier.

Condensers

One 0.00025 mfd. fixed condenser.

One two gang 0.00035 mfd. condenser, with equalizers.

One 20-100 mmfd. equalizer, used at full capacity as detector plate bypass condenser.

Three 0.01 mfd. mica fixed condensers.

Two 8 mfd. electrolytic condensers, one with two insulating washers and connecting lug.

Three shielded blocks, three 0.1 mfd. condensers in each block. (Black, common, grounded; reds interchangeable).

Resistors

One 10 ohm center tapped resistor.

One 150 ohm pigtail resistor.

One 5,000 ohm potentiometer with a-c switch attached.

Two 0.1 meg. pigtail resistors (100,000 ohms).

Three 0.25 meg. pigtail resistors (250,000 ohms).

Six 0.5 meg. pigtail resistors (500,000 ohms).

Three 0.02 meg. pigtail resistors (20,000 ohms).

Two 0.01 meg. pigtail resistors (10,000 ohms).

Miscellaneous Other Parts and Accessories

One dynamic speaker, with 1,800 ohm field coil, tapped at 300 ohms, and pentode output transformer built in.

One vernier dial, ghost type, with escutchen, scale, pilot lamp.

One three point, double throw rotary selector switch, shaft insulated from everything (for use with tapped coils for switching wave bands); keyed knob.

One chassis, 13.5 x 7.75 x 3 inches, with seven socket holes; extra socket is for speaker plug.

Three 235 sockets, one 224 socket, one 247 socket, one 280 socket and one speaker socket.

One midget cabinet to fit (not suitable if plug-in coils are used for wave shifting).

One knob to match keyed knob of wave band switch.

One dial knob.

Six tube shields and bases, two shields to be cut down for use as coil shields as directed.

Four grid clips.

One roll of hookup wire.

Two dozen 6/32 machine screws and nuts.

[Note: If plug-in coils are used, the potentiometer has no switch, a separate shaft type a-c switch is used, and two separate matched knobs are needed.]

A Two-Tube Modi

Useful in Testing and Ser

By Burto

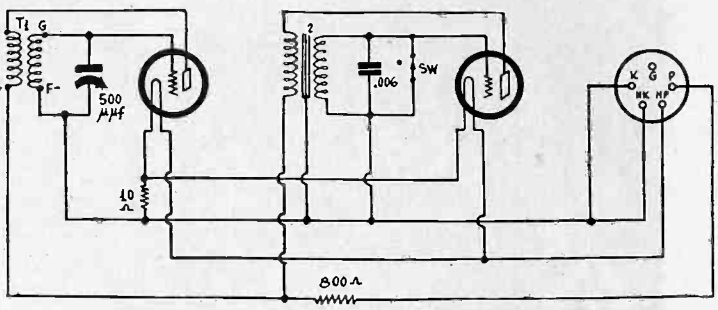

FIG. 1

The circuit diagram of a modulated radio frequency oscillator for use in testing radio receivers and superheterodynes in particular.

WHEN adjusting superheterodyne receivers during production and servicing it is necessary to have a modulated oscillator covering both the broadcast band of frequencies and the intermediate frequency. It is first needed for adjusting the intermediate frequency amplifier for greatest response at 175 kc, or at whatever intermediate frequency is used. For this purpose the output of the oscillator should be modulated with a tone that may be heard easily through many, and perhaps loud, competing noises. After the intermediate frequency amplifier has been tuned to the desired frequency, an oscillator is needed for adjusting the broadcast tuner and the oscillator. For this purpose it is sometimes convenient to have the output of the oscillator modulated and sometimes to have it unmodulated. Therefore the test oscillator should be provided with a switch by means of which the modulation frequency may be cut out, and this should be done so that there is no change in the calibration of the oscillator when the switch is thrown.

Two-Tube Test Oscillator

The modulated oscillator shown diagrammatically in Fig. 1 was built to cover the broadcast band as well as the intermediate band from about 90 kc to 350 kc. Since it was desirable to cover the different frequency bands without switches, plug-in coils were provided. One coil was adjusted to cover the broadcast band. It was wound with 71 turns of No. 32 enameled wire on a 1.25 inch diameter of the tube base type. The tickler for this coil was wound with 50 turns of the same wire. The calibration curve for this coil and a 500 mmfd. General Radio type 247 condenser is given in Fig. 2. As will be noted, the frequency is adjustable between 525 and 1,500 kc. Of course, another 500 mmfd. tuning condenser can be used if desired but the calibration curve will not be the same, for it depends on the cut of the plates. However, the frequency coverage will be about the same for any 500 mmfd. condenser, provided the same coil is used.

Calibrating the Oscillator

The calibration of the oscillator in the broadcast band is very simple. A receiver of good sensitivity is required. Tune in a station of known frequency. Turn the oscillator condenser until a squeal is heard in the loudspeaker. Adjust for zero beat. The reading on the oscillator dial then fixes the position of the known frequency. For example, in the sample calibration curve the dial reading for 600 kc is 21. This was obtained by tuning in a signal known to have a frequency of 600 kc and turning the oscillator condenser for zero beat. Other points were located similarly throughout the band.

This method may fail at the extremes of the curve for lack of stations of known frequency, or any stations at all. In that case the range may be extended by means of harmonics. Suppose we cannot find a station of 1,500 kc but we can find a station of 750 kc. If we first tune in the 750 kc station and turn the oscillator for zero beat we locate the 750 position. If now, without touching the tuning of the receiver, we turn the oscillator dial to where 1,500 kc should come in, we again hear a squeal, though not so loud, and the zero beat position locates the 1,500 kc accurately. Care should be taken not to get the wrong squeal, for there will be many points where a squeal will be heard. As a rule, the second harmonic, which in this case is used, gives the second strongest squeal.

Reversing Procedure

By the same method, reversed, it is also possible to locate positions below the broadcast band. For example, suppose the oscillator will actually go down to 500 kc. The broadcast set may be tuned to a station of 1,000 kc and the oscillator turned until the squeal appears as the condenser is set near maximum. In this case the second harmonic of the oscillator beats with the fundamental of the broadcast frequency tuned in. In the first case the second harmonic of the signal frequency beat with the fundamental of the oscillator.

An attempt should be made to locate points for every five divisions on the oscillator condenser, including zero and 100. When these points have been located on the graph a smooth curve should be drawn through all the points. If the frequencies at zero and 100 cannot be found, too much reliance should not be placed in the apparent trend of the curve near the ends, for there is very little change in the frequency between about 97 and 100 and between zero and 3 on the dial. Just how the curve will run near the ends of the scale will depend on the particular condenser used. It is assumed that the dial has been set so that zero coincides with minimum capacity and 100 with maximum.

The Circuit

The circuit consists of one radio frequency amplifier and one audio frequency amplifier. Both are of the tuned grid type and each tube is a 230, 2-volt type. In the completed oscillator there are four sockets, two for the tubes, one for the radio frequency coil and another for the battery cable. The cable socket was made of the UY type so that no mistake could be made in plugging in. The r-f coil socket was made of the UX type but it was clearly marked so that a tube would not be plugged into it. The wiring of the coil and the cable sockets is shown in Fig. 1.

Transformer T2 used in the audio frequency oscillator was an old one-to-one power transformer. When this was connected with a 0.006 mfd. condenser across the winding in the grid circuit, the frequency genereated was about 2,000 cycles per second. An old audio coupling transformer can also be used, but if this is a good one, the generated frequency is likely to be too low even when no condenser is connected across either winding. An old cheap transformer that will give a shrill whistle when con-

How to Wind Coils fo

(*Continued from preceding page*)

0.00025 mfd. condenser and 0.1 meg. (100,000 ohm) grid leak in the detector stage would be omitted, and the interstage secondary returned to ground. If a switch is to be used, then that secondary is returned to B plus maximum, although this does not affect the grid bias, which is negative by about 7.5 volts. Despite the leak and condenser this is a high negative bias detector, and not a leak-condenser detector. It is the bias that distinguishes the type of detector. The leak simply affords a means of establishing the grid bias independent of the secondary coil return. The tuned circuit for this coil, in Fig. 1, is bypassed by one of the 8 mfd. filter condensers.

If UY plugs are used, since they have five terminals or prongs, P for the antenna coil plate may go to aerial, heater adjoining plate (HP) to ground, one extreme of the secondary also to ground, two taps to heater adjoining cathode (HK) and cathode (K), respectively, while G goes to grid. Therefore the five prongs are in service. For the interstage coil P may go to plate, HP to B plus, which is also the connection for the end of the secondary, while the two taps go to HK and K, and the other extreme to G. Hence the coil socket terminals would be wired in the set in that manner, just as if the coils were in position, for when the coils are inserted, the proper connections result.

Assuming now that plug-in band shifting is to be selected, using 1.25 inch diameter, at the bottom, near the prongs, wind the antenna primary, 12 turns of No. 24 silk covered wire. Connect the beginning of the winding to P prong, end of winding to HP prong. Leave 1/16 inch space and wind 32 turns of No. 28 enamel wire, the beginning of the winding, adjoining the end of the plate winding, going to HP prong, as did the end of the primary winding. The end of the secondary goes to the grid prong.

The primary of the other coil consists of 12 turns of No. 28 enamel wire, beginning to P, end to HP. Leave 1/16 inch space and wind 32 turns of No. 28 enamel wire and connect the end to the G prong.

All windings are in the same direction.

The foregoing accounts for one set of coils. Two more sets, a total of three sets, or six coils are needed.

The next pair consist of 8 turns primaries, 1/16 inch spaces,

lated R-F Oscillator

cing Superheterodynes

Villiams

nected up as an oscillator is preferred. If a lower frequency is desired it is only necessary to connect a small condenser across one of the windings. A one-to-one output transformer designed to operate between an ordinary power tube and a magnetic speaker will also work well and will give a suitable frequency with a small condenser across either winding.

Cutting Out Modulation

A switch Sw is provided in the grid circuit of the audio oscillator for cutting out the modulation frequency. The switch in the drawing is set for no oscillation. When it is thrown to the blank point the circuit will oscillate. Since the audio tube is left in the circuit there is practically no change in the voltages when the switch is thrown and for that reason there is no change in the radio frequency generated by the first tube.

A common 10 ohm ballast resistor is used in the filament circuit. This assumes that the two tubes are of the 230 type and that the filament supply voltage is 3 volts. If it is desired to use other tubes it is only necessary to change the value of the ballast resistor and the supply voltage. For example, if the two tubes are 201A the ballast resistance should be 2 ohms and the battery voltage should be 6 volts.

For modulation an 800 ohm resistor is used in the plate circuits. This is not by-passed. This resistance caused satisfactory modulation without overloading the radio frequency tube.

A plate voltage of 45 volts was used and it gave good results. However, the circuit will also work on 22.5 volts just about as well.

Making Use of Oscillation

Apparently there is no means for taking off the oscillation for use in test applications. All that is necessary is to place a wire near the oscillator coil and to connect one end of this wire to the antenna lead of the set, or to a grid clip of an amplifier tube, or to a plate. The intensity of the signal picked up can be varied by varying the distance between the wire and the oscillating coil. In some cases it is not even necessary to use the wire but just place the oscillator near the receiver under test, and in still other cases, and particularly when the circuit is generating an intermediate frequency, it is necessary to wrap the wire around the oscillator coil for several turns. In all cases the coupling should be as loose as possible.

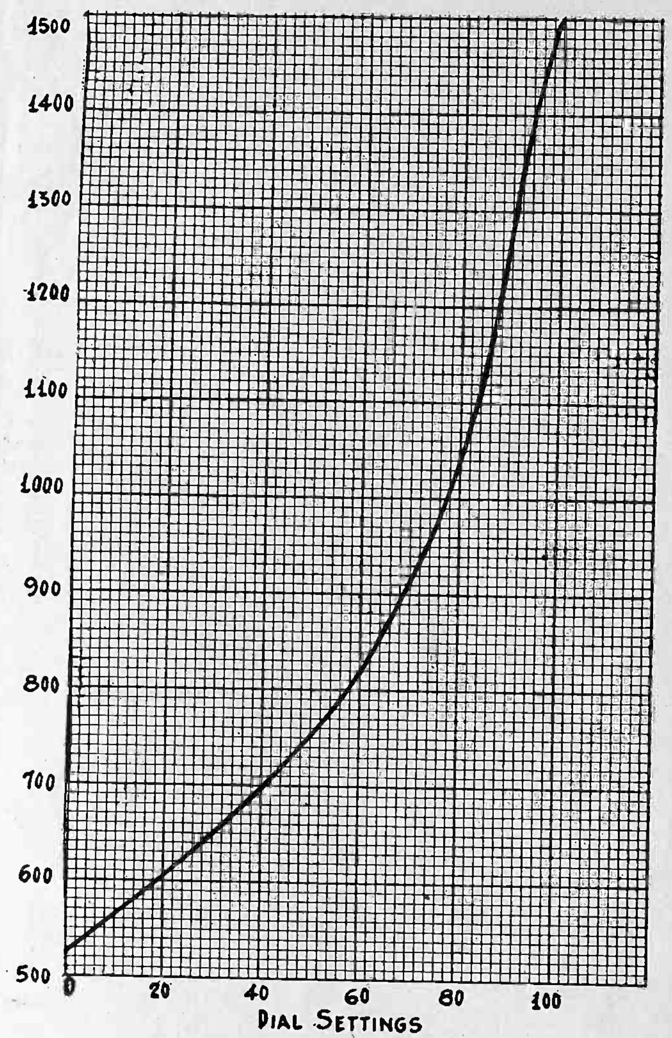

FIG. 2

The calibration curve of the broadcast band coil of the oscillator. The range is from 525 to 1,500 kc.

Long Wave Coils

The oscillator coils for the long waves are made of duolateral chokes coupled closely. For each two chokes are required. It is not practical to give the winding data for these coils for they can be wound only by machine. However, coils already wound can be used and the turns reduced until the inductance is correct. The calibration is not easy unless a calibrated oscillator covering about the same range is available. It can be done, however, using harmonics of broadcast stations. For example, suppose we have a coil covering the 150 to 350 kc band. If we tune in a broadcast station having a frequency of 600 kc we will get a squeal with the oscillator when the dial is set at maximum for the fourth harmonic of 150 is equal to 600 kc. Likewise, if we tune in a station of 700 kc we will get a squeal when the oscillator is set at minimum for the second harmonic of 350 is 700 kc. The difficulty arises from the fact that there are squeals everywhere on the intermediate frequency oscillator and it is hard to tell which harmonic is involved. But this comes with experience.

Long Wave Curves

In Fig. 3 we have two sample calibration curves of long wave coils in this oscillator. One covers the range from 72.5 to 170 kc and the other from 155 to 364 kc. The calibration was actually done against an oscillator which covered the range from 100 to 200 kc but it could have been done just about as well against broadcast station signals. In fact it will be done over

(Continued on next page)

imple Short Wave Set

and 11 turn secondaries, No. 28 enamel wire, except for antenna primary, No. 24.

The last pair consist of 4 turn primaries, 1/8 inch space, and 4 turn secondaries, using No. 18 enamel wire same wire as above.

If switching is to be used, instead of plugging in to change the wave bands, then constructionally you will make only two coils, and tap them, returning the secondary of the interstage coupler to the HP connection, that is, both the primaries and secondaries of both coils go to the same points exactly, in respect to each other, although comparing interstage coils for plug-in wave changing with switched wave changing, the secondary returns go to different places, as will be emphasized again.

Therefore for switching wind 12 turns of No. 24 single silk covered wire for the primary of the antenna coupler, beginning to P, end to HP. Leave 1/16 inch space. Connect the begining of the secondary winding to HP, wind four turns, tap and bring the tap to HK, wind 7 more turns (total now is 11), tap, bring the tap to K, and wind 21 more turns, completing the required number of a total of 32 turns, end to grid prong.

The interstage coil is wound exactly the same way, except that the primary is No. 28 enamel wire, the same as all secondaries, or, if desired, the No. 24 wire may be used on the primary here, too, although with no improvement.

The wave band coverage will be approximately as follows: 200 to 67 meters for the largest coils, 67 to 23 meters for the next pair, and 23 to below 15 meters for the next pair, or, if switching is used, consider the word "taps" replacing the word "pair."

The tuning capacity used is working out the above coil data was 0.00035 mfd., and a two gang condenser may be used, if provided with equalizers. Although the volume control will change the frequency a little, this is helpful, as some discrepancies in peaking will creep in from one band to another, and the slight change can be compensated for in the volume control. If the limiting resistor is 150 ohms you will have sufficient leeway, provided the rheostat (which may be a potentiometer used as a rheostat) is not much more than 5,000 ohms.

The cable connections for the Rola series F speaker, are, left to right, at back: plate to HP; B plus maximum to HK, grid return to G, ground to P, B minus to K.

Curves on Oscillator

How to Calibrate Simple, Handy Device

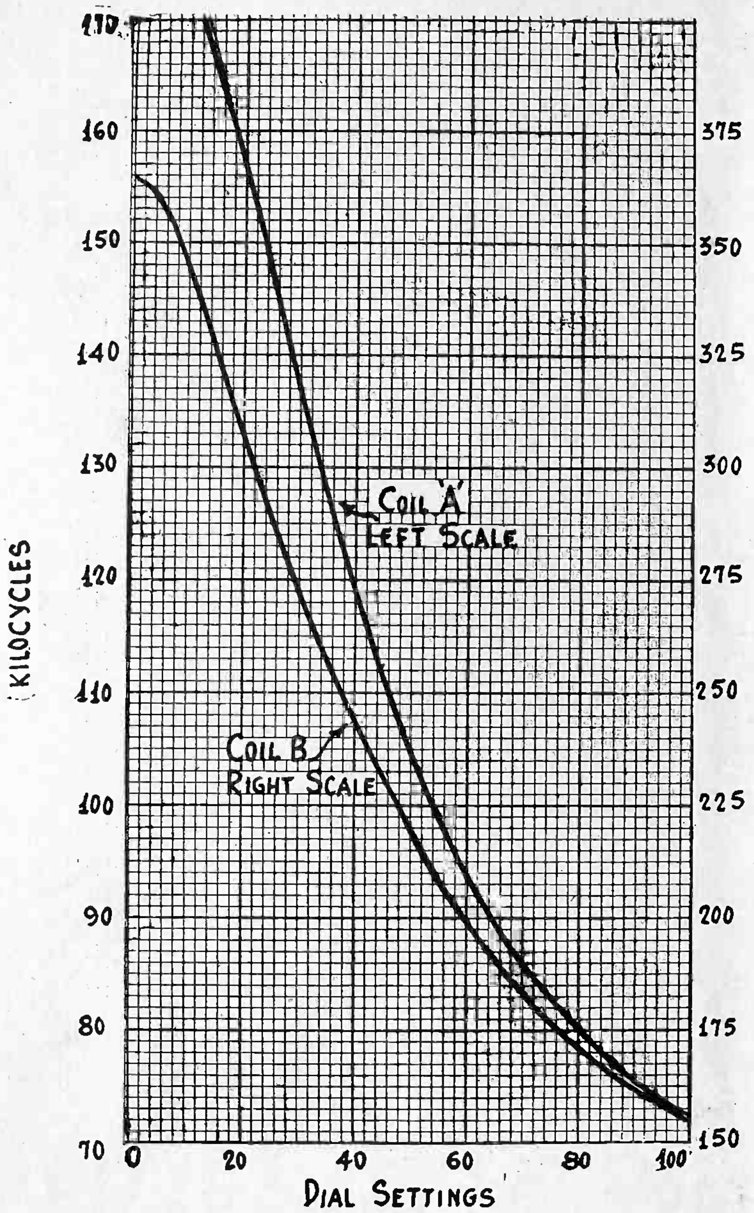

FIG. 3
Two calibration curves of two coils jointly covering the range from 72.5 to 364 kilocycles. "Scale" refers to frequencies at left and right.

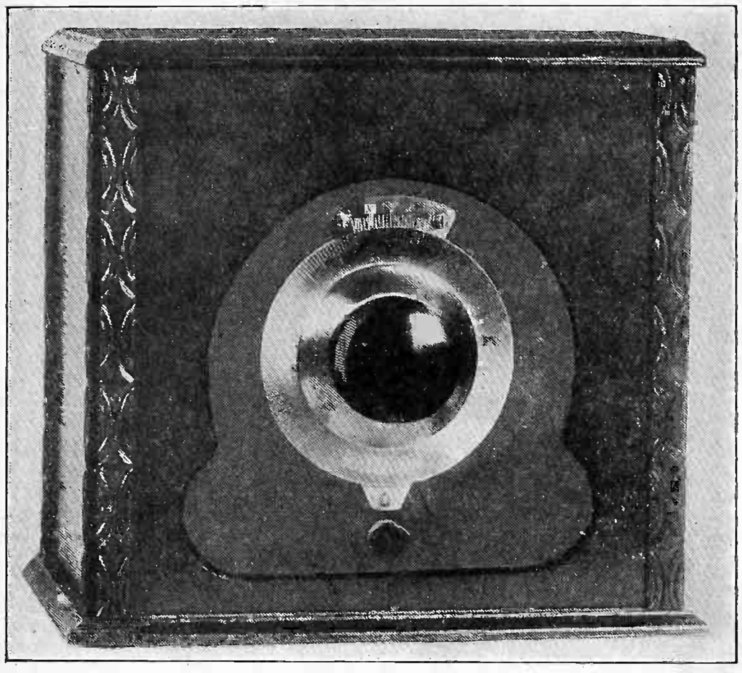

FIG. 4
The panel contains only the condenser dial but may also contain the switch Sw.

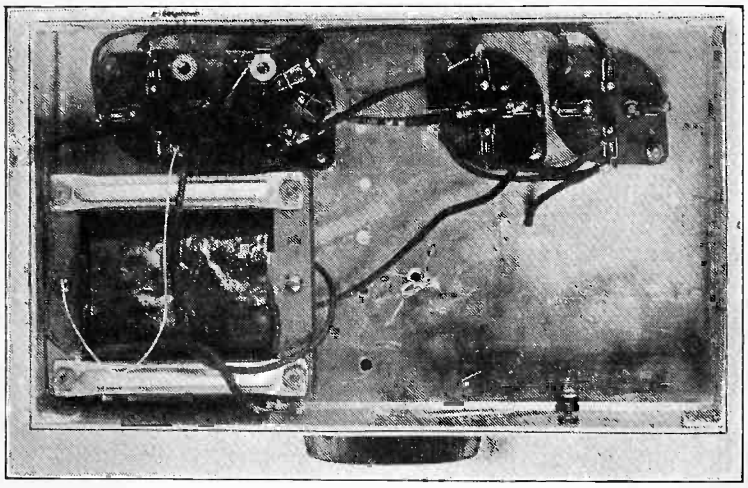

FIG. 5
A view of the bottom side of the subpanel showing the position of the audio oscillating transformer and the wiring.

(*Continued from preceding page*)

against these stations because broadcast station signals are more reliable than laboratory oscillators.

In calibrating one oscillator against another, and the other may be the broadcast station oscillator, it is well to remember that squeals are heard whenever any harmonic of one beats with any harmonic of the other. For example, let F be the frequency of the known signal and let f be the frequency of the unknown. Let m be any harmonic of F and let n be any harmonic of f. Then the condition for zero beat is that $mF = nf$, or $f = mF/n$. The lower the values of m and n the stronger will be the squeal near the zero beat position. For instance, when $m=1$ and $n=1$ we have the strongest squeal and then the two frequencies are equal.

When we calibrate a low frequency oscillator against a broadcast frequency, or broadcast frequencies, m will in most cases be unity and n will have higher values.

When calibrating an oscillator by the beat method it is well not to have the signals modulated because the sound will only cause confusion. The zero beat positions will not be silent. The modulation on the broadcast frequency will not cause as much trouble in this respect as the modulation on the other oscillator. Hence close the switch Sw when calibrating.

Views of Assembled Oscillator

In Fig. 4 is a view of the interior layout of the assembled oscillator. This shows the tuning condenser, the oscillating coil, the two tubes, and the power supply cable. In Fig.5 is a view of the bottom side of the subpanel showing the position of the audio oscillating transformer and the various small parts such as the two resistors and the audio tuning condenser. Fig. 6 shows a drawing of the front panel. The panel, incidentally, is of aluminum so that there is no body capacity in tuning. In addition to the shielding effect the only object of panel is to provide a reference for the dial.

Extending the Range

If it is desired to make coils that will cover short wave frequencies they can easily be made in the same manner as the broadcast coil, using the same size wire and the same size form. The primary and the secondary for these coils may be made equal as to the number of turns. The first coil just above the broadcast band can have half the number of turns, the next half as many as the first short wave coil, and so on. It is better to have more than enough coils and have plenty of overlap between ranges than to be short. This method of halving will give plenty of overlap.

Calibration of the small coils can be done by means of harmonics of broadcast stations without any difficulty. The first band is very easy because the second harmonic of broadcast stations may be used. For the next band third and fourth harmonics will have to be used.

Oscillator Frequency Stability

Methods for Reducing the Fluctuation

By Brunsten Brunn

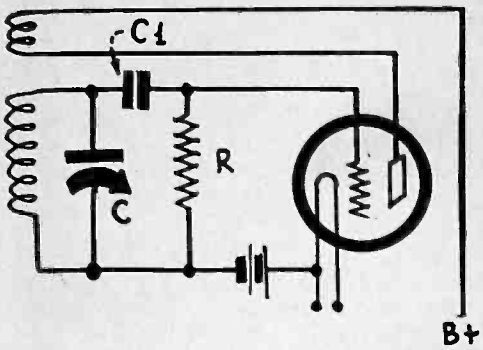

FIG. 1

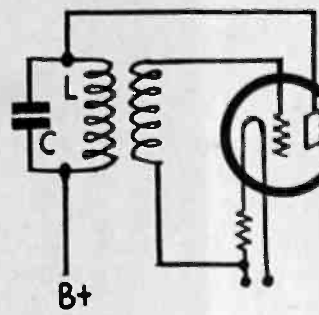

FIG. 2

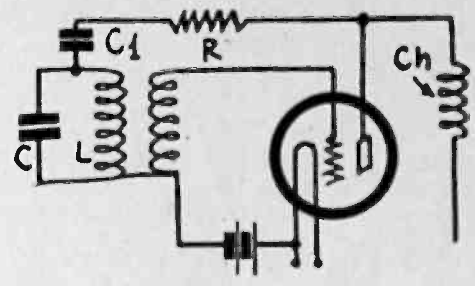

FIG. 3

A simple feed-back oscillator in which a stopping condenser C1 and a grid leak R have been used to stabilize the frequency. (Fig. 1.)

A tuned plate oscillator in which no attempt at stabilization has been made. (Fig. 2.)

The same oscillator as in Fig. 2 after it has been treated to increase the stability of frequency. R has a high value. (Fig. 3.)

MUCH thought is now given to the stabilization of vacuum tube radio frequency oscillators in respect to frequency fluctuation. Greater and greater frequency stability is always demanded. Part of this is imposed by official rulings, part by the crowding of radio channels and part by the fact that at high frequencies if the carrier is not constant the quality of the signals is impaired.

Frequency fluctuation is caused by many different effects. The main ones are temperature variation, vibration, and voltage fluctuations. Vibration is not a serious factor because steps can easily be taken to prevent it. Temperature changes, which affect mainly the inductance and capacity of the frequency determining circuit, can also be controlled within fairly narrow limits by means of thermostats. Hence the principal cause of frequency fluctuations is voltage variation. Changes are not confined to any one voltage but may occur in plate, grid, and filament voltages. When the circuit is battery operated the variation in the voltage is in part due to temperature and this can be eliminated as was stated above. But the voltage also varies with age and this is not so easily compensated for.

A-C Operated Circuits

If the oscillator is completely operated from an alternating line the voltage fluctuations are mainly due to a fluctuation in the load on the line. There are means, more or less effective, for compensating such variations. Frequency variations also occur as a result of varying the load on the oscillator tube, but this may be reduced to a very small value by coupling the oscillator to the grid circuit of another tube from which the load is taken.

If we assume that temperature effects on the inductance and the capacity in the frequency determining circuit are negligible, the stabilization takes the form of preventing fluctuations in the plate and grid resistances of the oscillating tube or of preventing the fluctuations from affecting the oscillatory circuit.

The most important condition for frequency stability is that the loss in the oscillating circuit should be small, that is, that the selectivity should be as high as possible. One reason why quartz piezo oscillators are so stable in respect to frequency is that the selectivity of the quartz oscillator is enormously high. If the selectivity of a frequency determining circuit consisting of inductance and capacity could be made as high as that of quartz, the frequency stability of such a circuit would be of the same order of magnitude.

Reason for High Stability

The reason for high frequency stability of a highly reasonant circuit is not difficult to see. The frequency varies because the reasonant circuit is driven off its natural frequency by a small amount depending on the phase shift of the feed back circuit. In a highly resonant circuit the phase shifts very rapidly with frequency about the reasonant frequency. Hence for a given shift in the feed back, this is compensated for by a much smaller change in the frequency in a highly reasonant circuit than in a broad circuit. If the phase shift is too great the circuit simply stops oscillating, and this occurs much sooner, for a given amount of feed back, in a highly reasonant circuit than in a broad circuit.

Let us compare two circuits, each having an inductance of 200 microhenries and a capacity of 200 mmfd. The natural frequency is then 795 kc. Let the resistance in one be 40 ohms and that in the other 4 ohms. That is, the selectivity of the second circuit is ten times that of the other. Suppose now that the phase shift of the feed back is such as to force the circuit to oscillate one electrical degree off its natural frequency. In that case the low selectivity circuit will oscillate 278 cycles off the natural frequency and the high selectivity circuit will oscillate only 27.8 cycles off the natural frequency. If the phase shift is a retardation the frequency shift will be an increase.

In-Phase Feed Back

If there is no phase shift in the feed back circuit, the circuit as a whole will oscillate at the natural driven frequency of the frequency determining circuit, that is, the frequency will be determined by the LC of the reasonant circuit and the oscillator will be relatively frequency stable.

It is not an easy matter to separate the oscillator components so that it is known whether or not there is a phase shift, so that the above observations are quite theoretical. However, they indicate in many instances what to do when a given change occurs in frequency.

It is apparent that if the phase shift is small only a small change can occur in the frequency when given changes are made in the circuit outside the reasonant circuit.

One of the methods of stabilizing the frequency is to isolate the frequency determining circuit as much as practicable from the tube and power sources. This isolation removes the effect of tube resistances and capacities from the resonant circuit and so tends to hold the frequency constant. Moreover, if this isolation is done by means of high resistances the phase shift is reduced and so allows the resonant circuit to oscillate nearer its natural frequency. It also removes or minimizes the effect of varying grid and plate resistances.

Effect of Grid Leak

The use of a grid condenser and leak in an oscillator has always been found to stabilize the frequency. The reason for this is that this tends to keep the grid resistance of the tube constant as the voltages and the load vary. A similar treatment of the plate circuit has been found to stabilize the frequency, and for a similar reason. Besides, if the resistance added is put in series with the feed back circuit the phase shift of the feed back is reduced. Limiting the amplitude of oscillation also tends to stabilize the frequency because this prevents to some extent the tube from operating on a positive bias during any part of its swing, that is, it tends to keep the grid resistance infinite.

The use of very close coupling between the plate and the grid coils has also been found by experience to stabilize the frequency. This has been pointed out by F. B. Llewellyn of Bell Laboratories, who has given the mathematical theory for it. On the basis of phase shift this effect may be explained on the assumption that close coupling tends to reduce the phase shift although Mr. Llewellyn explains it from another point of view.

Incidentally, in his paper on frequency stabilization in the December issue of the Proc. I. R. E., Mr. Llewellyn considers frequency stabilization of all types of oscillator exhaustively, treating the subject both mathematically and experimentally. He finds that in any oscillator there is a critical capacity or inductance that may be inserted in the grid or plate circuit which will render the generated frequency independent of the battery voltages. For every type of circuit he gives an expression for determining the critical value. He also shows that

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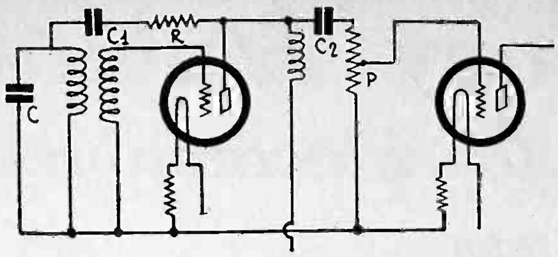

FIG. 5

In this tuned plate oscillator an extra amplifier tube has been added to isolate the more thoroughly the tuned circuit from the tubes.

(*Continued from preceding page*)

impedances may be inserted both in the plate and grid circuits to achieve the same effect, giving expressions from which these impedances may be computed for any type of circuit. Although the author does not say so, these critical impedances are those required to produce the proper phase shift so that the net shift is zero when the resonant circuit oscillates at its natural driven frequency, that is, the frequency determined by LC of the resonant circuit.

Sample Circuits

In fig. 1 is a typical tuned grid oscillator in which LC is the frequency determining circuit. C1 is a stopping condenser which tends to isolate the tuned circuit from the tube, and R is a grid leak which tends to keep the grid resistance constant. The tickler coil should be coupled closely to the oscillating coil L if the circuit is to be relatively frequency stable.

In Fig. 2 is the tuned plate oscillator. No attempt to stabilize the frequency has been made in this circuit and the frequency will depend to a large extent on the load as well as on the battery voltages. In Fig. 3 is the same circuit after it has been treated so as to stabilize the frequency. If the reactance of condenser C1 is small and that of the choke Ch is very large, the phase of the feed back, as well as the intensity of the feed back, depends on the value of resistance R. If this is as large as possible consistent with oscillation, the circuit will be relatively frequency stable. This stability is enhanced by making the coupling between the coil L and the grid coil close. It is possible that by choosing a particular value of C1 that the frequency at some value will be still more stable.

Connecting the Load

In Fig. 4 is the oscillator in Fig. 3 with a tube added for taking off the load. The grid of the second tube is connected to a voltage divider P through a small condenser C2 to the plate of the oscillator tube. If the load is taken off the plate circuit of the second tube, changes in the load can produce very little effect on the frequency, provided that the voltage sources are thoroughly by-passed.

In Fig. 5 is an oscillator in which two tubes are used for generating the oscillation. The first tube is coupled resistively to the second tube and then the plate circuit of the second tube is coupled back to the resonant circuit as in Fig. 3. The object is to permit the use of a higher value for the feed back resistance R. Only a small part of the output voltage of the first tube is impressed on the grid of the second tube. This method, and the use of a large value of R, tends to isolate the tuned circuit LC more completely. The load is taken off as in Fig. 4 from the first tube.

In Fig. 6 is a typical tuned plate oscillator which has been

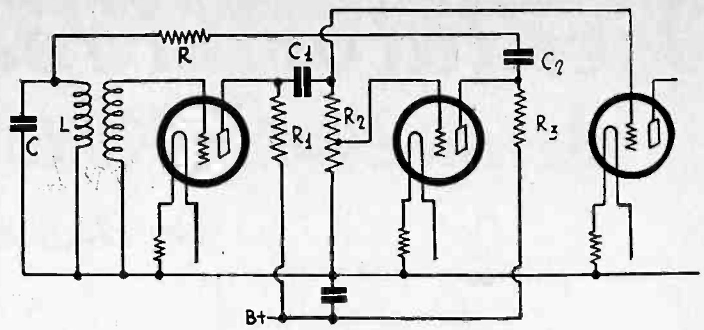

FIG. 4

This oscillator is the same as that in Fig. 2 but an extra load tube added in such a manner as to minimize the effect of varying load.

stabilized with an impedance in the feed back circuit. Ch is a choke coil which has a very high reactance at the resonant frequency of L1C3. C5 is the stabilizing capacity, and M is the mutual inductance between the tuned coil and the grid coil. If k is the coefficient of coupling that is, if $M^2=k^2L1L2$, then the value of C5 is determined by $k^2/(1-k^2)$ multiplied by C3. Assume that we couple L1 and L2 so closely that the value of k is 0.8. Then the value of the expression containing k is 1.778. If then the tuning condenser C3 has a value of 200 mmfd., the value of C5 should be 356 mmfd. Of course, the stabilization is effected at only one frequency, that determined by 200 mmfd. and the inductance of the coil L1. If we could use unity coefficient of coupling the value of C5 would be infinite, that is, we would use as large a condenser as possible. If the coupling coefficient is 0.9, the value of C5 would be 842.5 mmfd. when the tuning condenser has the value 200 mmfd.

Single Frequency Stabilization

When a critical impedance is used to effect stabilization as in Fig. 6 the stability obtains at only one frequency. When the stabilization is done by "brute force" it applies more or less over a wide band of frequencies. The critically adjusted circuit is useful in a standard frequency circuit that may be used as a reference frequency in calibrating other circuits. For example, a stable oscillator may be made to generate a frequency of 400 kc. This may be used for calibrating other oscillators both of higher and lower frequencies by the harmonic method.

In case it is desired to have a stabilized oscillator the frequency of which may be varied without upsetting the stability, it can be made by ganging condensers so that the stabilizing capacity varies with the tuning capacity. This is especially applicable to the Colpitts type oscillator. Fig. 7 shows such an oscillator as given by Llewellyn. The stopping and by-pass condensers are supposed to be very large. The other values are indicated in the circuit.

Design Values

If this circuit is to be built to cover the broadcast band C1 and C2 may be 0.0005 mfd. variable condenser put on one shaft. L3 should have an inductance of 335 microhenries. L4 and L5 each should have an inductance of one-half this amount. An inductance of 335 microhenries may be made by winding 95 turns of No. 28 enameled wire on a 1.75 inch form. An inductance of half that value can be obtained by winding 59 turns of the same kind of wire on the same size form.

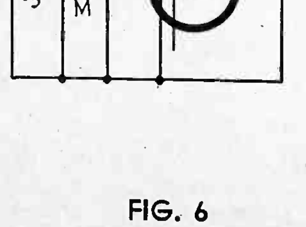

FIG. 6

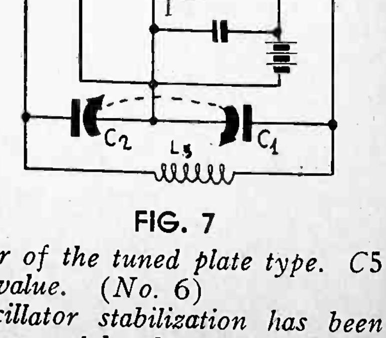

FIG. 7

A plate stabilized oscillator of the tuned plate type. C5 has a critical value. (No. 6)

In this Colpitts type oscillator stabilization has been effected for all frequencies covered by the tuner. C1 and C2 are ganged and are equal. L4 and L5 are also equal and equal to one half the inductance of L3. (Fig. 7.)

Phonograph Amplifiers

Earphone Hookup, Two and Three Stage Circuits

By Warren J. Edwards

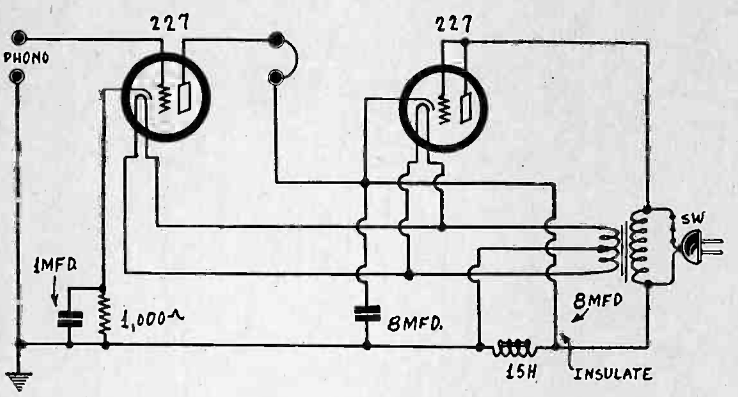

FIG. 1

A simple audio amplifier and power supply, to enable earphone reproduction of phonograph records.

WITH a phonograph pickup it is not possible to obtain reproduction unless the output of the pickup is fed to a tube circuit from which sound may be reproduced by inserting earphones or speaker. Therefore Fig. 1 is presented as a simple a-c operated device for achieving audibility. The next circuit, Fig. 2, has two stages of audio, instead of only one, while Fig. 3 has three stages. The constants are marked on the diagrams. For Figs. 2 and 3 regulation power supply is used, but for Fig. 1 a filament transformer will suffice, if the hookup is followed as shown.

The diagrams, Figs. 2 and 3, may be used as power amplifiers following a radio tuner's detector, provided a load is put on the detector tube either in the set or in the amplifier, and the direct current of the B supply fed to the detector plate that way, and in addition a condenser of 0.01 mfd. or higher connected from plate of detector to grid of the power amplifier. If variable mu tubes are used for r-f in the tuner, and a screen grid or other tube as detector, then only maximum B plus and the screen voltage are necessary from the B supply, and are afforded by Figs. 1 and 2. Fig. 1 affords a d-c voltage of about the same as the root mean square line voltage, the only precautions being that the rectifier tube should not have a cathode leakage, which few tubes have, and that the electrolytic condensers should be first class. If either of these conditions fails, then rectifier tubes will not last long.

Transformer Connections

Of course, one must insulate the designated 8 mfd. condenser if a metal panel is used, because of the voltage difference between the cases of the two 8 mfd. capacities. This voltage difference is the drop in the choke, so if no insulation is provided the choke is shorted out.

The primary of the filament transformer is connected to the line in the usual manner. Besides, either side of the primary goes to the joined grid and plate of the 227 tube used as rectifier, while the other primary terminal is connected to the case of the insulated 8 mfd. condenser and to one side of the choke. The other side of the choke, like the center of the filament transformer, goes to ground, which is not B minus. It will be noted that B minus is really one side of the line.

The biasing resistor for the 227 audio amplifier may be 1,000

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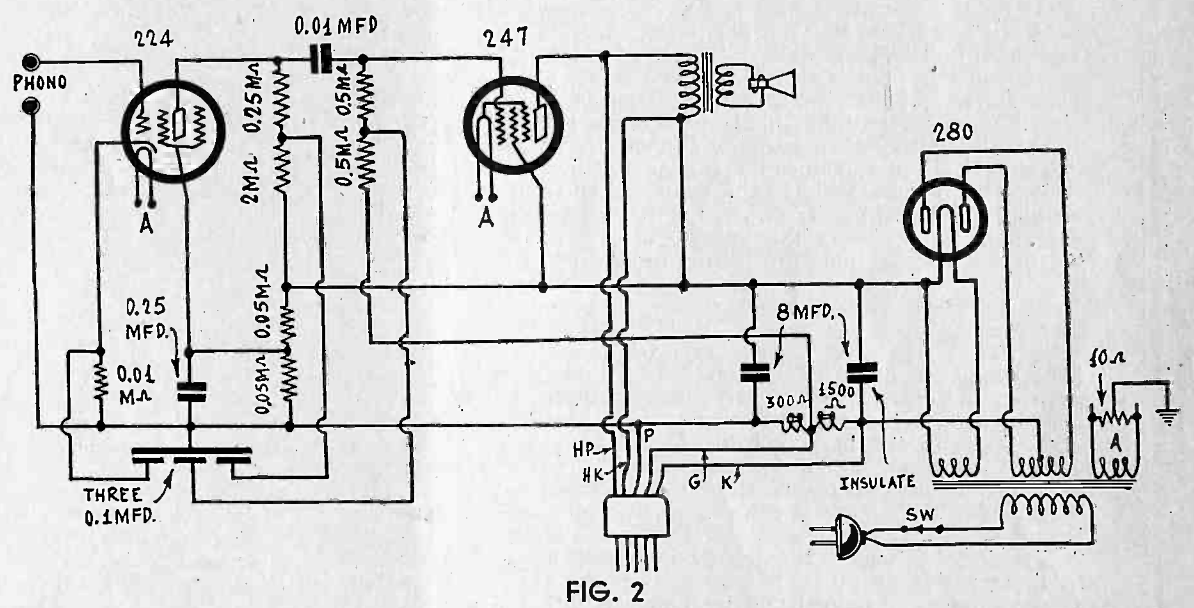

FIG. 2

A two stage audio amplifier, with pentode output and a complete power supply. This produces enough volume for loudspeaker reproduction in any home.

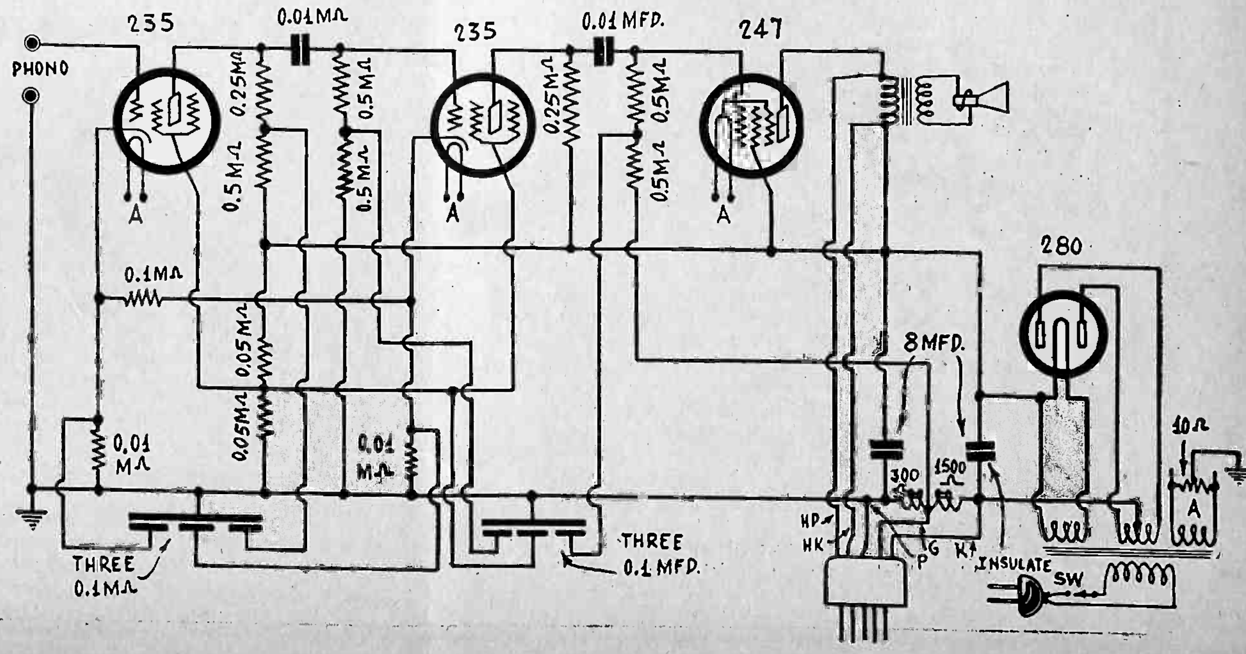

FIG. 3

Where the room is especially large this circuit may be built. Although it consists of three stages of screen grid audio it is stable.

A Universal Six Tube A

Simple Changes Adapt Receiver to

By Willia

PREVIOUSLY we have described automobile receivers in which part of the grid bias was obtained from the storage battery in the car. In these it was assumed that in most automobiles the negative side of the storage battery is connected to the car chassis, and therefore the circuits were wired accordingly. But many cars have the positive side of the battery connected to the chassis. A receiver wired with the idea that the negative side of the battery is connected to the chassis will not work in a car in which the positive is connected to the chassis, unless special arrangements have been used.

It is quite possible to make the receiver universal by keeping the filament circuit distinct from the plate and grid circuits, but in this case it is not possible to add the voltage of the storage battery to the plate battery nor to utilize the voltage in the storage battery for bias. It is desirable to boost the plate voltage by the six volts in the storage battery and it is also desirable to use this voltage for bias. It saves by-passing of bias resistors as well as the resistors themselves, and in general it improves the performance of the receiver. Anyone who has attempted to design a good automobile receiver will appreciate that it is necessary to take advantage of every trick that will improve the sensitivity and the tone of the set.

Remote Control Complications

If the receiver is insulated from the car chassis, except at points where connections are desired, there is little trouble in any case, but when the control unit is strapped to the steering column and when the control forms a part of the circuit, complications arise which impose certain restrictions on the wiring. One faulty connection is likely to short-circuit the car battery if the circuit has been wired for a car in which the negative is grounded and it is used in a car in which the positive is connected to the car chassis. Let us see whether it is not possible to connect the circuit so that it will be applicable to all cars and still utilizing the voltage of the storage battery to boost the plate voltage and also for bias purposes.

A Universal Receiver

In Fig. 1 we have the diagram of a six tube automobile receiver in which the circuit has been arranged so that it may be used for either type of car wiring. But even so, the connection cannot be made blindly.

We have in the battery cable four leads. One of these is devoted to the positive 135 volts on the plate battery, the second is devoted to the positive 67.5 volts for the screens, the third is devoted to the B return, which is made to the positive side of the heater circuit so as to add the storage battery voltage to the plate voltage. We have one left and this we connect to the positive side of the storage battery in cars in which the negative is grounded and we connect it to the negative in cars in which the positive is grounded. That is, in each case we connect it to the live side. The other side will be connected automatically through the juncture of the car and the receiver chasses.

On the receiver chassis is a socket into which the remote control plugs. To P of this socket we connect the antenna and the antenna terminal of the input coil. This connection is the same for both types of car wiring. The volume control built into the remote control device is a potentiometer, and one side of this connects through the cable to the P prong on the plug, thus making connection with the antenna and the input coil. To G on the socket for the remote control we connect the low ends of the antenna and first tuned coil and also the negative side of the heater circuit. Through the remote control cable G connects with the slider on the potentiometer. This connection also is the same for both types of car wiring.

The K on the socket picks up the 300 ohm bias resistance for the first two tubes and through the remote control cable connects with the remaining end of the potentiometer. There is no difference in this connection regardless of the car wiring. It should be noted that there is yet no connection to the negative side of the storage battery.

Connecting the Heater Circuit

Now suppose we have a car in which the negative side of the battery is grounded. We then use the fourth lead in the battery cable and connect it to the positive side of the storage battery and to Hp on the remote control socket. The lead in the remote control cable which connects with Hp first picks up the fuse,

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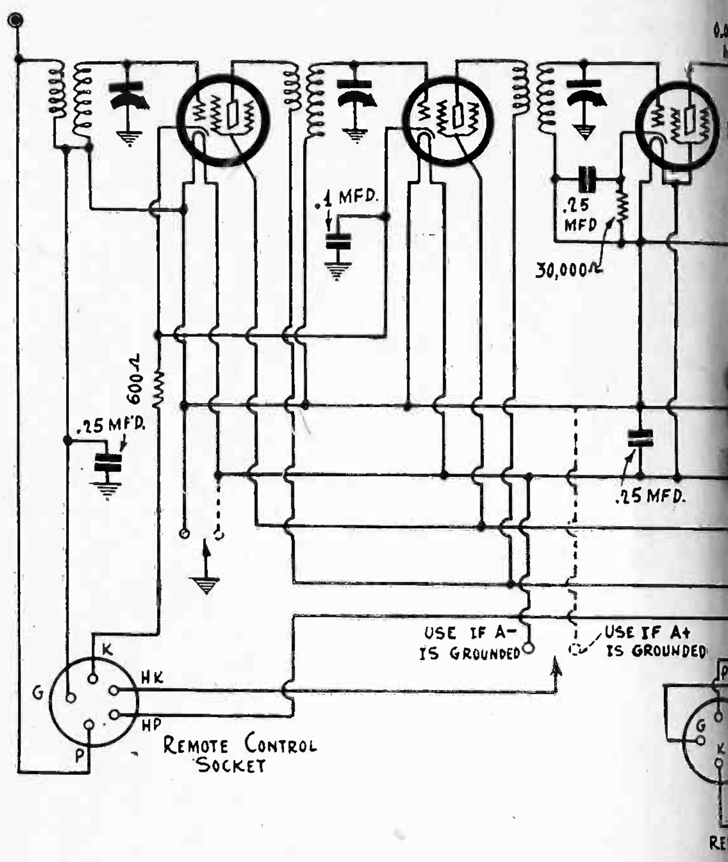


FI

This is a diagram of a six-tube automobile receiver whic car battery is grounded. Slightl

LIST (

One remote control unit containing dial, pilot light, volume control, and connecting plug and cable.
One chassis for a six tube receiver, with metal container.
One metal box for the plate battery.
Eight UY sockets.
One 600 ohm resistance.
One 300 ohm resistance.
One 0.25 megohm resistance. One 1.0 megohm resistance.

Power Amplifiers for Ph

(*Continued from preceding page*)

ohms, as marked on the diagram, or may be from 800 to 2,000 ohms, not being at all critical in this circuit. The volume will be all-sufficient for earphone use.

Filters Prevent Feedback

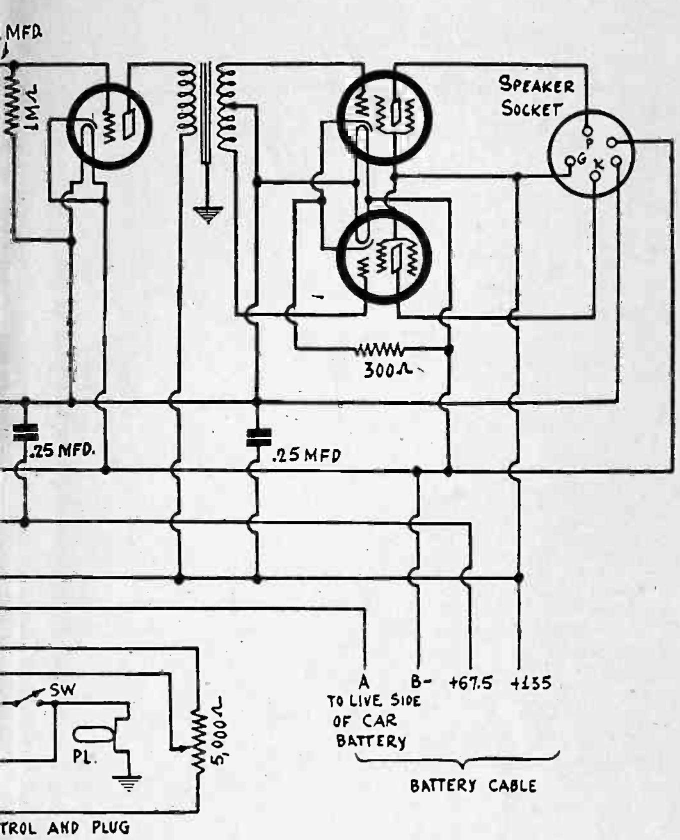
Fig. 2 shows a 224 screen grid tube as first audio amplifier. Since resistance coupling is used to the pentode output tube, the 224 is highly suitable, particularly as the two stage circuit is stable, and if there would be any tendency toward instability it is removed by the resistor-capacity filters in the plate and grid circuits. These filters prevent feedback.

The transformer used will be serviceable also for the heaters of a tuner, as two or three heater tubes can be worked as to this power from the general run of transformers.

The speaker is of the dynamic type with the now familiar field coil that serves also as B supply choke and affords bias for the pentode. A five lead cable, with UY plug, connects speaker, field coil and output transformer, the connections now almost standard being shown in the diagram.

The three stage amplifier uses 235 tubes, because their stability is of a higher order, although 224's could be used, due to the adequacy of the plate and grid circuit filtration. The gain from

utomobile Receiver
ositive or Negative Car Grounding
A. Jones



be used either when the positive or the negative of the rent connections are required.

RTS

Two 0.1 mfd. condensers.
Five 0.25 mfd. condensers.
One set of spark suppressors on the spark plugs, and one d. spark killer condenser to 80 across generator brushes.
One triple gang 0.00035 mfd. condenser.
Three automobile t-r-f coils to match condensers.
One push-pull input transformer.
One special dynamic type, 6 volt field type.

ograph and Other Uses

three stage amplifier is easily large enough to overload the tode, with phonograph use, so the volume control is brought play. This control is not shown in any of the digrams ause the pickups have such a control built in.

Audio Regeneration

The stability is great enough even to support some extra feedk purposely introduced, as through the 0.1 meg. resistor join- the cathodes of the first and second audio tubes. This pro-es a little audio regeneration. Also, the very method of tode bias through the drop in the part of the choke coil vides additional audio regeneration. However, the 0.1 mfd. es a small amount only, so that all danger of instability, h as motorboating, high-pitched continuous squeal or other ilar evidences of audio oscillation, are avoided.

The design, Fig. 3, is especially noteworthy, since it represents olution of the mystery of how to build a three stage resistance pled audio amplifier, screen grid tubes throughout, and yet run into trouble. The circuit is along lines now familiar readers of these columns, as the solution was perfected in DIO WORLD's laboratories, and is embodied by this time in eral circuits featured in these columns.

then the switch and then the pilot light as well as another lead which goes back through the cable and connects with Hk. This terminal on the remote control connects with the positive side of the heater circuit. One side of the pilot light is connected to ground, that is, to the frame of the remote control unit and hence to the car and set chasses. Thus the pilot light is on as soon as the switch is closed. But the tubes in the set do not get any current because there is no connection to the negative side of the heater circuit. This is made by connecting the negative side of the heater circuit to the receiver chassis.

When the negative side of the car battery is grounded the 0.25 mfd. condenser between ground and the negative side of the heater circuit is short circuited. Hence for this type of car wiring the condenser may be omitted.

Positive Side Grounded

When the positive side of the car battery is connected to the chassis the fourth lead in the battery cable is connected to the negative side of the battery. It still is connected to Hp on the remote control socket. As before, this live side, now negative, connects with the fuse, the switch, and the pilot light. The ground side of the pilot light is now positive so the lamp lights up as soon as the switch is thrown to the closed position. The lead in the remote control cable which connects with Hk should now be connected to the negative side of the heater circuit as shown by the dotted line. To complete the heater circuit so as to give the tubes and the field current when the switch is closed, it is necessary to ground the positive side of the heater circuit, according to the dotted line. The 0.25 mfd. condenser between ground and the negative side of the heater circuit is now necessary. It serves to complete the three tuned circuits. Since this condenser constitutes a common impedance among the three circuits, it will do no harm to make it even larger than 0.25 mfd.

Connection Differences

Assuming that the 0.25 mfd. condenser is kept for both types of car wiring and the circuit is wired as in the diagram, the differences between the two connections are slight and can be effected in a few minutes.

The volume control potentiometer is connected in the same way in both cases. The wiring of the cable to the remote control unit remains the same. The fuse, the switch, and the pilot light are also connected the same in both instances, one side of the pilot light being connected to the frame of the control unit.

When the negative of the car battery is grounded, the unused lead in the battery cable is connected to the positive side of the battery and Hk on the remote control socket is connected to the positive side of the heater circuit in the set. The negative side of the heater circuit is connected to the chassis.

When the positive of the car battery is grounded, the unused lead in the battery cable is connected to the negative side of the car battery and Hk on the remote control socket is connected to the negative side of the heater circuit in the set. The positive side of the heater circuit is connected to the chassis.

Voltages Unchanged

These connections leave all the voltages unchanged when the circuit is altered from one type of car wiring to the other. The only difference lies in moving the ground connection from the negative to the positive of the heater circuit. In some cases the slider on the potentiometer in the remote control unit is connected to the frame. This connection should be removed, particularly when the positive of the car battery is grounded.

If it is not known which side of the car battery is grounded it can be determined very quickly and easily. With a voltmeter one side of the meter is connected to the chassis of the car and the other is connected first to one terminal and then the other of the battery. The one which gives no reading is grounded. In the absence of a voltmeter the test can be made with a small 6 volt light. Connect one side to the chassis of the car and the other alternately to the two terminals of the battery. In one position of the free lead the lamp will light up. That is the live terminal and the other is grounded. In the absence of any test instrument use a wire. Connect one side to the chassis of the car and brush the other end momentarily over the terminals of the battery. In one case there will be a spark. That is the live terminal. In the other there will be

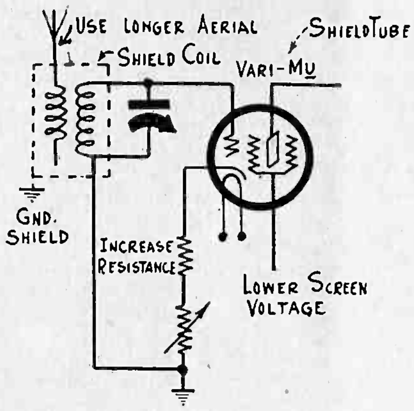
(*Continued on page* 18)

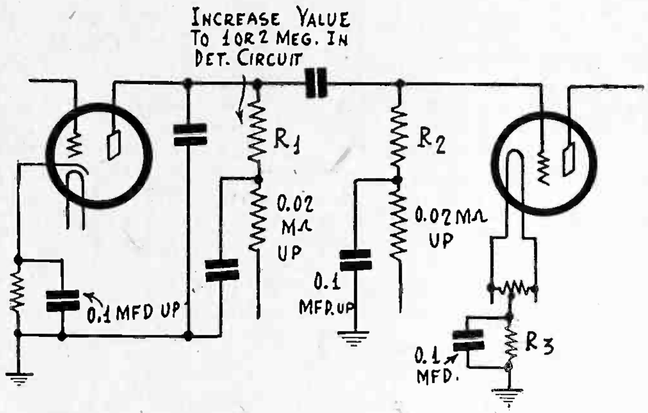
Stopping Oscillation

Remedies Applied to Radio and Audio

By Jack Tully

The location of the limiting or "hop-off" resistor is shown at left, with some r-f squealing remedies. At right R1 is the detector load, R2 the grid leak, R3 the output (power) tube biasing resistor.





[*The December 19th issue contained an article on the solution of radio frequency coil winding problems, telling how to arrive at the correct solution even if you do not actually know the capacity of the tuning condenser used, and giving data for short waves as well as for broadcast waves. Last week's article, December 26th, dealt with solution of voltage division problems in a-c receivers. Next week's article will deal with short wave converter coupling. The series is intended as a help to beginners.*—EDITOR.]

STABILITY at both radio and audio frequencies is necessary in a receiver. Instead of neutralizing methods previously popular, now that screen grid tubes are the rule, careful shielding is used for r-f stability, with adjustment of the biasing resistor value so that any tendency toward incipient oscillation is removed. The varable mu tubes make such bias adjustment practical, since there is little drop in sensitivity, although the bias is increased considerably. The recommended value of resistance, hence bias voltage, may be exceeded greatly, even by 100 per cent., for stability reasons. Also, the selectivity is increased at the same time. Another option is to reduce the screen voltage, but this is not usually so handy.

R-f choke coils in screen and plate leads may be used, with fixed condensers from the "high" side of the choke to ground, but as the other methods suffice, the chokes are not as popular as formerly. Instead of chokes, resistors may be used, of the order of thousands of ohms in screen leads and a few thousand ohms in plate leads.

Equalized Sensitivity

If it is desired to make a t-r-f set amplify all the broadcast frequencies virtually evenly, it is practical to put 1,000 ohm resistors in each of the r-f plate leads, without a condenser across them. This of course reduces the selectivity, a fact to be considered in circuit design, but the higher wavelengths get about as much amplification as the lower ones, an otherwise unusual situation. Of course this is a corrective for instability at radio frequencies, because the instability would be at the high frequencies, whereas the amplification is cut down for these frequencies by the series plate resistors, and we borrow from Peter High to pay Paul Low.

The shielding should be used in all cases where there are more than one stage of t-r-f. The shields should be copper or aluminum, not tin or iron, as the latter two cause heavy eddy current losses, and drop the inductance more considerably, so that coil data given for shielding conditions will not apply accurately, as tin or iron shields are not intended by those who give the coil winding directions. Some sets having numerous tubes are so poorly designed that brute force methods must be adopted to make them workable, and in such instances tin or iron shields may be used, but broadness may result, and indeed the general performance will be poorer than with fewer tubes in a circuit more sensibly designed and built.

Parallel Resistor as Antenna Compensator

The shield must be grounded, otherwise it is not a shield. It is also advisable to put a shield over the r-f and detector tubes, or, in a superheterodyne, over the intermediate and second detector tubes as well. These tube shields increase the capacity slightly, and the tuning condensers have to be peaked with the shields on, or, if the shields are newly put on, the tuning condensers repeaked.

Thus r-f stability is reduced to a simpler practice than formerly. There remains, however, the consideration of primary turns. In the antenna circuit, the more primary turns, and the longer the aerial, the more stability. Both these factors introduce greater resistance. Some set manufacturers put a parallel fixed resistor across the antenna primary, so that the set will not oscillate no matter how short an aerial is used.

Any one having a set that oscillates on a short but not on a long aerial, and who wants to use a short aerial, may resort to the same practice. With no aerial connected, adjust a variable resistor until oscillation stops. Then measure the resistance in circuit and replace with a fixed resistor of the same or approximately the same value.

Reduction of primary turns of interstage couplers reduces the tendency toward squealing, and of course increases the selectivity while reducing also the sensitivity. The fewer turns mean looser coupling, and looser coupling spells increased selectivity. A short aerial is a form of loose coupling, in effect, since a smaller input is delivered to the primary, hence the secondary.

Sometimes when you build a set you hear two stations at one setting, and this will happen at different dial positions. Also, a peanut whistle is frequently heard. These are due to too low selectivity. If the tuner rejected the interfering carrier the beat whistle would not be heard.

Stability at Audio Frequencies

In audio circuits stability is just as important, indeed perhaps more important, for at r-f we may use a manual control, but at a-f we have no control. Therefore to get rid of instability, such as motorboating, high-pitched continuous whistle, blasting or other forms of oscillation (for that is what they are), the positive feedback should be removed.

If an audio channel is unstable it is heaping on added cause of the same kind of trouble to use large bypass condensers across individual biasing resistors, so reduce these values to r-f proportions, say, not more than 0.1 mfd. That applies to the condenser across the detector biasing resistor as well, as the detector handles audio frequencies, hence must be rated as an audio tube. In circuits other than detector the condenser may be omitted entirely.

Also, filter circuits should be included. One for each stage is advisable, and may be in the grid circuit, but if the audio is high gain, then two in each stage, one in the grid, the other in the plate circuit, should be used. An exception exists in the case of single stage audio, where one filter, in the power tube grid circuit, suffices.

Leaving the resistors in the amplifier as you find them, values for filtering may be from 0.02 meg. up, and the condenser from 0.1 mfd. up. The condenser is connected from the joint of the two resistors to ground.

Substitutes for Very High Capacity

These filters are anti-feedback devices and should be used in unstable audio circuits. If not needed of course do not include them. Sometimes the filters will improve a bad condition, but not cure it entirely. Resort to omission of condensers from biasing resistors is next tried, and if even that fails, the grid leak values are decreased. Try decreasing the value of any one grid leak in the audio circuit. Since the amplifier may be considered as a unit impedance, it is not necessary to make reduction in more than one grid circuit. However, if you haven't low enough values to stop the trouble, then lesser reduction effected in each of the audio grid ciruit should be tried.

It is assumed that the filter condenser across the end of the rectifier, the set's maximum B plus, has a 8 mfd. or higher capacity from that point to ground, and a large capacity helps get rid of instability in the high or medium-pitched frequency region. Such a condenser for elimination of low frequency oscillation is of no use. The capacity to be effective on the very low frequencies would have to be of the order of a 100 mfd., and the alternative recommendations are more practical.

(*Continued on page* 18)

The Economical Converter

Coil Data, Other Constants, and Connections

By Henry B. Herman

LIST OF PARTS

Coils

Two coils, one for modulator, one for oscillator; two windings on each; secondaries tapped.
One 300 turn honeycomb coil.
One 20 volt transformer.
One 15 henry B supply choke coil.

Condensers

Two 0.00035 mfd. tuning condensers.
Three 0.00025 mfd. fixed condensers (one with grid clips).
Two 8 mfd. condensers, with mounting nut and lug for each.
One equalizer, 20-100 mmfd.
One 0.0015 mfd. fixed condenser.

Resistors

One 5 meg. grid leak.
One 1,200 ohm fixed resistor.

Miscellaneous Parts and Accessories

One a-c cable and male plug.
Three leads for external connection (ant., gnd., output).
One 10x8x3 inch cabinet.
One a-c toggle switch.
Hardware: two dozen 6/32 machine screws, two dozen nuts, two dozen screws; one machine screw 2 inches long; two threaded bushings for mounting coils on socket screw; two right angle brackets for coils.
Two flexible leads, tipped at both extremes.
Two dials.

EXCELLENT results have been obtained by users of the short wave converter described in the August 29th and December 12th issues, there being a little constructional difference between the two, but no performance difference.

Besides, there was an error in the previously printed pictorial, having to do with the grid leak-condenser position, and the accidental grounding of the modulator grid lead. The diagram was correct schematically in both instances, but wrong pictorially in both instances, as Joseph Moynihan, of Mohawk, N. Y., kindly pointed out.

The coil data have been revised to apply strictly to the short waves, instead of some broadcast inclusion, and this application is good no matter what intermediate frequency is used. The frequency may be selected on the basis of sensitivity of your receiver. The data are: modulator coil, 15 turn primary, 1/16 inch space, 3 turns and tap, six turns more and tap, 16 turns more and stop; oscillator coil, 20 turn tickler, ⅛ inch separation, 8 turns and tap, 3 turns more and tap, six turns more and tap, 12 turns more and stop. The totals of secondaries are 25 turns (modulator) and 21 turns (oscillator). The wire is No. 28 enamel. The 8 turns on the oscillator are not part of the secondary, as the eighth-turn tap is grounded, but constitute the pickup coil, associating the modulator through its cathode with the oscillator through its grid. The diameter is 1.75 inches.

Only three connections need be made externally, these with wire outleads: one the connection to converter of aerial removed from set, another the connection to ground post of the set where ground is left intact, and the third, output of converter to vacated antenna post of set.

The operation of the converter is to select some intermediate frequency that is clear of direct broadcast pickup, after converter and set are turned on, and to leave the modulator dial (at left in top view) at minimum capacity, plates unmeshed. Then use the oscillator to pick up a strong station. Then turn the modulator dial until the station comes in loudest. Then use different intermediate frequencies of the set, leaving the modulator dial untouched, but always changing the oscillator setting to keep up with the change in the setting of the receiver dial. Use the same loud signal, compare results, and your ear will disclose what the best intermediate frequency is for your set, or at least whether nearer one or the other end or middle of the set dial. Often there is no difference in intensity over a quarter of the set dial, but nearly always a distinct difference between the two extreme settings, usually the higher frequency setting of the receiver giving much keener response. Then always use the same intermediate frequency and calibrate the converter dial settings for the three inductive values.

(*Continued on page* 18)

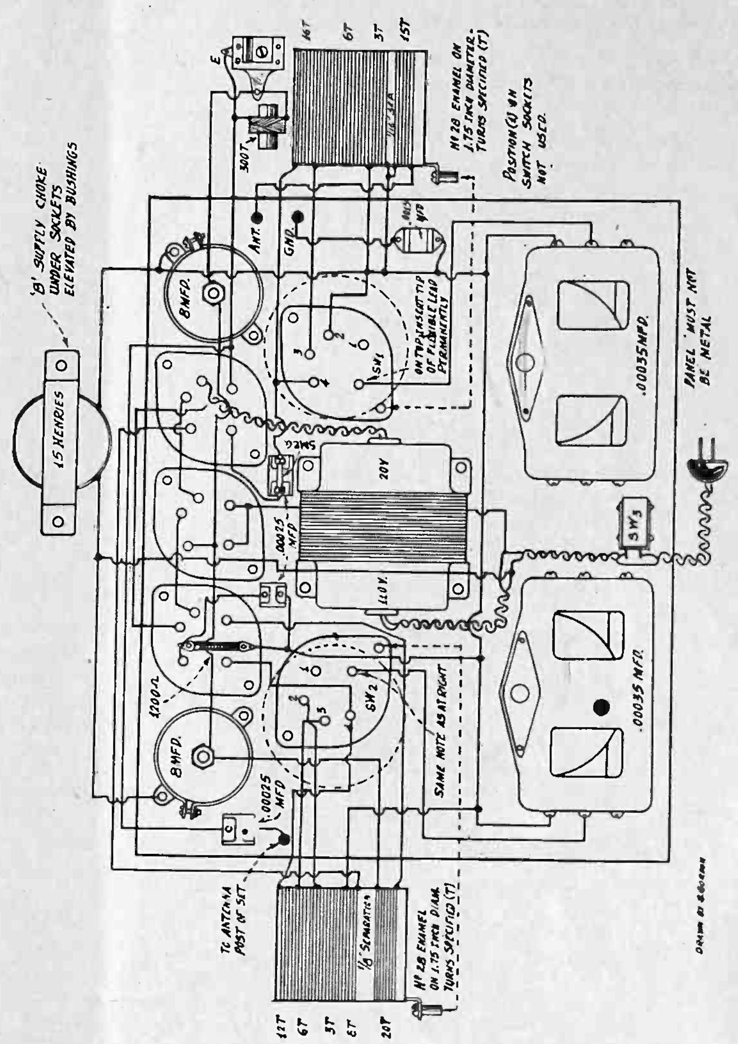


FIG. 1

Pictorial diagram of an extremely economical short wave converter that is an excellent performer. The schematic diagram is printed below.

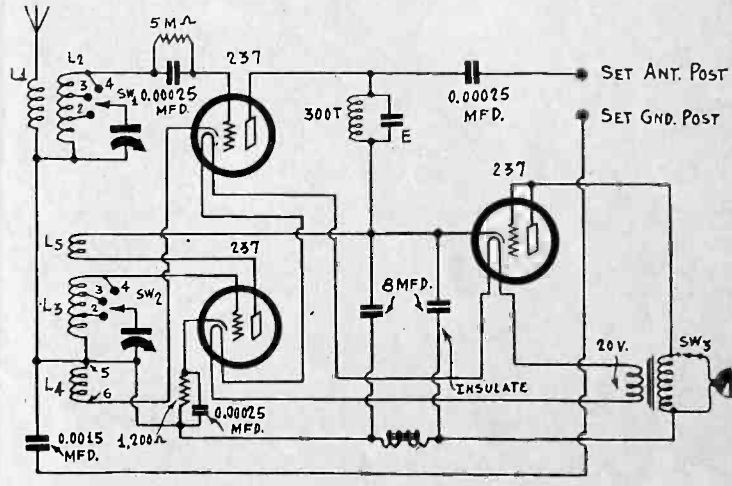


FIG. 2

The schematic diagram shows the connections at a glance, while the pictorial diagram (Fig. 1.) gives the physical layout and wiring, too. The output equalizing condenser is set at minimum for a high intermediate frequency and turned down with a screwdriver for tuning to a lower frequency. Once set it is left thus.

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.

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Universal Converter

WILL you please supply a hookup for a short wave converter that can be attached to a Kolster K-21 set?—D. J. MacD., Chicago, Ill.

The converter diagrammed on page 15 of this issue will serve your purpose. This converter works with any receiver.

* * *

B Power From Radiola Unit

KINDLY give details for connecting the converter described in the December 12th (1931) issue to a Radiola 28, with 104 loudspeaker and UP-972 a-c package. Can the voltages supplied in the 104 unit be used on a short wave set or a converter of any type?—J. R. McL., Sheraden, Pittsburgh, Pa.

The converter described in the December 12th issue, and concerning which further data will be found in the present issue, page 15, does not require any external B voltage, for it supplies all its own power. However, if you desire to revamp the converter circuit yourself, as your question seems to suggest, to obtain only the B voltage externally, connect ground of converter to ground of your set, and connect the B plus lead of the converter to the 90 volt post on the terminal strip of the power unit (attached to the 104 speaker). This lead is the third one from the right, next to the two posts marked "field."

* * *

Improvement of T-R-F

I AM still using a 1926 Diamond of the Air, with some changes. The first tuned radio frequency stage has a 235 tube, the second stage of r-f is resistance coupled, also 235, while there is a tuned input to the 227 detector. The first audio is resistance coupled 224, second audio 227, with 245 a-c output. I have never seen anything in print using such an r-f channel. I incorporated this combination so that I could work a converter, and have had good success. The last converter was taken from Blueprint 628-B. This one works the best of the several converters I have made. Have I the right combination on the two stages of r-f? Can you suggest a better combination? Should I change over to three tuned circuits for more sensitivity and selectivity? Or could I get more out of a set similar to that of Blueprint 627? I have been a reader of RADIO WORLD for almost 10 years and experiment quite a lot, especially with resistance coupling.—C. C. W., Loomis, Calif.

The sensitivity and selectivity can be improved considerably if you will substitute a tuned stage for the resistance coupled r-f stage. As a rule, resistance coupled r-f amplification is of little use, because there is amplification without selection, and besides the amplification does not begin to compare with that obtainable from a tuned stage. Since you have a set in working condition, and need make only a small change to improve it considerably, we suggest you economize by replacing the resistance coupled stage, as recommended, rather than build an entirely new set. The 627 that you inquire about is a most remarkable set, considering that it has a total of only five tubes, including rectifier. You showed ingenuity in using the 628-B Blueprint, which is for a six-tube all-wave set, for a converter. You will find that with the recommended tuned stage you will get much better results from all converters. To get high class results it is advisable to have a set that has a sensitivity of at least 25 microvolts per meter, which your set probably will have when the recommended improvement is made. Of course, the coils must be shielded and the shields grounded if you want to avoid oscillation trouble.

* * *

Building a Converter

PLEASE recommend me a suitable hookup for a short wave converter. I have five Pilot coils, three windings each, one seven plate condenser, one 27 plate midget condenser, and a 5 plate midget. Also I have a number of fixed condensers and grid leaks.—G. D., Somerset, Mass.

You can build a converter with two tuned circuits. Evidently the 27 plate midget is a Hammarlund midline junior, and its capacity then would be 0.0002 mfd., which is suitable. You could use the large condenser in the modulator circuit, putting in series with it a 0.00025 mfd. fixed condenser, to make the actual capacity only a little more than that of the 0.0002 mfd., assuming the large one is 0.005 mfd. As for the coils, since no information is given about them, with separate tuning of each condenser, one pair of coils could have 30 turn secondaries, the next pair 12 turn secondaries, enough tickler winding on the oscillator coil to afford oscillation all over at all settings, usually requiring about half as many tickler as secondary turns. The general hookup of the converter descrbed in this issue may be followed, as that circuit is fundamentally very sound, affords fine results for the number of tubes used, is economical and has proven a good means of getting distance.

* * *

Coil Connections for 627 Blueprint

IN building the 627 circuit, five tubes, a-c operated, t-r-f, I have not been able to get results. I checked the wiring and it is as diagrammed. The coils I got from Roland Radio Co. have a lug soldered to the shield base. The bottom of the base is marked: ground symbol, G, P and B. I get a continuity click through all windings. What is the voltage from plate to maximum B plus? I also got 15 plate condensers and are these O.K.? Is it all right to displace a coil with a socket to provide more room? Please define B minus connections.—A. L., Philadelphia, Pa.

The coils have the secondary return grounded to the shield, so no connection is to be made to any lug for ground, save end of antenna primary, since the chassis and shields are grounded. P goes to plate and B to B plus, except of course for the coil used in the antenna circuit, when P goes to aerial and B to ground. Connect G of coils to tuning condenser stators, and do not make any connection to the lug represented by the ground symbol, unless you want to tune higher than the highest broadcast frequency, when a switch would slide the stator connection from G to ground symbol. However, make the coil connections as previously directed, at first, disregarding switching, and then you will get results. Your present connections (shown in diagram with letter) short out nearly all the secondary. It is all right to move the coil to a position the diagram shows occupied by a socket. The maximum B plus to plate return of tubes should show a potential difference of about 50 volts. B minus to K of speaker socket goes to the can side of the electrolytic condenser. Both condenser caps are joined to B plus maximum. The 15 plate condensers are all right as supplied by this company.

* * *

Coils and Audio

LOOKING over a list I was interested in coils. I would like to get a set of five shielded coils, to use with gang tuning, trimmers manually operated from the front panel. This is a Silver Marshall Sargent-Raymont, remodelled for a-c tubes. I desire to try other coils and shields. Please let me know what to use. Also, the tone has changed in my set to a marked degree. The sounds are muffled or forced, and are of higher pitch. It sounds as if something is holding the sound back. Previously I could have heard a pin drop. I suspect the audio amplifier, as I tried grid leak detection, thinking poor detection was the cause. Also, the hum I used to get, due to high gain audio, is absent. I am using a Wright-De Coster dynamic speaker, Model 107, which is sensititve and realistic, so, again, I suspect the audio amplifier—J. W. W., Mt. Vernon, N. Y.

You may use standard 0.00035 mfd. coils, except that the primaries will be too large for several t-r-f stages, and will have to be cut down, which can be done easily, by removing turns. Use the coils as you get them. Of course there will be oscillation. Then remove primary turns, say, five turns on each coil at first, then two turns at a time, until this disappears. Normally the primaries have 25 turns, or thereabouts. Such a set as you have will get along better on 15 turns or thereabouts. You should use variable mu tubes. We are sending you data on coils, or you may follow the instructions in the December 12th (1931) issue for winding them. The sound trouble in your set seems to be, as you suggest, in the audio channel. An open grid return or winding is a likely guess. Test the plate and grid impedances for continuity, and biasing resistors for opens and shorts. The higher pitch is due to the suppression of the low notes, which would take place if the grid impedances were open. Also, as a precaution, test your speaker. Try coupling detector to the output audio stage, for if the trouble is in preliminary audio you will define it that way. Check up all voltages and performance of tubes.

* * *

Push-Pull Amplifier

COMPLETE parts are on hand for a double push-pull power amplifier and would like to build as follows: first stage resistance coupled, using a 224; second stage, 224 push-pull; output 247 push-pull. Please give me a criticism of this proposal.—W. D., Herrin, Ill.

The second audio stage should be transformer coupled, as there is no satisfactory resistance coupled push-pull method generally avail-

able, and 224 tubes can not well be used with a transformer, so also put in two 227 tubes as the second stage. The rest can be as you suggest.

* * *

Horn Speaker for 627

HAVING followed the Blueprint 627, five tube a-c t-r-f set, I have the set complete, except that have no dynamic speaker with field coil etc. and would like to use a horn type speaker of 700 ohms d-c resistance or thereabouts. Please tell me what connections to make.—A. Z., New York, N. Y.

You should use a dynamic speaker with the field coil tapped as prescribed, for best results. However, if you must press your horn speaker into service, connect a B supply choke coil from either filament of the 280 rectifier to the B plus prong of the speaker socket, and connect the two 8 mfd., one from rectifier filament to ground, the other from the opposite terminal of the B choke to ground, and put a 400 ohm resistor from center of the 2.5 volt filament to ground, connecting the grid return of the pentode to ground also. The B choke connections may be made to the speaker socket by using the two H terminals for connecting the B choke, one terminal of choke to one prong, other terminal to other prong. Then the positive B after choke prong and cathode prong may be joined, and cathode and grid prongs used for the horn speaker connections.

* * *

Resistor a Filter Choke Substitute

HAVING started to build a midget set, one of three published in the September 5th (1931) issue, I would like to know whether I can substitute a resistor for the filter chokes in the B supply, and if so of what wattage rating? I also would like to know the ratio of the pentode output transformer.—A. B., Oakland, Calif.

The proposed substitution can not be made, because a resistor does not provide any filtration in this position. The ratio of the transformer depends on the impedance of the voice coil of the dynamic speaker. Some pentode output transformrs, to work into 15 ohm voice coils, have a ratio of 45-to-1.

* * *

Coil Data in Converter

WILL you please express a preference as between the converters described in the October 10th and 17th (1931) issues? I have nearly all the parts for either one. Please give coil data. I have 32 double silk and 18 enamel wire.—G. S. G., Monroe, N. Y.

The converter shown in this week's issue is superior to those. If two dials are used for independent tuning of the two circuits, as suggested, a wider scope is permissible, because any intermediate frequency then may be used. For 0.00035 mfd. condensers, 1.25 inch diameter tubing, the largest secondary may consist of 32 turns of No. 30 double silk covered wire, for the modulator, and 25 turns for oscillator. The modulator primary may consist of 12 turns, the oscillator pick up coil of 8 turns, the plate winding of 15 to 20 turns. The ratio of frequency is about 3-to-1 for 0.00035 mfd. condensers, so the secondaries for succeeding coils would have one-third the number of turns of the preceding coil, all secondaries equal for these, while primary maintains 1-to-4 ratio and tickler has one-half the number of turns on the secondaries. You may use the No. 18 enamel wire for the smallest coil, antenna primary and two secondaries, with the smaller wire for the plate and pickup windings.

* * *

Patient About Monitor Set

MY sincerest wishes that the laboratory type monitor set you are working on will prove a success, as I would like something for wide frequency coverage that really would perform extraordinarily well. The 15-2,000 meter possibility is alluring, and I don't mind the four separate dials of this t-r-f set a bit. The circuit will appeal to DX fans who really want results. I am saving all copies of RADIO WORLD containing articles concerning this circuit, and desire to know if you have any literature you can send now that contains information not already published. I am patient about waiting, as I agree that the thing to do is to take time and get the circuit just right. I am going to start building this circuit just as soon as you say the word go. Will you spread the amateur bands on your machine? You should provide for television, too.—C.R.G., Wellington, Kan.

Work is going along steadily on the monitor receiver, which consists of three stages of t-r-f, tuned detector input, two stages of resistance coupled audio, with 247 output, and a B supply with 280 rectifier, total, seven tubes. At first 0.000325 mfd. condensers were used, and it was intended to let them cover almost all the broadcast band, for the first coils, and from 250 meters to about 85 meters for the next band. The broadcast coverage was all right, but the first short wave band found the stations too crowded, and tuning too difficult, as there is a separate dial for each tuned stage. Series capacities were to be cut in for the lower waves. But since then it has been decided to split up the broadcast band, using smaller capacity, and have the same capacity obtain for all waves, probably 0.00015 mfd. The set was tried with 0.000325 mfd. on television, but it was too difficult to "find" the stations, except those that came in strongly. The smaller capacities will cure this, and also afford adequate amateur band coverage without crowding. Band spanning for amateur use is not intended, but individually it may be achieved by using band spanning coils with parallel condensers in them, a topic that probably will be treated when the constructional articles finally are printed. The advisability of making the set a little wider, so that larger diameter shields may be used, has become apparent, also. Vernier dials are a requisite. There is no literature available, and about all the information to be imparted has been prnted in articles in RADIO WORLD, *or in the University Department. It was expressly stated the circuit is not ready for general construction, but, as said previously, when these data are ready they will be publishd. So watch* RADIO WORLD *from week to week. The articles were published in the October 24th, October 31st, November 7th and December 5th (1931) issues. The circuit was inspired by the similar monitor receiver used at the Grand Island frequency monitoring station of the Radio Division of the Department of Commerce, which, however, is battery operated, and really includes two receivers, one with four stages of t-r-f, the other with three stages, but we are confining ourselves to a single receiver to cover the same band, and also are utilizing a-c operation.*

* * *

Dynatron Converter

THE October 24th (1931) issue contains a short wave converter for which I wish you would give me the coil data.—D.N., Los Angeles, Calif.

This convrter had two separately tuned circuits, one the modulator, the other the oscillator, and was intended for 0.00035 mfd. tuning. The oscillator was padded for the first or longest wave band. The dynatron oscillator was included. L3, modulator, may consist of 32 turns of No. 28 enamel wire on 1.25 inch diameter, L5, the companion largest coil, oscillator, 20 turns of No. 28 enamel wire, L2 and L5 have 11 turns of No. 18 enamel or other covered wire, and L1 and L4 have 4 turns of No. 18 wire.

* * *

Midgets Inconsistent

SOME midgets sets I have with choke primaries do not perform the same. Some are sensitive, others not. I have a five converter but the 227 rectifiers burn out.—R.W.E., Cleveland, O.

Suggest you use an interstage coil for antenna coupler in the midgets. Use this as the antenna coupler instead of the choke primary coil in the weak sets. Improvement should be considerable, as choke primaries detune at one end if peaked at other, or detune at both ends if peaked at middle frequency. Put a 500 or 600 ohm resistor in parallel with the limiting resistor in the r-f cathode leg or substitute 300 ohms for resistor now there. Defectve 8 mfd. would cause the converter trouble. Measure the current through the 8 mfd. If plus 2 ma steady, after starting, that's your trouble. Otherwise too low bias on other tubes, or a defect in those tubes, would cause the same trouble.

* * *

Picture "Shimmies"

AT present I am operating a television receiver, disc and motor that cause the pictures to "shimmy." Previously there was no such trouble. I inspected everything and I can find no cause for the trouble. Please suggest a remedy.—W.R., New York, N. Y.

Inspect the neon lamp socket support. You may find that is a screw that fits into a threaded hole below. The screw permits adjusting the height of the lamp so that the illumination is in the plane of the scanned area. This screw needs a locknut. As soon as you tighten down the support the lamp will not wobble and the shimmying effect will disappear.

* * *

Projected Pictures

IN establishing projected television, is it necessary to have a lens disc, and also a projecting lens, and may I use my present neon lamp, which has 1 inch plates?—H.U.D., Chicago, Ill.

Projected television requires a high powered neon lamp, e.g., a crater lamp, also a lens disc, and a viewing screen a few feet from the disc. The lenses on the disc, one len at each hole, suffice for home use. No extra lens for projection is necessary. Your lamp will not do.

* * *

Not Enough Picture Strength

MY neon lamp does not give what I consider sufficient brilliance. Also, the pentode output tube of the short wave receiver gets red hot when I switch to television, although there is no such trouble when I tune in the television signals by sound. Please rush remedy, as I am afraid I will burn out the 247.—N.I.P., Fargo, N. D.

To give better picture strength, put a limiting resistor in series with the neon lamp, 10,000 ohms, 2 watts. This reduces the d-c flowing in the lamp, the no-signal brillance of the lamp is less, while the signal brilliance is comparatively greater. The situation obtains because the lamp is a current operated device, and a given amount of variation produced by the signal becomes a larger percentage of the total illumination when the no-signal illumination is kept low.

(Continued on next page)

Radio University

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(Continued from preceding page)

Hence the remedy provdes what might be termed better picture strngth. The pentode gets red hot because the screen voltage is 250 volts when the effective plate voltage (due to the resistance of the lamp dropping some 200 volts) is only 50 volts. Put a 10,000 to 25,000 ohm 2 watt rsistor in series with the pentode screen and leave it there for aural or visual reception. Please state what television stations you tune in at Fargo, as we are at a loss to tell how you get television results over long distances.

* * *

Too Selective for Television

MY set consists of two stages of t-r-f, with skinny primaries, and a tuned detector input, regeneration being used in the detector. My dials are separate. Regeneration does not seem to do any harm except at spillover. When I try to tune for television it must always be by sound, for I can not tune sharply enough otherwise. Then, too, when I switch from sound to vision I have to retune.—H.E., Brooklyn, N.Y.

Increase the number of primary turns. The set then will tune more broadly, as it should, for television is better served by a lower order of selectivity than you have. Regeneration does not do any harm, unless overdone, that is, unless the tube breaks into oscillation. When the set is oscillating regular patterns are readable on the screen, as you know, and may appear as wavy lines, and will change form and intensity as the degree of oscillation or frequency is varied slightly. The ruinous effect of regeneration on detail seems to be mostly theoretical at the present state of picture definition at the receiving end. Tuning by sound is almost imperative, at least until you have the television stations calibrated, and even then you have to produce lght somewhere, to read the dials, as you are looking in amid darkness. The necessity for retuning arises from the change in voltages introduced when the power tube load is changed. Remember that the d-c in the B supply drops about 25 ma when the neon lamp is switched to replace the speaker. The retuning is not a hardship. Some volume controls, as in cathode leads of r-f tubes, also detune slightly.

* * *

Tin Shields

I READ something by Herman Bernard in the December 12th (1931) issue on coils that I would like to ask about. In fact, I have seen the same admonition by scores of writers and engineers on the same thing. And that is the practice of using tin or any other material containing iron for shielding against radio frequency currents. Although I have never quite understood just the reason for this caution, I want to speak of a case right here in my own city that is beginning to make me lose faith in this theory. I have a friend here who built a ten-tube super-heterodyne, and for shields on his r-f coils and i-f transformers, he went to the local canning factory and obtained some new unused tomato cans, and after polishing them up nicely put them over all the coils. They absolutely killed all oscillations that were present beforehand, and stabilized the whole set as well as I have ever seen copper shields do. And with no more loss in volume than any other shield. Now, mind you, these cans are pure tin, and this is an actual case, no theory, so what is the reason for cautioning builders not to use tin or iron metals for r-f shielding, as I cannot see any difference, unless it might be a loss which is greater than copper, which in this case the ten tube gain took care of?—H. J. R., Mason City, Iowa.

Theoretically, the best shielding material is the best conducting material. Thus silver comes first, copper second, and perhaps aluminum third. The lower the loss in the material the better does the metal reflect the waves without loss. There will be a decrease in the inductance when a shield of such material is put over a coil, but there should not be a great loss in effectiveness if the coil is retuned. There will be some loss because there will be some current in the shielding. But conductivity alone is not the determining factor in the shielding property of the material. The permeability also enters. The greater the permeability the greater the shielding effect, and aa tin can is made mostly of iron which has a high permeability. At low frequencies the permeability of iron such as used in tin cans may be a 1,000 or more times greater than the permeability of silver or copper, for which it is unity. Even at radio frequencies the permeability is considerably higher for iron than for the best conductors. We should expect to find tin cans highly efficient as shields at radio frequencies as well as at audio frequencies. The losses would undoubtedly be somewhat greater in the tin can than in cans made of better conducting metals, but in a ten tube superheterodyne there is so much amplification that much can be thrown away in the interest of stability.

Stabilizing Audio by Filters and Leak Values

(Continued from page 14)

No fear need be felt about frequency discrimination when leak values are lowered, biasing resistor condensers omitted or reduced in capacity, or resistor-capacity filters inserted, as the instability is itself proof positive of discrimination of a high order, and the remedies are really for the elimination of discrimination. Theoretical considerations of stopping condenser values as compared to grid leak values, also bypass capacities requisite for avoiding negative feedback in biasing resistors, and other such ideas, while mathematically sound, are computations made without regard to the presence of audio regeneration, much less the excessive amount that causes the trouble. Regeneration is there aplenty, and enough of it should be removed to insure stability. If it were not for regeneration, resistance coupled amplifiers would not produce the gain they do, which is approximately the mu-factor of the tubes used.

In the detector circuit sometimes the enlargement of the plate resistor is necessary even until the value of 1 meg. or more is reached, so that stability will be certain. The reason is, the higher this resistance, the less feedback through the detector. The increased value of the plate load sometimes will require increasing the value of the biasing resistor, for the current has been lowered, and the bias, too, unless the value of the biasing resistor is increased. If the 224 tube is used as detector, the applied plate voltage, the maximum of the B supply (say, not more than 275 voltes), the screen voltage 45 volts, then the negative bias should be around 5 volts, but if the screen voltage is lifted to 90 volts (whereby the r-f screen voltage is applied also to the detector), then the negative bias may be lifted to 7.5 volts, or even more, good detection having been enjoyed on as high as 9 volts negative bias under these conditions. Since the biasing voltage can not be measured with ordinary instruments, it is well to measure the current when the resistor is about 50,000 ohms in the biasing circuit. The current will be about 0.2 milliampere and will change very slightly as the bias is proportioned correctly, so the resistor may be selected on the basis of the previously ascertained current.

Universal Auto Set; How to Test for Ground

(Continued from page 13)

no spark. That is the grounded one. The polarity of the battery is marked, sometimes with "POS" for the positive and sometimes this terminal is simply painted red. If there is no distinguishing mark, a voltmeter will tell which is plus and which is minus.

Incidentally, the circuit in Fig. 1 is a complete receiver and the diagram may be used for building a set. All the necessary values of condensers and resistances are given, except those of the tuning condenser and coils. It is customary to use a gang of three 0.00035 mfd. condensers for tuning and coils to match. These are standard values.

As the pick-up in a car is minute, it is absolutely necessary to have a high gain in the receiver. Selectivity is not as important a factor as it is in a receiver intended for home use. Hence it is permissible, in fact almost necessary, to design the circuit so as to achieve sensitivity even if selectivity must be sacrificed. This simply means that the coils used should have high impedance primaries. In the circuit shown, as many as 100 turns, closely coupled to the secondary, have been used successfully when the secondary had about 140 turns. t is admitted that the selectivity is not of the best with this combination but it is ample to separate all local stations from each other. And when the car is used out in the country remote from all stations, even better separation is possible.

Blank Post Useful if Condenser is Small

(Continued from page 15)

The converter not only is a good one but it is extremely easy to build and costs only a little. You can wind the coils yourself or obtain them commercially. The converter will work on any type of receiver, including superheterodynes. The wave band shifting is done by moving the stator connections of the tuning condensers from extreme to one tap or another, only two intermediate taps being needed for 0.00035 mfd. condensers to cover from 200 to 15 meters. The coil data locate these taps accurately. The condenser grids are brought to a socket post. On top the panel a flexible lead is inserted permanently to this post, then moved to any of the three coil positions—one of the two taps or one extreme. One switch socket post is blank, not being needed. It may be used if smaller capacity condensers are in service, such as 0.0002, 0.00015 or 0.00015 mfd., for then three intermediate taps are necessary, smaller condensers having a smaller frequency range for a given inductance.

REVISED CODE PROPOSED BY RADIO BOARD

Washington.

Secrecy regarding a proposed new code for the Federal Radio Commission was dispelled when the details were made public by the Commission simultaneous with transmission to Congress of proposed legislation.

The Board proposes:

Station license limitation to one year, instead of three years.

A strong anti-lottery law.

Right to suspend station licenses for 30 days as a milder preventive measure than cancellation.

1600-1700 kc band for television instead of 2850-2950 kc band, sound track on 1550 kc.

Station License Time Limit

Concerning the license time limitation the Board asks the following be enacted:

"No license granted for the operation of a radio station shall be for a longer term than one year, and any license granted may be revoked as hereinafter provided. Upon the expiration of any license, upon application therefor, a renewal of such license may be granted from time to time for a term not to exceed one year, but action of the Commission with reference to the granting of such application shall be limited to and governed by the same considerations and practice which affect the granting of original applications."

Anti-Lottery Provision

In the provision against lotteries the following is the language:

"No person shall broadcast by means of any radio broadcast station for which a license is required by law of the United States, any information concerning any lottery, gift enterprise, or similar scheme, offering prizes dependent in whole or in part upon lot or chance, or any information concerning any ticket, certificate or instrument representing any chance, share or interest in or dependent upon the event of any lottery, gift enterprise or similar scheme offering prizes dependent in whole or in part upon lot or chance. or any list of prizes or information concerning any list of prizes awarded by means of any such scheme, and any person so doing, upon conviction thereof, shall be fined not more than $1,000 or imprisoned not more than one year, or both."

New Rule for Records

Phonograph records, call letter announcements, and quota distribution also are covered.

Regulations relating to announcements of transcription and phonograph broadcasts, now General Order 78, will specify only that language describing such production be "clear:"

"A mechanical reproduction shall be announced as such just before it is broadcast, except when its use is merely incidental, as for an identification or background. The exact form of announcement is not prescribed, but the language shall be clear and in terms commonly used and understood. The following are examples of statements sufficient for the purpose:

"(a) 'This is a mechanical reproduction.'

"(b) 'This is a player-piano record.'"

Call Letter Announcements

Call letter announcements, now required every 15 minutes under General Order 8, may be announced at least every 30 minutes:

"Each license of a broadcast station shall announce the call letters and location as frequently as practicable during the hours of operation, and in any event before or after each program being broadcast. In no event shall more than 30 minutes elapse between such announcements, and in so far as practicable these announcements shall be made on the hour and half hour. These requirements are waived when such announcements would interrupt a single consecutive speech; and in such cases the announcement of the call letters and location shall be made as soon as possible."

Quota Under Radio Law

General Order 102, concerning quota distribution, was revised so where no interference might result, slight deviation from the rigid mathematical formula determining quota will be permitted.

The second part of the new regulations concerns practices and procedure before the Commission. Parties to proceedings before the Commission may appear personally or through attorneys, so long as the persons who appear conform to ethical standards of legal conduct.

When such action is considered by the Commission to be in public interest, properly filed applications may be granted without hearing, on a conditional 20-day basis. If any party is aggrieved, a hearing may be called for upon application filed with the Commission within 20 days after the decision. Such applications must contain a statement of the applicant's interest in the decision, and a sworn objection to facts presented in the Commission's decision.

The "broadcast day," now specified as 12 hours, under General Order 105, for unlimited time stations, is amended to include half-time stations, and other classes of stations, pointing out that every station must operate at least two-thirds of the total time allotted to it for a broadcast day, with the exception of Sunday. Violation of this rule will lead to time reduction of the violating station.

Hoover Spoke 29 Times, Record

Washington.

Five hundred and fifteen broadcasting hours were utilized by the United States Government over the networks of the National Broadcasting Company during 1931, M. H. Aylesworth, President of the Company, reported.

The report disclosed that 329 government officials spoke over the radio, making a total of 720 addresses. Virtually every day during 1931 some activity of the Federal Government was discussed over the network.

President Hoover, the report showed, spoke 29 times, which is the greatest number of times any President has been heard over the radio in one year; Vice-President Curtis made three radio speeches; the Chief Justice, Charles Evans Hughes, spoke five times.

Every member of the cabinet faced the microphone at least once during the year.

2 TELEVISION BAND CHANGES IN NEW RULES

The frequency of 1,550 kilocycles, just above the broadcast limit, is designated as the visual broadcast sound-track. This will enable ordinary sound-receivers to pick up sound accompaniments to television broadcasts, without addition of any shortwave unit. The sound-track was formerly designated as 1,604 kilocycles.

Television Revision

Replacing the 2,850-2,950 kilocycle experimental television band, the Commission specifies the band between 1,600 and 1,700 kilocycles, formerly assigned to aviation. This affects only one of four bands, the others (intact) being 2,000-2,100, 2,100-2,200, and 2,750 to 2,850. W9XR, Chicago; W1XAV, **Boston;** W2XCP are on 2,850-2,950. The ultra frequencies are not affected.

The Commission deleted General Order 56, regarding visual broadcasting regulations, and substituted the following provisions in the regulations:

"The licensee of an experimental visual broadcast station shall not permit the transmission of programs involving advertising features. This regulation, however, shall not be construed to prevent the transmission of a visual broadcast program simultaneously with a regular broadcast station program having commercial aspects, provided that commercial announcements, either oral or visual, shall not be made on the visual broadcast frequency. In all such simultaneous transmissions from a broadcast station in the band 550 to 1,500 kilocycles and from a visual broadcast station in the band assigned to visual broadcasting, the regular broadcast station shall make the regular commercial announcement only on the broadcast frequency.

Language Specified

"Both stations shall make the announcements of call letters for both the broadcast station and the visual broadcast station on their respectively frequencies; provided that when commercial announcements are made on the broadcast frequency, and the use of the visual broadcast frequency is referred to, the following form of announcement only shall be used:

"This program is being broadcast by television over station ——— on the frequency of .... kilocycles. These visual broadcast transmissions are experimental."

IMPORTANT NOTICE TO CANADIAN SUBSCRIBERS — RADIO WORLD will accept new subscriptions at the present rates of $6 a year (52 issues); $3 for six months; $1.50 for three months; (net, without premium). Present Canadian subscribers may renew at these rates beyond expiration dates of their current subscriptions. Orders and remittance should be mailed not later than January 31st, 1932. Subscription Dept., Radio World, 145 W. 45th St., New York, N. Y.

A THOUGHT FOR THE WEEK

THE field of journalism is now furnishing a good proportion of our important and edifying air programs. One of the latest recruits from reportorial and literary ranks is Ada Patterson, whose signature as a "by line" has been attached many hundreds of times to her various contributions to newspapers and magazines. During her brilliant years of service in journalism Miss Patterson has interviewed many of the leaders of the stage, music, politics and science; and it is natural that her program each Wednesday at 4:15 P. M. over WMCA should be entitled "Interesting People I Have Met." Miss Patterson, besides knowing her work well and loving it, has the human touch that makes everything she does stand out while sounding the note of authority. Her training has been long, her observations intelligent and her results gratifying to those who know, admire and esteem her as a clever woman and a conscientious artiste.

RADIO WORLD

The First and Only National Radio Weekly

Tenth Year

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

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

Hawaii-U. S. Phone Service

Direct radiophone connection between the American continent and the Territory of Hawaii was opened formally recently by Secretary Wilbur when he talked by radio from Washington with Governor Lawrence M. Judd of the Territory, in Honolulu, the connection having been made possible by the completion of a communication channel by the American Telephone and Telegraph Company.

Wires carry the voices from points on the American continent to San Francisco. Then short waves serve to connect San Francisco with Honolulu. From Washington to Honolulu the total distance is about 5,500 miles. The distance from Washington to San Francisco being about 3,000 miles and that from San Francisco to Honolulu being 2,500 miles.

Naval Radio Stations Shut

Washington.

The Federal Government closed down its naval radio stations at the Great Lakes Naval Training School, near Chicago, as a measure of economy, according to an announcement from the Navy Department. The equipment, however, will be kept in operating condition so that it may be used for communication with training vessels of the Naval Reserve Units during their Great Lakes cruises next summer. The Navy department also closed the radio stations at Savannah, Ga., and at St. Augustine, Fla., permanently.

WMAK Ordered to Quit

WMAK, Buffalo, N. Y., has been ordered off the air by the Federal Radio Commission. The station was operating on a frequency of 1,040 kc. with a power of 1,000 watts and was operated by the Buffalo Broadcasting Corporation.

The Buffalo area would receive adequate service without WMAK, the Commission stated in its decision. The Commission's action sustained Examiner Ralph Walker.

Station Sparks

By Alice Remsen

It Might Be Worse

(For Tony Wons, WABC, 9:30 A.M. every day except Sunday)

WHEN everything just seems all wrong,
And you're as blue as blue can be,
Because you own an empty purse,
Just grin and say "It might be worse."
You might have fallen down the stairs,
Or tripped on a banana peel,
Instead of just an empty purse,
It might have been a whole lot worse.
Just think that if you owned a yacht,
You might be drowned far out at sea;
Compared with that an empty purse
Assuredly is "Not so worse!"

A. R.

* * *

And Don't Forget—If you're feeling blue or sore at the world because hard luck pursues you, tune in on Tony Wons and his scrapbook some morning. He'll probably give you a little touch of philosophy that will make you feel better.

* * *

Nat Shilkret, with his thirty-six piece orchestra, and Alex Gray, musical comedy baritone, as soloist, comprise the show for the new Chesterfield account on WABC. Baritones are becoming more fashionable than tenors. They sound softer over the "mike" and seldom go off key. The new program is scheduled to open on Monday, January 4, at 10:00 p.m. and will be heard every night except Sunday at that period.

* * *

At Last Jack Foster, the most popular of New York's daily radio columnists, has succumbed to the lure of radio's beckoning hand. He will assist in the inauguration of a series of literary programs to be broadcast over an N. B. C.-WJZ network at 3:15 p.m., E. S. T., beginning Thursday, January 7th. Mr. Foster will introduce Thomas L. Stix, president of the Book League of America, who will outline and explain the purpose of the program. In subsequent broadcasts contemporary American literary figures will be interviewed.

* * *

May Singhi Breen has taken up the cause of the much maligned ukulele. The Musicians' Union refuses to recognize it as a genuine musical instrument. May will prove that it is, by playing several very difficult classical and jazz compositions upon her silver-fretted favorite ukulele before a group of Musicians' Union officials. Let's hope that May melts their adamantine hearts and wins her Union card.

* * *

Voice of Firestone has at last signed Lawrence Tibbett, for its Monday night broadcasts on the N.B.C.—WEAF network. It is the first time an active member of the Metropolitan Opera staff has been allowed to contract for a radio series. Tibbett will make his initial appearance in the series on January 4. By the way, I wonder what has happened to the original "Firestone Voice," Franklin Bauer. Heard its contralto, Vaughn de Leath, a few Sundays back on WOR, as guest artist on the Ludwig Baumann program. As usual, Vaughn did a very good job.

* * *

Paul Whiteman Will Present a symphonic jazz concert for a very worthy cause—a benefit for unemployed musicians at the Metropolitan Opera House, on Sunday night, February 28. Rudy Vallee will appear as guest conductor. Mark this date on your new calendar and try your best to be there.

* * *

Don Carney takes his talents over to an N.B.C.-WJC coast-to-coast network on Friday, January 1, when he opens on a new program series to be sponsored by the Chesebrough Manufacturing Company. The new series will be called "Friendship Town," portraying modern small-town life. Associated with Mr. Carney in the cast will be that fine actor, Edwin Whitney; Pick Malone and Pat Paget, well-known radio blackface comedians; Virginia Gardner, Edith Spencer and Harry Salter's orchestra.

* * *

New Year Greetings Will Be Heard from Germany and England over WABC on New Year's Eve. Between 6:00 and 6:20 p.m. chimes will be heard from the ancient German cathedral and university city of Heidelberg; a students' chorus will also sing a program of New Year music; then at 7:00 p.m. Big Ben, the famous clock atop the Houses of Parliament in London, will be heard striking the English midnight and ushering in the New Year.

* * *

Sidelights

CAROL DEIS, soprano on the N.B.C. Black and Gold program, is a native of Dayton, Ohio . . . RALPH KIRBERRY, N.B.C.'s Dream Singer, served in a tank corps during the World War . . . BOB CHILDE, of the Fireside Singers, holds the ping-pong championship of Detroit, Mich . . . WILLIAM S. RAINEY was once a tenor in the Metropolitan Opera Co. . . . ART JARRETT carries a lucky guitar pick . . . SINGIN' SAM is still playing vaudeville between broadcasts. . . . So is BING CROSBY . . . TED WEEMS once had John Coolidge as guest conductor, while he danced with the fiance of the Ex-President's son . . . The legal profession is well represented on radio—f'rinstance: CASEY JONES studied law; ART JARRETT and BING CROSBY both took legal courses; MILTON RETTENBERG was admitted to the bar of the State of New York; SCRAPPY LAMBERT is another graduate lawyer . . . NAT BRUSILOFF hails from Washington, D. C. . . . So does KATE SMITH . . . CARL FENTON'S first broadcast was in September, 1924, when his band was invited to furnish music at the welcome-home of the first round-the-world flight . . . MORTON DOWNEY is back at the Central Park Casino . . . BING CROSBY'S full name is Harry Lillis Crosby.

* * *

COMIC CUTS

The meek little man was telling Ted Weems about his trip to Europe: "And when you were in Rome," Ted inquired, "did you do as the Romans did?" "No," was the reply. "My wife was along. I did as she did."

* * *

Judging by the following, contributed by Little Jack Little, England radio listeners suffer as much as we do: A woman entered a butcher's shop with her small daughter. Some tripe was displayed on the counter and the little girl asked what it was. "Tripe, dear," replied her mother. "That's funny," said the child, "Daddy says that's what we get over the wireless."

SPLIT SECONDS MARK TIMING OF BIG CHAIN

Time is literally money in the broadcasting business, and its value is so great that it is checked to the split second several times daily.

There are ninety-seven clocks in the National Broadcasting studios and offices at 711 Fifth Avenue, New York, and each one gives exactly the same time as every other. They are set from the Naval Observatory clock in Arlington, Virginia, at noon and at 10 p. m.

And three times daily time signals are sent out by the N.B.C. to its associated stations across the country, so that synchronization of programs may be perfect not a second wasted.

In the broadcasting studios and control rooms clock-watching is a very important part of the day's work. Without it, network programs would be an impossibility.

How To Read Arlington Time

Arlington gets its time from the Naval experts who "shoot the sun" at frequent intervals. It is exact to a small fraction of a second. And Arlington sends out its signals by short-wave radio for five minutes twice daily, broadcasting the ticks of the clock.

The second-by-second time broadcast starts five minutes before the hour. The twenty-ninth second of each minute is eliminated so that the listening engineer is warned that thirty is next. From fifty-six to fifty-nine inclusive, the ticks again are eliminated to give warning that number sixty is next. The ten seconds immediately preceding the hour also are silent, and then the hour is sounded with a gong.

The same system of second-by-second clicks is used to send the signals to the N.B.C. associate stations, except that in this case, instead of short-wave radio, the Morse wires which link the stations are utilized.

Synchronization Essential

The ninety-seven clocks in the N.B.C. Building are checked from the master chronometer immediately after the Arlington signals are received, to guard against any possibility of variation.

The absolute synchronization of network units is essential, so that one program may not overlap another. For instance, a station in Chicago may be scheduled to pick up a network program starting at 9 p. m. in the N.B.C. studios in New York. Therefore the previous program must be off the air at exactly nine. The same accuracy is required in all the other eighty-four stations on N. B. C. networks.

In addition, time must be allowed for the local station announcements at stated intervals. The N.B.C. chimes are the cue for these. As the chimes end, each station switches off the network and the announcer gives the call letters. The stations remain off exactly fifteen seconds, and then switch back on to the national chain again.

Clocks Highly Accurate

Because of this operation by the second, each of the N.B.C. clocks is equipped with a large red second hand which circles the dial every minute. Variation, according to N.B.C. engineers, does not total more than five seconds in six months.

KALEIDOSCOPE

A searchlight radio loudspeaker can encompass an audience within a radius of three miles. Concentration to this unusual degree gives rise to a problem if its going to earn a living. The flock of listeners must be increased.

* * *

A receiver is a necessity, insists the National Association of Broadcasting, and might cite the charitable feature of orphan sets being adopted by so many families. A. B.

ODDITIES BARED IN STATION TEST

A survey has been made by N. W. Ayer & Son, Inc., a leading advertising agency, of the value of various stations as advertising media. Hyland L. Hodgson, in charge of the broadcasting division said:

"Primarily we wanted to know exactly where each station was heard and to what degree; that is, which was first preference, second, third and fourth. But we have also found out some of the vagaries of radio.

"There is a general belief that all radio is more effective at night than in the daytime. Yet we find some localities where Station A gives perfect broadcasts during the day but cannot be heard at night. Such is the report from a section in the West.

"In North Carolina we find that one section consistently listens in on a Florida station at certain times although there is a good station only 35 miles distant. Atmospheric conditions are said to be responsible.

"From a good territory in Oregon we hear that the best reception is from the South and that a Los Angeles station 1,200 miles away is more effective than another station only 200 miles away.

"In Montana there is a town which finds daylight reception impossible while still another reports that 'a local station is giving marvelous daytime reception' especially to rural listeners. Other sections of the West and Middle West report certain stations which have widespread rural acceptance, due to the types of programs, weather information, market reports and such. This is particularly true of a number of stations in Wisconsin, Nebraska and the Dakotas.

"We find also that some stations actually 'hop over' one or two counties and then go merrily on with perfect broadcasts; that some are useless in the daytime and others to all intents and purposes dead at night; there are others which are far more effective in summer than in winter and some that are popular or unpopular because of their programs and others because of their 'attitude'. For instance we have this information from a town in Nebraska: 'Station X is one of the least popular, as they have a snooty attitude which doesn't take; people don't have to listen, you know; and they sure won't if they do not like the station's manner'.

"From central Wisconsin we get the information that there is one completely 'dead' spot for a powerful and otherwise effective station; from another section we learn that Station Y is popular because of its children's programs."

TUBE PRICE REDUCED

The Arcturus Radio Tube Company, Newark, N. J. has reduced the list price of the 122 D-C screen grid tube to $3.

N.B.C. PROGRAM LIST FOR YEAR TOTALS 33,000

Thirty-three thousand broadcasts involving more than one quarter million participants in a score of nations comprised the 1931 program year of the National Broadcasting Company.

The N.B.C. year revealed the world in review with stirring events and dynamic personalities on the air for the first time. First international addresses by Premier Mussolini and Pope Pius XI inaugurated the radio cycle. World flights, political and sport spectacles followed. A globe-girdling tribute to Marconi, the Oxford-Harvard debate and the radio premiere of Metropolitan Opera climaxed broadcasting of 1931.

Analysis of a typical broadcasting month showed program percentages to be: music, 62.9 per cent; literature, 11.8 per cent; educational (all types), 21.3 per cent; religion, 2.5 per cent, and novelties, 1.5 per cent.

Broadcasting developments by N.B.C. brought the addition of $1,000,000 in talent to daytime programs, establishment of television studios and laboratories atop the Empire State Building, addition of a second Pacific Coast network, and the signing of a lease for twenty-seven studios and other space in Radio City. Included also was the linking of KGU, Honolulu, with domestic networks, and the exclusive broadcasting and entertainment alliance with the Waldorf-Astoria Hotel.

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.

Robin Matthew, 5 St. Michaels Pl., Charleston, So. Carolina.
Jos. M. Darg, 1402 No. 16th Ave., Melrose Park, Ill.
Wesley Williams, Radio-Trician, 23 Pearl St., San Francisco, Calif.
Lloyd U. Wolff, Wolff Repair Shop, 129 No. Willow St., East Aurora, N. Y.
Graydon Constantine, R.F.D. No. 2, Oshkosh, Wis.
Elwood Brooks, Receiver & Short Wave set parts, 1636 E. 36th St., Cleveland, Ohio.
Floyd L. Nycum, Receiver & Short Wave set parts, 6118 Lorain Ave., Cleveland, Ohio.
Howard Merrill, R.F.D. 1, Box 48, Lake Leelanan, Mich.
H. W. Davis, R. No. 2, Leonard, Texas.
Porter Simpkins, Rt. 2, Vernon, Tex.
Ivan A. Burroughs, 1765 Douglas Ave., Clearwater, Fla.
H. T. Siefers, 1101 N. 6th St., Lafayette, Ind.
Mike Banas, R.F.D. 3, Smithfield, Pa.
B. C. Montgomery, Box 18, Rock Falls, Ill.
Lucien Lesaffre, 178 Water St., Lawrence, Mass.
Jacob D. Shear, 80 N. Pine St., Gloversville, N. Y.
Lee Russ, 4354 W. Thomas St., Chicago, Ill.
Harold Scott, "Utility Shop," Marmarth, No. Dak.

NEW INCORPORATIONS

Radio Weekly Publishing Co., New York, N. Y.—Atty., M. G. Lowenstein, 25 Broad St., New York, N. Y.
Todd Transformer Corp., electrical machinery and mechanical engineering—Atty., J. Glenn Anderson, Newark, N. J.
Autogiro Specialties Co., Wilmington, Del., aircraft—Atty., Corporation Trust Co., Wilmington, Del.
George R. Thayer Co., Binghamton, N. Y., musical instruments—Attys., Merchant, Waite & Waite, Binghamton, N. Y.
Gallant School of Music, Inc., Hoboken, N. J., deal in musical instruments—Attys., Levenson, Comen & Levenson, Hoboken, N. J.

[The list of United States broadcasting stations is being published serially. The December 19th issue gave the data on stations from 550 kc (545.1 meters) to 1040 kc (288.3 meters), while last week's issue, December 26th, covered 1050 kc (285.5 meters) to 1230 kc (243.8 meters). The data are complete as to information about stations, and are corrected up to press time. Note the fullest possible particulars are given. Next week the final instalment will be printed.—Editor.]

BROADCASTING STATIONS BY FREQUENCIES—*Continued from last week*

1240 KILOCYCLES—*241.8 Meters*

WXYZ	Detroit, Mich.	Kunsky-Trendle Broadcasting Corporation	1KW	Unlimited.
KTAT	Fort Worth, Tex. T—Birdville, Tex.	S. A. T. Broadcast Co.	1KW	Shares with WACO.
WACO	Waco, Tex.	Central Texas Broadcasting Co. (Inc.)	1KW	Shares with KTAT.
KGCU	Mandan, N. Dak.	Mandan Radio Assn.	250W	
KLPM	Minot, N. Dak.	John B. Cooley	250W	

1250 KILOCYCLES—*239.9 Meters*

WGCP	Newark, N. J.	May Radio Broadcast Corporation	250W	Shares with WODA and WAAM.
WODA	Paterson, N. J.	Richard E. O'Dea	1KW	Shares with WGCP and WAAM.
WAAM	Newark, N. J.	WAAM (Inc.)	1KW; 2KW-LS[18]	Shares with WODA and WGCP.
WDSU	New Orleans, La. T—Gretna, La.	Joseph H. Uhalt	1KW	Unlimited.
WLB	Minneapolis, Minn. T—St. Paul, Minn.	University of Minnesota	1KW	Shares with WRHM, KFMX, and WCAL.
WRHM	Minneapolis, Minn. T—Fridley, Minn.	Minnesota Broadcasting Corporation	1KW	Shares with WLB, KFMX, and WCAL.
KFMX	Northfield, Minn.	Carlton College	1KW	Shares with WLB, WRHM, and WCAL.
WCAL	Northfield, Minn.	St. Olaf College	1KW	Shares with WLB, WRHM, and KFMX.
KFOX	Long Beach, Calif.	Nichols and Warriner (Inc.)	1KW	Unlimited.

1260 KILOCYCLES—*238.0 Meters*

WLBW	Oil City, Pa.	Radio-Wire Program Corporation of America	500W; 1K-LS	Unlimited.
KWWG	Brownsville, Tex.	The Brownsville Herald Publishing Co.	500W	Shares with KRGV.
WTOC	Savannah, Ga.	Savannah Bradcasting Co. (Inc.)	500W	Unlimited.
KRGV	Harlingen, Tex.	KRGV (Inc.)	500W	Shares with KWWG.
KOIL	Council Bluffs, Iowa	Mona Motor Oil Co.	1KW	Unlimited.
KVOA	Tuscon, Ariz.	Robert M. Riculfi	500W	Daytime.

1270 KILOCYCLES—*236.1 Meters*

WEAI	Ithaca, N. Y.	Cornell University	1KW	Daytime.
WFBR	Baltimore, Md.	Baltimore Radio Show (Inc)	500W	Unlimited.
WASH	Grand Rapids, Mich.	WASH Bradcasting Corporation	500W	Shares with WOOD.
WOOD	Grand Rapids, Mich. T—Furnwood, Mich.	Kunsky-Trendle Broadcasting Corp.	500W	Shares with WASH.
WJDX	Jackson, Miss.	Lamar Life Insurance Co.	1KW	Unlimited.
KWLC	Decorah, Iowa.	Luther College	100W	Daytime. Shares with KGCA.
KGCA	Decorah, Iowa.	Charles W. Greenley	50W	Daytime. Shares with KWLC.
KOL	Seattle, Wash.	Seattle Broadcasting Co. (Inc.)	1KW	Shares with KTW.
KUOR	Colorado Springs, Colo.	Reynolds Radio Co., Inc.	1KW	

1280 KILOCYCLES—*234.2 Meters*

WCAM	Camden, N. J.	City of Camden	500W	Shares with WOAX and WCAP.
WCAP	Asbury Park, N. J.	Radio Industries Broadcast Co.	500W	Shares with WCAM and WOAX.
WOAX	Trenton, N. J.	WOAX (Inc.)	500W	Shares with WCAM and WCAP.
WDOD	Chattanooga, Tenn. T—Brainerd, Tenn.	WDOD Broadcasting Corporation	1KW; 2½KW-LS	Unlimited.
WRR	Dallas, Tex.	City of Dallas, Tex.	500W	Do.
WIBA	Madison, Wis.	Badger Broadcasting Co.	500W	Do.
KFBB	Great Falls, Mont.	Buttrey Broadcast (Inc.)	1KW; 2½KW-LS	Do.

1290 KILOCYCLES—*232.4 Meters*

WNBZ	Saranac Lake, N. Y.	Earl J. Smith and William Mace, doing business as Smith & Mace.	50W	Daytime.
WJAS	Pittsburgh, Pa. T—North Fayette Township, Pa.	Pittsburgh Radio Supply House	1KW; 2½KW-LS	Unlimited.
KTSA	San Antonio, Tex.	Lone Star Broadcasting Co. (Inc.)	1KW; 2KW-LS	Shares with KFUL.
KFUL	Galveston, Tex.	News Publishing Co.	500W	Shares with KTSA.
KLCN	Blytheville, Ark.	Charles Leo Lintzenich	50W	Daytime.
WEBC	Superior, Wis.	Head of the Lakes Broadcasting Co.	1KW; 2½KW-LS	Unlimited.
KDYL	Salt Lake City, Utah	Intermountain Broadcasting Corporation	1KW	Do.

1300 KILOCYCLES—*230.6 Meters*

WBBR	Brooklyn, N. Y. T—Rossville, N. Y. (Staten Island).	Peoples Pulpit Association	1KW	Shares with WEVD, WHAZ, and WHAP.
WHAP	New York, N. Y. T—Carlstadt, N. J.	Defenders of Truth Society (Inc.)	1KW	Shares with WEVD, WHAZ, and WBRR.
WEVD	New York, N. Y. T—Forest Hills, N. Y.	Debs Memorial Radio Fund (Inc.)	500W	Shares with WHAP, WHAZ, and WBBR.
WHAZ	Troy, N. Y.	Rensselaer Polytechnic Institute	500W	Shares with WEVD, WHAP, and WBBR.
WIOD	Miami, Fla. T—Miami Beach, Fla.	Isle of Dreams Broadcasting Corporation	1KW	Unlimited.
KFH	Wichita, Kans.	Radio Station KFH Co.	1KW	Shares with WOQ.
WOQ	Kansas City, Mo.	Unity School of Christianity	1KW	Shares with KFH.
KGEF	Los Angeles, Calif.	Trinity Methodist Church, South	1KW	Shares with KTBI.
KFJR	Portland, Oreg.	Ashley C. Dixon, trading as Ashley C. Dixon & Son.	500W	Shares with KTBR'
KTBR	Portland, Oreg.	M. E. Brown	500W	Shares with KFPR.
KFAC	Los Angeles, Calif.	Los Angeles Broadcasting Co.	1KW	

1310 KILOCYCLES—*228.9 Meters*

WKAV	Laconia, N. H.	Laconia Radio Club	100W	Unlimited.
WEBR	Buffalo, N. Y.	Howell Broadcasting Co. (Inc.)	100W; 200W-LS	Do
WMBO	Auburn, N. Y.	WMBO, Inc.	100W	Do.
WNBH	New Bedford, Mass. T—Fairhaven, Mass.	Irving Vermilya, trading as New Bedford Broadcasting Co.	100W	Do.
WOL	Washington, D. C.	American Broadcasting Co.	100W	Do.
WGH	Newport News, Va.	Hampton Roads Broadcasting Corporation	100W	Do.
WEXL	Royal Oak, Mich.	Royal Oak Broadcasting Co.	50W	Do.
WFDF	Flint, Mich.	Frank D. Fallain	100W	Do.
WBEO	Marquette, Mich.	Lake Superior Broadcasting Co.	100W	Do.
WHAT	Philadelphia, Pa.	Independence Broadcasting Co.	100W	Unlimited. (C. P. only.)
WTEL	Philadelphia, Pa.	Foulkrod Radio Engineering Co.	100W	Shares with WHAT.
WJAC	Johnstown, Pa.	Johnstown Automobile Co.	100W[19]	Shares with WHAT, WCAM.
WFBG	Altoona, Pa.	William F. Gable Co.	100W	Shares with WRAW.
WRAW	Reading, Pa.	Reading Broadcasting Co.	100W[20]	Shares with WJAC.
WGAL	Lancaster, Pa.	WGAL, Incorporated	100W	Shares with WFBG.
WSAJ	Grove City, Pa.	Grove City College	100W	Shares with WGAL.
WBRE	Wilkes-Barre, Pa.	Louis G. Baltimore	100W	Unlimited.
WKBC	Birmingham, Ala.	R. B. Broyles, trading as R. B. Broyles Furniture Co.	100W	Unlimited.

(1310 *kilocycles continued on next page*)

[18] C. P. to increase power to 2½ KW-LS.
[19] License granted to increase power to 100 w.
[20] C. P. to increase power to 250 watts-LS.
[21] C. P. to increase power to 100 watts.
[22] C. P. to increase power to 100 watts.

BROADCASTING STATIONS BY FREQUENCIES—*Continued*

1310 KILOCYCLES (Cont.)

WTJS	Jackson, Tenn.	Sun Pub. Co.	100W	
WTSL	Laurel, Miss.	G. H. Hanseman	100W	
WROL	Knoxville, Tenn.	Stuart Broadcasting Corporation	100W	Do.
KRMD	Shreveport, La.	Robert M. Dean	50W	Shares with KTSL.
WSJS	Winston-Salem, N. C.	Winston-Salem Journal Co.	100W	Unlimited.
KTLC	Houston, Tex.	Houston Broadcasting Co.	100W	Do.
KFPM	Greenville, Tex.	Dave Ablowich, trading as The New Furniture Co.	15W	Do.
KTSM	El Paso, Tex.	W. S. Bledsoe and W. T. Blackwell	100W	Shares with WDAH.
WDAH	El Paso, Tex.	W. S. Bledsoe and W. T. Blackwell	100W	Shares with KTSM.
KFPL	Dublin Tex.	C. C. Baxter	100W	Unlimited.
KFXR	Oklahoma City, Okla.	Exchange Avenue Baptist Church	100W 250W-LS	Do.
WKBS	Galesburg, Ill.	Permil N. Nelson	100W	Do.
WCLS	Joliet, Ill.	WCLS (Inc.)	100W	Shares with WKBB.
WKBB	Joliet, Ill.	Sanders Brothers Radio Station	100W	Shares with WCLS.
KWCR	Cedar Rapids, Iowa	Cedar Rapids Broadcast Co.	100W	Shares with KFGQ and KFJY.
KFJY	Fort Dodge, Iowa	Cedar Rapids Broadcast Co.	100W	Shares with KFGQ and KWCR.
KFGQ	Boone, Iowa	Boone Biblical College	100W	Shares with KWCR and KFJY.
KGFW	Ravenna, Nebr.	Central Nebraska Broadcasting Corporation	100W	Unlimited.
WBOW	Terre Haute, Ind.	Banks of Wabash (Inc.)	100W	Do.
WJAK	Marion, Ind.	Marion Broadcast Co.	50W	Shares with WLBC.
WLBC	Muncie, Ind.	Donald H. Burton	50W	Shares with WJAK.
KGBX	St. Joseph, Mo.	KGBX (Inc.)	100W	Unlimited.
KFBK	Sacramento, Calif.	James McClatchy Co.	100W	Do.
KCRJ	Jerome, Ariz.	Charles C. Robinson	100W	Do.
KGCX	Wolf Point, Mont.	First State Bank of Vida	100W 250W-LS	One-half time.
KGEZ	Kalispell, Mont.	Donald C. Treloar and Stanley R. Church, doing business as Treloar-Church Broadcasting Co.	100W	Unlimited.
KFUP	Denver, Colo.	Fitzsimmons General Hospital, U. S. Army	100W	Shares with KFXJ.
KFXJ	Grand Junction, Colo.	R. G. Howell and Charles Howell, doing business as Western Slope Broadcasting Co.	100W	Shares with KFUP.
KMED	Medford, Oreg.	Mrs. W. J. Virgin	100W	Unlimited.
KXRO	Aberdeen, Wash.	KXRO (Inc.)	100W	Do.
KIT	Yakima, Wash.	Carl E. Haymond	50W	Do.
WFDV	Rome, Ga.	Rome Broadcasting Corp.	100W	

1320 KILOCYCLES—*227.1 Meters*

WADC	Akron, Ga.	Allen T. Simmons	1KW	Unlimited.
WSMB	New Orleans, La.	Saenger Theatres (Inc.) and Maison Blanche Co.	500W	Do.
KTFI	Twin Falls, Idaho	Radio Broadcasting Corporation	250W[25]	Shares with KID at night
KID	Idaho Falls, Idaho	KID Broadcasting Co.	250W 500W-LS	Shares with KTFI at night.
KGHF	Pueblo, Colo.	Curtis P. Ritchie and Joe E. Finch	250W 500W-LS	Unlimited.
KGMB	Honolulu, Hawaii	Honolulu Broadcasting Co. (Ltd.)	250W	Do.

1330 KILOCYCLES—*225.4 Meters*

WDRC	Hartford, Conn. T. Bloomfield, Conn.	WDRC (Inc.),	500W	Unlimited.
WSAI	Cincinnati, O. T. Mason, Ohio.	Crosley Radio Corporation (lessee)	1KW	Do.
WTAQ	Eau Claire, Wis. T—Township of Washington, Wis.	Gillette Rubber Co.	1KW	Shares with KSCJ.
KSCJ	Sioux City, Iowa	Perkins Brothers Co.	1KW 2½KW-LS.	Shares with WTAQ.
KGB	San Diego, Calif.	Don Lee, Inc.	500W	Unlimited.

1340 KILOCYCLES—*223.7 Meters*

WSPD	Toledo, Ohio	Toledo Broadcasting Co.	1KW.	Unlimited.
KFPW	Fort Smith, Ark.	Southwestern Hotel Co.	50W	Daytime.
WCOA	Pensacola, Fla.	City of Pensacola, Fla.	500W	Unlimited,
KFPY	Spokane, Wash.	Symons Broadcasting Co.	1KW	Do.

1350 KILOCYCLES—*222.1 Meters*

WAWZ	Zarephath, N. J.	Pillar of Fire	250W	Shares with WMSG, WCDA, and WBNX. (C. P. only.)
WMSG	New York, N. Y.	Madison Square Garden Broadcast Corporation	250W	Shares with WAWZ, WCDA, and WBNX.
WCDA	New York, N. Y. T—Cliffside Park, N. J.	Italian Educational Broadcasting Co. (Inc.)	250W	Shares with WAWZ, WMSG, and WBNX.
WBNX	New York, N. Y.	Standard Cahill Co. (Inc.)	250W	Shares with WAWZ, WMSG, and WCDA.
KWK	St. Louis, Mo. T—Kirkwood, Mo.	Greater St. Louis Broadcasting Corporation.	1KW	Unlimited.
WEHC	Emory, Va.	Emory & Henry College	500W	
KIDO	Boise, Idaho	Boise Broadcasting Station	1KW	Unlimited.

1360 KILOCYCLES—*220.4 Meters*

WFBL	Syracuse, N. Y.[27]	Onondaga Radio Broadcastting Corporation	1KW	Unlimited.
WQBC	Vicksburg, Miss.	Delta Broadcasting Co. (Inc.)	500W	Daytime. (C. P. only.)
WCSC	Charleston, S. C.	Lewis Burk	500W	Unlimited.
WJKS	Gary, Ill.	Johnson-Kennedy Radio Corporation	1KW 1¼KW-LS	Shares with WGES.
WGES	Chicago, Ill.	Oak Leaves Broadcasting Station (Inc.)	500W 1KW-LS[28]	Shares with WJKS.
KGIR	Butte, Mont.	KGIR (Inc.)	500W	One-halt time.
KGER	Long Beach, Calif.	Consolidated Corp. Broadcasting	1KW	Shares with KPSN.

1370 KILOCYCLES—*218.7 Meters*

WRDO	Augusta, Me.	WRDO, Inc.	100W	Unlimited (C. P. only).
WQDM	St. Albans, Vt.	A. J. St. Antoine	100W	Daytime.
WLEY	Lexington, Mass.	Carl S. Wheeler, trading as Lexington Air Stations.	100W 250W-LS	One-half time.
WSVS	Buffalo, N. Y.	Elmer S. Pierce, principal, Seneca Vocational High School.	50W	Unlimited.
WBGF	Glens Falls, N. Y.	W. Neal Parker and Herbert H. Metcalfe	50W	Do.
WPOE	Patchogue, N. Y.	Nassau Broadcasting Corporation	100W	Do.
WCBM	Baltimore, Md.	Baltimore Broadcasting Corporation	100W 250W-LS	Do.
WBTM	Danville, Va.	L. H., R. G., and A. S. Clarke, doing business as Clarke Electric Co.	100W	Shares with WLVA.
WLVA	Lynchburg, Va.	Lynchburg Broadcasting Corporation	100W	Shares with WBTM.
WHBD	Mount Orab, Ohio	F. P. Moler	100W	Unlimited.
WHDF	Calumet, Mich.	Upper Michigan Broadcasting Co.	100W 250W-LS	Do.
WJBK	Highland Park, Mich.	James F. Hopkins (Inc.)	50W	Shares with WIBM.
WIBM	Jackson, Mich.	WIBM (Inc.)	100W	Shares with WJBK.
WRAK	Williamsport, Pa.	Clarence R. Cummins	100W	Unlimited.
WELK	Philadelphia, Pa.	WELK Broadcasting Station (Inc.)	100W 250W-LS	Do.

(1370 *kilocycles continued next week*)

[25] C. P. to increase power to 500 watts—LS.
[28] On Sundays.
[26] C. P. to increase power to 500 watts.
[27] C. P. to move transmitter to Collamer, N. Y., and increase power to 2½ KW—LS.

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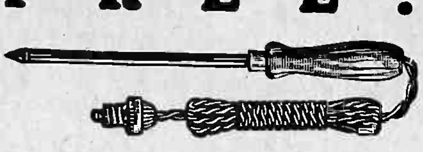

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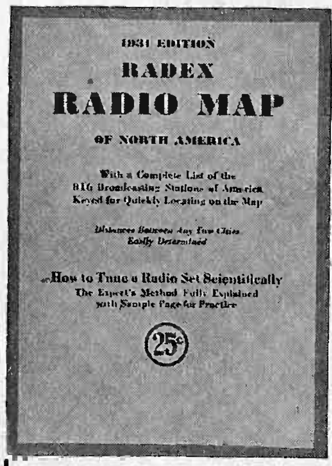

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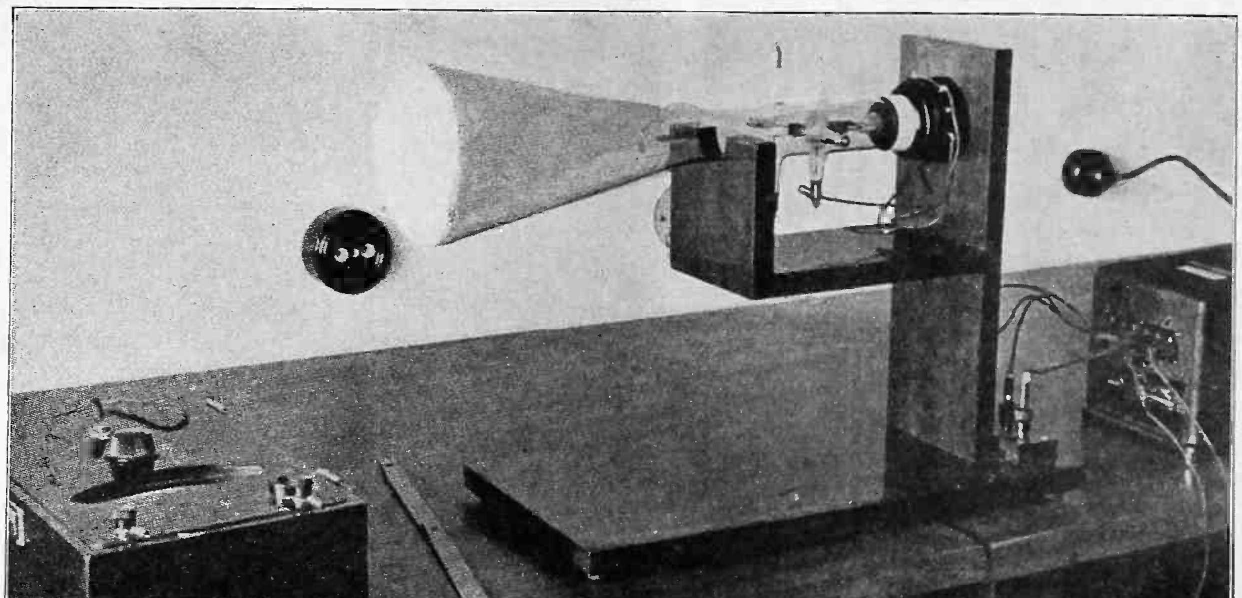

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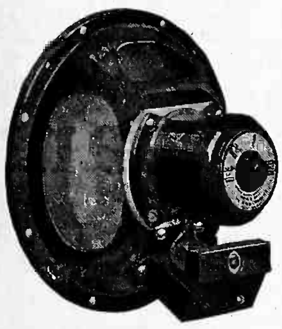

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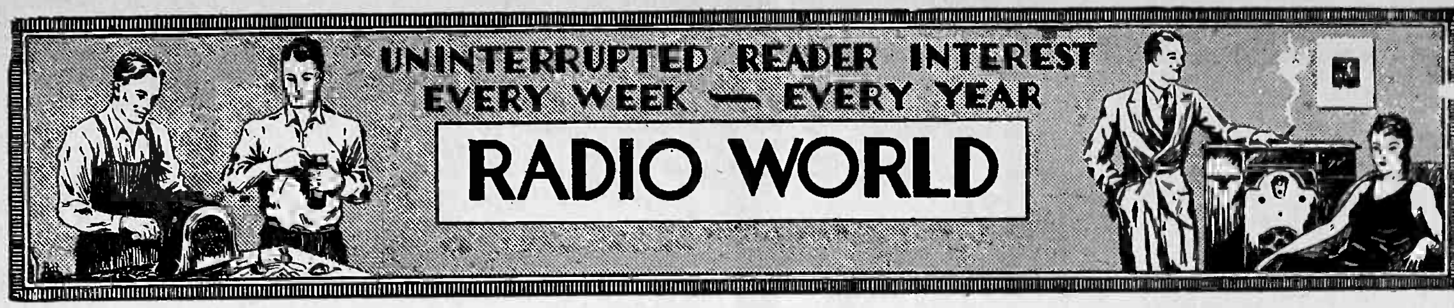

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Converter Solutions
Argument Presented for Separate Tuning

By Jack Tully

THE short wave converters now offered to the public consist principally of those with two tuned circuits, condenser ganged, r-f untuned if any is used ahead of the modulator, and switch control of band shifting. They may be grouped as follows:

1—Mixer and rectifier, with heater power also, for a-c operation; battery equivalent, which omits power.
2—Mixer, rectifier and intermediate frequency amplification; battery equivalent that omits power.
3—Mixer with plug for taking the heater and B power from the set.
4—Untuned r-f, mixer and rectifier; battery equivalent that omits power.
5—Untuned r-f, mixer and intermediate amplification; battery equivalent that omits power.
6—Mixer, with filament power for a-c operation, B voltage to be obtained from the set.
7—Untuned r-f and mixer, with B voltage to be obtained from the set.
8—Autodyne mixer and rectifier, with heater power also, for a-c operation; battery equivalent without power.
9—Autodyne mixer, with heater power, for a-c operation, B voltage to be obtained from the set.

A tenth possible classification, for a-c or battery use, would be the converter with only oscillator tuning, and untuned modulator; and an eleventh the same, except for an untuned r-f stage. But tuning of the modulator has become virtually standard, therefore all systems using untuned modulator are omitted.

Improvements Introduce Limitations

All of these types have their special advantages, all of them work, but the differences are worth considering, since the problem of satisfactory design of a converter to fill all needs and requirements has not yet been solved, and it is doubtful whether it is solvable.

This does not mean that converters are no good, for they may produce excellent results. It means simply that when you institute an improvement in one direction you run into a limitation that affects something else concerning the converter. Therefore astuteness in design is necessary. Some manufacturers now blissfully blossoming forth in the converter field have much experience ahead of them.

Let us consider the different devices in the order of their tabulation.

Take the mixer only, as covered by (1), (3), (5), (7), (8), (9), the presence or absence of rectifier having nothing to do with the radio frequency operation. It is assumed that the modulator and oscillator are both tuned, in all instances, as they should be for sensitivity and selectivity. In (8) and (9) the same tube is used as oscillator and modulator, in the other instances a separate tube performs each of these two functions. It is better always to have separate tubes, but for economy reasons the autodyne system can be excused, for it does work, but it generates generous harmonics, even though it can be just as sensitive as the separate method.

The mixer, then, consists of a circuit tuned to the incoming frequency, that of the transmitting station, and constancy governs this tuning, for nothing that takes place afterward should affect this circuit. For a given capacity condenser a given inductance is required and the frequency span is known.

Oscillator Requirements

With the modulator the situation is quite different. What the extreme frequencies of oscillator tuning should be will depend on the intermediate frequency. Suppose 1,500 kc is the intermediate frequency, the one to which your set is tuned when the converter is connected. Then, if the incoming frequency or transmission is, say, 6,000 kc, then the oscillator should be generating 7,500 kc. The difference is the intermediate frequency. If some other intermediate frequency is used, then the oscillator has to be redesigned accordingly. Suppose the intermediate frequency is 550 kc. Then the oscillator would have to be set at 6,550 kc for a transmission frequency of 6,000 kc.

As small condensers are used for tuning the average ratio over the bands to be covered will be not much over 2-to-1, so if the converter is to be effective starting at 1,500 kc, the modulator would tune from that frequency to 3,000 kc. For an intermediate frequency of 1,000 kc, then, the oscillator would tune from 2,500 to 5,000 kc. But the oscillator is of not much use after 4,000 kc, for the modulator can not tune to frequencies high enough to keep pace, since it stops at 3,000 kc, hence the oscillator should stop at 4,000 kc instead of at 5,000 kc. This can be accomplished by padding the oscillator, which consists of using principally a series condenser to cut down the capacity or, really, the ratio of maximum to minimum capacity, the inductance being selected on the basis of the required capacity. All padding resolves itself into the establishment of a particular capacity ratio, for the frequency ratio is the square root of the other.

Thus the first band may be covered, but notice particularly that it is on the basis of a selected intermediate frequency only!

Intermediate Frequency Fixed

In virtually all of the commercial converters there are two tuned circuits with condensers ganged. So soon as ganging is used it is necessary for the manufacturer to select the intermediate frequency. When that selection is made it is well to include intermediate frequency amplification in the converter, for the user's choice already is gone, and the extra sensitivity and selectivity become advisable. The set's r-f amplification can be disregarded, and considered only as a coupler to second detector, if two i-f stages are included.

In the other bands the percentage of difference between the oscillator and the modulator frequencies becomes less, so that fixed trimmed adjustments may be used for keeping the two circuits tracking tolerably. The absolute value of difference in frequency is the same, but the percentage becomes less because higher frequencies are being tuned.

Therefore we find that of the nine classifications, six require that the intermediate frequency be a particular one. But (4), (5) and (6) cover a mixer with a stage of untuned r-f ahead, so the same applies to them—no selection of intermediate frequency is offered therefore by any of the converters!

Really, when this situation obtains, no choice whatever is left, because even slight retuning is not practical to the user, since the tracking of the oscillator and modulator is upset to the same

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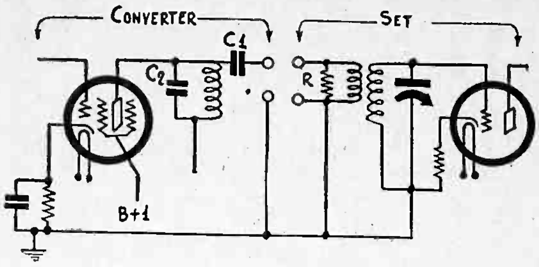

Fig. 1

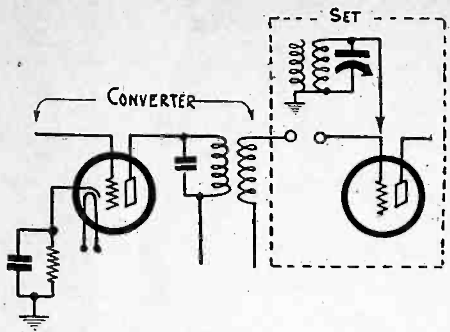

Fig. 2

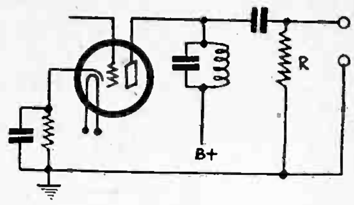

Fig. 3

If the output is tuned and loosely coupled to the set (Fig. 1), the tube may be screen grid, otherwise use a general purpose tube, omitting screen connection. Instead of connecting to antenna post, the output may go to the cap if the set is screen grid. (Fig. 2). A grid return is needed for the set tube. If not present, supply one, R in Fig. 3, 20,000 to 100,000 ohms.

(*Continued from preceding page*)

absolute extent that the intended intermediate frequency is altered.

Most Want to Hear Europe

Therefore, so soon as we tune both modulator and oscillator, and use a gang condenser, we can not alter the intermediate frequency. It may so happen that the intermediate frequency selected is one on or near which there is a powerful local, hence interference due to direct pickup of this local would make reception practical only when that station is off the air, unless detuning of the intermediate frequency in the set is resorted to, with the large sensitivity drop attendant on even slight detuning, or the direct interference is trapped out. To this end some manufacturers provide a wave trap to be inserted in the antenna circuit, to kill off direct interference from a station at or near the intermediate frequency.

Already we begin to notice that each advancing stroke introduces a new hazard. If we tuned only the oscillator, and had an untuned modulator, then we might select any intermediate frequency, for the limiting factor of tracking with a differential tuned circuit is gone—but so is some sensitivity and also the much-needed selectivity to penetrate for distance. The station jam on the broadcast band is not nearly so bad as on the short wave bands, so that without selectivity sufficient to kill off adjacent channel interference the likelihood of much reception of foreign countries is small. Most persons buy converters to hear Europe.

Question of Guarantees

The improvement noted is the one of convenience of single dial operation, and the penalty paid is that the selection of intermediate frequency is denied the user. This denial well may be consistent with excellent results, especially if a wave trap is used, and particularly when the converter is made by a set manufacturer, and used on a set of his own manufacture, and of a model produced at about the time the converter was produced, for it may be safely assumed the manufacturer is not putting out a converter that works at an intermediate frequency unfavorable to his own set.

There are many types of sets, various number of tubes and a great variety of sensitivity and selectivity, so that no matter what kind of a converter is manufactured, since it has to be used with a receiver concerning which the converter manufacturer has no knowledge, it follows that performance can not be guaranteed, since one manufacturer can not guarantee excellent performance of another's set. The converter is the known quantity, but of itself will not produce reception. The receiver is the unknown quantity. The two must be worked together. Therefore the combination is an unknown quantity, and it is not commercially practical to guarantee unknown quantities.

Perplexities of Short Waves

Most receivers are of the tuned radio frequency type and as such have a rising characteristic, that is, amplify more at the higher frequencies. So, in general, it is preferable for a manufacturer to select a frequency not too far removed from that exteme. A good compromise may be to select a frequency near or at the geometric mean of the broadcast band, and 1,000 kc represents that fairly well. But it is still a compromise, since the set with which the converter is used may be ten times more sensitive at 1,500 kc or may have an inverse characteristic, due to compensation by the manufacturer, whereby the sensitivity is 100 times as great at 550 kc as at 1,500 kc. Still, the intermediate frequency selection is denied. Therefore if such denial exists, there should be built-in intermediate amplification, and this may be made to provide sufficient gain so that it becomes relatively immaterial in what region the set is most sensitive. The added stage increases the sensitivity beyond what it would be at any intermediate frequency without that stage.

The vogue for single dial tuning enveloped the broadcast receiver users so that all commercial sets are of that type and nearly all kit sets as well. For tuned radio frequency it is all right. For superheterodyne use it is all right, for covering a single band. For multi-band coverage with supers—and all converters are of this type—it is better to have independent tuning, particularly as one control (that used in the modulator) is by no means critical, and may not tune out a strong station at any point of the dial, when the oscillator is set to give response from that station. It is on weak signals that the modulator tuning becomes important, and in the case of ganging it may be a case of mistuning, for it is difficult to make the two circuits track over various bands.

A manual trimmer across the modulator's main tuning condenser would help, in the case of ganged tuning, if the coils were so designed that they afforded tracking when the modulator trimmer was at half maximum capacity, so that subtraction and addition of capacity could be applied. But most trimmers are in circuits so designed that only addition is possible so the frequency can be only decreased, whereas some circumstances may call for increase.

The advantages of separate tuning make one wonder why the manufacturers have not recognized them, for when a person gets interested in short waves he has much to learn about tuning, geography, time differences, frequency and wavelength equivalents, skip distances and other eccentricities and tolerance of high noise level. He should be given every assistance toward attaining results. The single tuning control system does not assist him to get results. It simply enables him to rotate two condensers with one motion.

Separate Tuning

It is therefore submitted that, since tuning of oscillator alone is not quite satisfactory, and modulator must be tuned also, that all ganging systems require a particular intermediate frequency, and that for wide application and usefulness of converters, and hence their endurance in the radio field, depend on results much more than on convenience, so that each circuit should be separately tuned. This separate tuning may exist, as stated, in conjunction with ganging, if a trimmer and other constants are rightly chosen, or any other method may be used, even variometer adjustment of inductance, but separate tuning is important, almost vital. The choice of experimenters may be in favor of two separate dials, for they, above all, want the results, and not the convenience at the expense of results, while even the lay users could find no objection to two fruitful dials compared to one semi-barren dial. Besides, the modulator "dial" may be a knob.

As in all branches of radio we must apportion selectivity and sensitivity. In a converter this is done to a considerable degree in the coupling between modulator and oscillator. If the coupling is tight the signal is much louder, but the selectivity is much less and the oscillation always overloads the modulator. If the coupling is too loose there will be no signals, if it is too tight there will be not nearly enough selectivity, and the modulator will tune the oscillator. However, the coupling between aerial and modulator has to be tight, or there must be a large input, so the aerial may be as long as you can conveniently make it, and erected as high as you can erect it. All considerations of half-wavelength antennas, doublets and multiple doublets don't apply to short wave converters. No matter how much theory may be written on the subject, the fact remains that the tighter the coupling and the longer the aerial, the louder the signal! In fact ,unless these two are large, the signals will be few. This

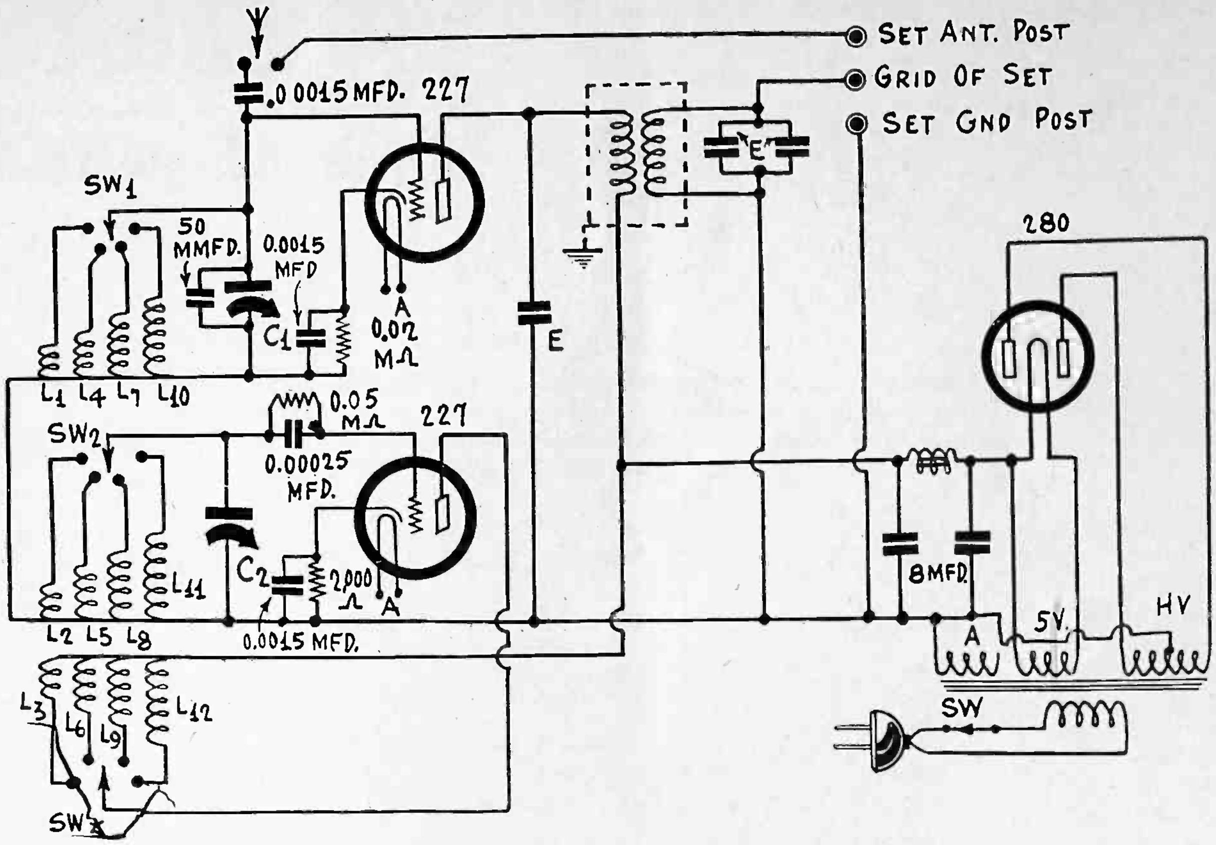

Fig. 4

Design of a converter, using separate tuning of oscillator and modulator, with a switch for band shifting. Any intermediate frequency may be used, 1,600 to 90 kc. or under.

is true although there is reduction in relative or apparent selectivity with a long aerial. The heightened modulator output helps because the output amplitude is proportional to the product of the modulator and oscillator r-f voltages.

Coupling Methods

The fact that the converter can not be considered wholly apart from the set is again brought home when one seeks a method of coupling the one to the other. Here the output tube and circuit of the converter, as well as the input circuit of the receiver, are of importance. Most receivers have a radio frequency transformer with primary in the antenna circuit and tuned secondary in the grid circuit. However, some sets have an untuned antenna stage, with an r-f choke coil or a resistor as the load, or if there is a transformer primary it has a resistance across it. These different load conditions, though the antenna is not connected in this circuit when the converter is used, present difficulties in coupling the converter to the set.

As for the tube, one of relatively low impedance is generally favored for untuned output, and that rules out the screen grid tube and brings in the general purpose tubes (227, 230, 201A, etc.). The intention is to put an inductive load on the output tube of the converter, and have a secondary or use a stopping condenser, so that when the antenna is removed from the set the output of the converter is connected instead. It has become popular to use a switch to throw the aerial from converter input to set input, but in the usual systems this leaves the converter's output load in parallel with the set's input and drops the input to the set when the converter is "off."

Since the primary winding of an antenna coupler may have a relatively low impedance, any attempt to tune the output of the converter would be nullified, unless account were taken of the receiver's input. Therefore the so-called matching of converter output to receiver input becomes a problem, particularly where r-f chokes or resistors are the set input load. Any primary means that the impedance is lower than the output and input circuits are coupled, because of the consequent parallel connection.

Tuned Output

However, if the converter output is tuned, then a high impedance tube may be used, provided the coupling to the set is loose, in which case also the connection to the set does not have the effect of short-circuiting the output. In Fig. 1, C1 is the stopping condenser, and for loose coupling should be small, while C2 is the condenser that tunes the output to the intermediate frequency. If C2 is large enough, and the coil it tunes is properly selected (e. g., a usual broadcast condenser and coil combination), then if C1 is 0.0001 mfd. or less, the coupling will be loose enough to render the output circuit relatively independent of the input circuit, except, of course, that C2 should be finally tuned when the coupling exists. By tuning C1 first with the coupling and then without it any change can be noted in the capacity required for the same frequency, and this serves as a check on whether the coupling is all right. If the difference is considerable, say a quarter of the dial, then C1 should be of considerably less capacity.

In Fig. 1 R is the resistance sometimes included in a set so that the receiver will not squeal when a short aerial is used, but for converter coupling it normally represents quite a loser, and results would be better if the resistor were out. Likewise, merely a resistor or an r-f choke coil as the set's antenna load usually present a poor coupling situation when the converter is hooked up, because of too low an impedance.

Grid Return Needed

If the receiver has a screen grid tube as the first valve, then it is practical to connect the converter output to the grid circuit of the receiver, and wholly ignore the antenna coupling in the set, as shown in Fig. 2, where the primary is tuned. The secondary also may be tuned, if primary and secondary are loosely coupled. The grid clip is removed from the set tube and the converter output connected to the tube cap. At all hazards, a grid return must be established for the first tube in the set. This is done in Fig. 2 (transformer secondary), but if the converter output is untuned, or has a stopping condenser as in Fig. 3, then a resistor or another r-f choke may be placed in the converter output to establish the grid return.

It is recommended that with screen grid sets some system be used that picks up the grid directly, as just discussed, for even when the usual connection to set's antenna post is made under circumstances otherwise all right, the secondary is detuned a little, and ordinarily there is no manual trimmer on the seat to take care of this, since gang condensers with permanent trimmers are used.

The foregoing concerns all types classified in the category. The converter that derives all power from an a-c set is no different than the others in radio principle, but raises the question whether universal application exists, especially as 3.5 amperes more current are taken from a set's power transformer. The autodyne would require only 1.75 amperes, but few autodynes exist, and they have their limitations.

In line with what has been said previously, a converter design

(Continued on next page)

A Short-Wa

Unit May Be Used

By Wa

HERE is a dual short-wave device. It is a converter or a tuner, by the flip of a switch. Throw another switch and the antenna is transferred from the device to the receiver. The wave band shifting is done by switching also, the tuning condenser being moved to lower points on the secondaries. If a three deck, four throw rotary selector switch of the insulated shaft type is used (also called three point, four throw and triple pole quadruple throw, three of the four positions may be used on two decks for the band shifting, and the third deck used, as to two throws only, for the antenna switching, the two remaining throws on the third deck being blank.

It is clear that when the aerial is switched to the present device that the input is taken from the receiver, to that extent, and transferred to the primary of the modulator coil. The action of the

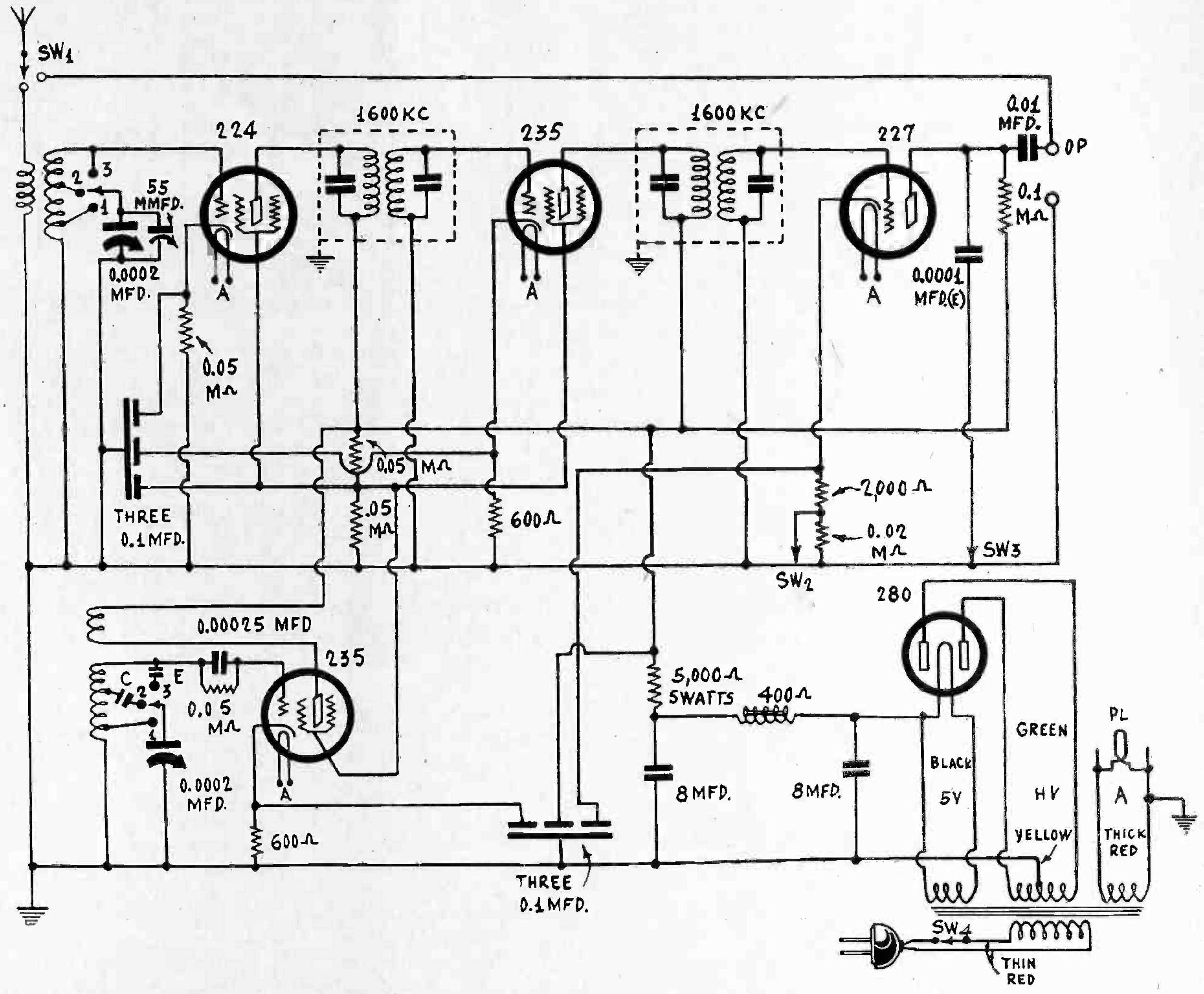

FIG. 1

What will you have? A short-wave converter? A short-wave tuner? Throw a switch and you have one or the other. On the tuner either earphones or a power amplifier may be used. An option is to plug into a set for audio amplification. Mixer coupling is effected by twisting together the modulator and oscillator control grid leads (to tube caps).

modulator and oscillator, the two circuits united through twisting together the control grid leads, results in a modulator output at the intermediate frequency, 1,600 kc, and the outfit is a converter if the 227 tube is biased for amplification, or a tuner if the tube is biased for detection. The output will handle either radio or audio frequencies.

Shorting Makes the Change

By putting two biasing resistors in series, one for amplification (2,000 ohms), the other for detection (0.02 meg., 20,000 ohms), the change from one point to another on the tube's characteristic curve is made simply by shorting out the larger value.

For detection, the output being audio frequencies, a plate bypass condenser is required. This is a detriment in the case of amplification, when we desire really to continue transferring radio frequencies, for we would be working on the converter principle. So an extra switch, SW-3, is included, to open the bypass condenser circuit. The same operation will open and close the two circuits if the switches SW-2 and SW-3 are in parallel. Switches of the snap type are commercially obtainable for that purpose.

If the device is used as a converter, the connections are: output post to antenna post of your receiver ground post of converter to ground post of receiver (where actual ground connection remains intact, aerial to the index of SW-1 and that switch thrown to the left, in Fig. 1.

Plugging into a Set

For utilization of the tuner, earphones may be connected across the output and ground posts, or the output post may be connected to the input of a power amplifier (P post of audio transformer, or to grid of first audio tube, if resistance or impedance coupling is used), or the audio amplifier of an existing receiver may be used, for tube economy, as perhaps only an extra 280 is needed, the rest of the tubes for the short wave tuner being taken out of sockets in the receiver. The connection then would be by a UY plug and cable lead (or UX, if the set detector requires such), the plate cable being the only one used.

As a tuner, that if, for use with external audio amplification only or for earphone reception, the system is autonomous, and is ratable in performance. As a converter, however, it is subject to the usual variations in performance that may be imposed by the receiver's lack of sensitivity. To get first-class results from a converter it is usually advisable to have a sensitive receiver, although in this case it is only necessary that the receiver be sensitive at or near the highest frequency that can be tuned in, which is almost always true. While the intermediate frequency would seem to be adamant at 1,600 kc, really 1,600 kc is simply the commercial designation for transformers that may be tuned considerably lower. Therefore if your set does not tune as high as 1,600 kc, and few sets do tune that high, adjust the intermediate frequency to meet the highest frequency of your set. This will slightly change the oscillator tuning

Coil Construction f

(*Continued from preceding page*)

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The inductance for the oscillator's tuned circuit has to be selected on the basis of the highest intermediate frequency, 1,600 kc, because then the difference is greatest, and the dial setting should represent about half the capacity of the tuning condenser. As the intermediate frequency is lowered, the difference is reduced between modulator and oscillator frequencies, so the oscillator frequency has to be lowered (more capacity used). Hence there should be 1,600 kc leeway from the chosen dial point to maximum capacity. The leeway in the other direction should be equal to the difference between maximum and minimum modulator settings. The two settings for the first band 0.00015 mfd. tuning would represent 1,500 kc and 3,600 kc, a

Combination

Converter or Tuner

. Brooks

characteristic, but that is no drawback, particularly as the modulator has a front panel trimmer across it, to take up discrepancies. As a converter squealing may result but is correctable by volume control adjustment of your set.

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The system is worthy of consideration as a tuner alone, even though it has only one stage of amplification. No credit for amplification is given to the modulator, for it is well known that the mixing process produces a loss, and no credit is given for amplification of a small order that takes place in the 227 even when a detector. However, the single intermediate frequency amplifying stage (requiring two transformers, one to couple to and the other from the amplifier tube) has such a high gain that squealing at the intermediate frequency is by no means impossible.

Just below the point of oscillation the amplification may be around 1,000, so by operating near that point the single stage is made extremely high gain. The coils are near enough together, despite shielding, to effectuate some feedback. The biasing resistor is made purposely high so there will be no oscillation trouble, but if more feedback is desired, all one needs to do is to use a lower value, to 400 ohms. The reason why 300 ohms are not recommended is that the full B voltage of a power transformer as used in five tube midget sets is supplied to all the tubes, around 275 volts, due to reduction in the 5,000 resistor. Higher value of biasing resistors are necessary in such instances of high plate voltage because the plate current does not increase with voltage increase nearly as fast as the requirement for negative bias increase.

Resistor Ratings

The resistor marked 5,000 ohms may consist of two 2,500 ohm units, or two 2,250 ohm units, if you have them, as the value is not critical, but should be greater, rather than less than, the specified value. The wattage is 5 watts. Other resistors may be 1 watt.

The voltages obtainable are: drop across 0.05 meg. (50,000 ohms) for biasing the 224 modulator, 7 volts, or thereabouts; across the separate 600 ohm biasing resistors, oscillator and intermediate, 3 volts; across the 2,000 ohm resistor alone in the second detector cathode, 4 volts; across the combination of the series resistors in that circuit, 2,200 22,000 ohms, 10 volts; plate returns in tuner, about 275 volts; screen voltage, 90 volts. An ordinary voltmeter will not measure accurately the voltage across the high value biasing resistors, or the screen voltage.

Coil Information

Using 1.25 inch diameter, the modulator coil may consist of 12 turn primary, 1/16 inch separation, and 25 turn secondary. The taps on the secondary are at the 16th and 21st turns from the grid end. The oscillator, on a separate form, same diameter, may consist of 15 turn tickler, 1/8 inch separation, 17 turn secondary, tapped at the 8th and 13th turns. The wire is No. 28 enamel.

If you desire to make the intermediate coils yourself, you should have shields for them, which may be copper or aluminum, and may

LIST OF PARTS

Coils

Two two-winding coils, one for modulator, other for oscillator, as described.
Two 1,600 kc intermediate frequency transformers.
One power transformer as for a five tube midget set.
One B supply choke coil, 15 henries, 400 ohms d-c resistance.

Condensers

Two 0.0002 mfd. condensers, which may be gauged by means of a flexible coupler.
One manual trimming condenser, 55 mmfd. or thereabouts.
One 0.00025 mfd. fixed condenser with grid clips.
Two shielded blocks, three 0.1 mfd. in each block; total, six capacities; black is common, reds interchangeable.
Two 20-100 mmfd. equalizers (E), one used at full capacity for detector plate bypass.
One 0.00035 mfd. fixed condenser (C).
One 0.01 mfd. mica fixed condenser.
Two 8 mfd. electrolytic condensers.

Resistors

Four 0.05 meg. pigtail resistors (50,000 ohms).
One 0.1 meg. pigtail resistor (100,000 ohms).
Two 600 ohm pigtail resistors.
One 2,000 ohm pigtail resistor.
One 5,000 ohm 5 watt resistor.

Miscellaneous

One vernier dial with pilot lamp.
One chassis, 13½ inches wide × 7.75 inches front to back, × 3 inches high, with four UY and one UX sockets.
Antenna-ground post assembly.
Output post.
One rotary selector switch, three sections, four throws per section; shaft insulated; keyed knob.
One knob for dial.
One single pole double throw antenna switch.
One single pole double throw parallel switch.
One a-c line switch.
One a-c cable and male plug.

wind 20 per cent. fewer turns than would be required for 0.00035 mfd. broadcasting tuning, on two tubings, one of them half the diameter of the other. Put the smaller winding inside and use it for the plates, the larger outside for the grids. Commercial coils are of the honeycomb type, machine wound, and hardly can be duplicated in the home workshop.

For 1 inch diameter tubing, put on about 100 turns of No. 31 wire, or any wire of about that size, and for 2 inch diameter, the outside row, put on 55 turns of No. 28 enamel. The condensers across the coils would be 20-100 mmfd. equalizers, which are of the compression adjustable type. The shield then should have around 3 inch diameter and totally enclose the coil assembly. Commercial coils, due to special winding, have about 2⅛ diameter.

Short-Wave Converter

difference of 2,100 kc, so the oscillator from the selected point should tune from 3,100 to 5,200 kc, which it can easily do, as the ratio of frequency is only a little more than than 1.6 to 1. Since the two dials are separate, or the modulator has a knob, the oscillator overlap is of no consequence.

Modulator and oscillator are coupled inductively, therefore three windings are on each of four forms. For the modulator the secondaries may consist of 40, 18, 8 and 4 turns, respectively, and for the oscillator, 25, 15, 8 and 4 turns, respectively, the separation being ½, ¾, 1 and 1.25 inches respectively, between secondaries, the plate winding for the oscillator being at extreme of the tubing and consisting of half the number of turns on the oscillator secondaries, except for the two smaller coils, when plate and grid windings are equal. The separation between plate and grid windings is ⅛ inch. The wire is No. 28 enamel throughout, the diameter 1.25 inch.

The coil switch is of the three tier type, with four connections on each tier. The shaft is insulated from everything. Low capacity type switches make the coil data applicable. The switch is of the rotary type and must be of precision manufacture to be valuable.

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Short Wave Editor, RADIO WORLD, 145 *West 45th St., New York.*

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A Short-Wav

Unit May Be Used

By Way

HERE is a dual short-wave device. It is a converter or a tuner, by the flip of a switch. Throw another switch and the antenna is transferred from the device to the receiver. The wave band shifting is done by switching also, the tuning condenser being moved to lower points on the secondaries. If a three deck, four throw rotary selector switch of the insulated shaft type is used (also called three point, four throw and triple pole quadruple throw, three of the four positions may be used on two decks for the band shifting, and the third deck used, as to two throws only, for the antenna switching, the two remaining throws on the third deck being blank.

It is clear that when the aerial is switched to the present device that the input is taken from the receiver, to that extent, and transferred to the primary of the modulator coil. The action of the

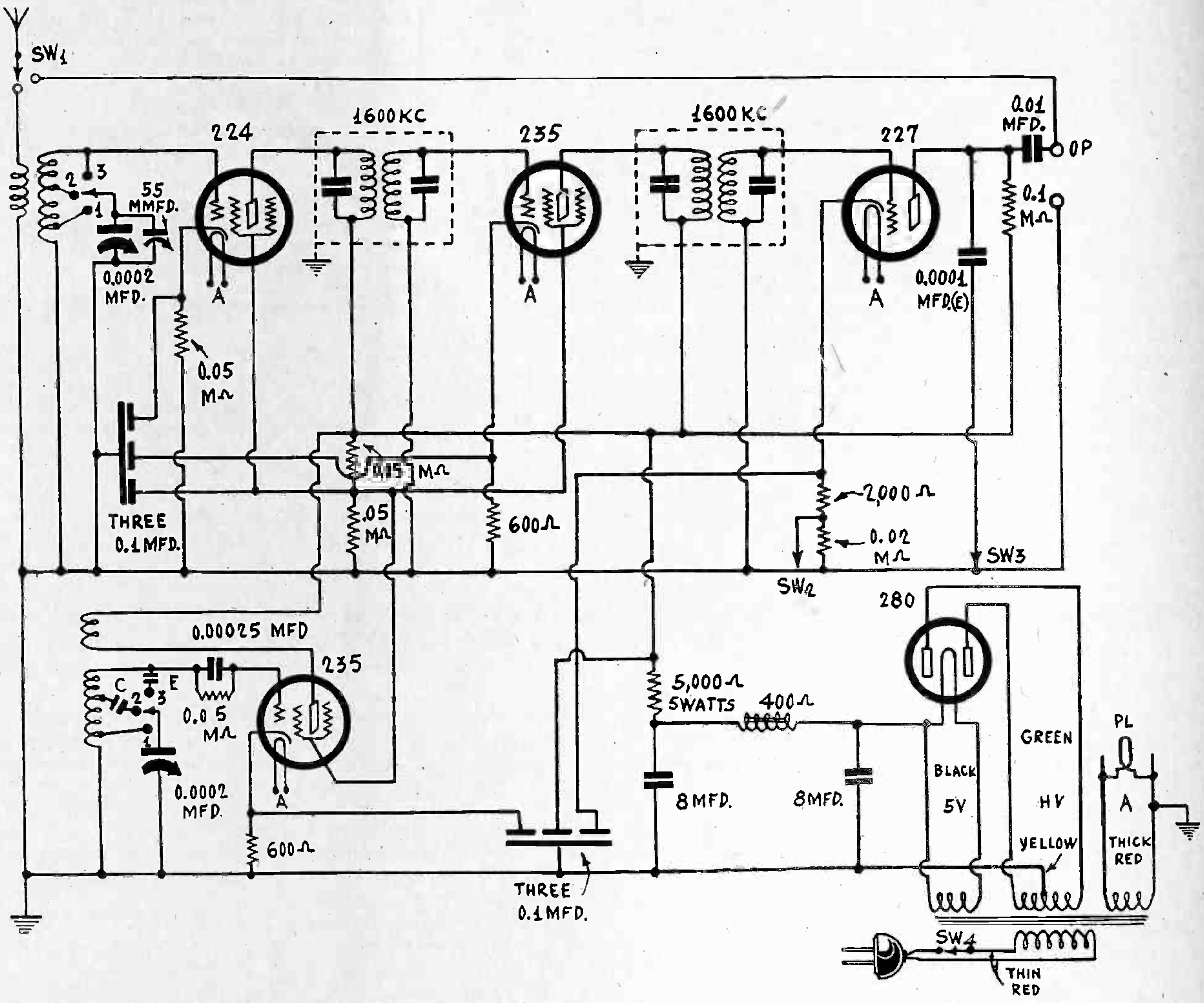

FIG. 1

What will you have? A short-wave converter? A short-wave tuner? Throw a switch and you have one or the other. On the tuner either earphones or a power amplifier may be used. An option is to plug into a set for audio amplification. Mixer coupling is effected by twisting together the modulator and oscillator control grid leads (to tube caps).

modulator and oscillator, the two circuits united through twisting together the control grid leads, results in a modulator output at the intermediate frequency, 1,600 kc, and the outfit is a converter if the 227 tube is biased for amplification, or a tuner if the tube is biased for detection. The output will handle either radio or audio frequencies.

Shorting Makes the Change

By putting two biasing resistors in series, one for amplification (2,000 ohms), the other for detection (0.02 meg., 20,000 ohms), the change from one point to another on the tube's characteristic curve is made simply by shorting out the larger value.

For detection, the output being audio frequencies, a plate bypass condenser is required. This is a detriment in the case of amplification, when we desire really to continue transferring radio frequencies, for we would be working on the converter principle. So an extra switch, SW-3, is included, to open the bypass condenser circuit. The same operation will open and close the two circuits if the switches SW-2 and SW-3 are in parallel. Switches of the snap type are commercially obtainable for that purpose.

If the device is used as a converter, the connections are: output post to antenna post of your receiver ground post of converter to ground post of receiver (where actual ground connection remains intact, aerial to the index of SW-1 and that switch thrown to the left, in Fig. 1.

Plugging into a Set

For utilization of the tuner, earphones may be connected across the output and ground posts, or the output post may be connected to the input of a power amplifier (P post of audio transformer, or to grid of first audio tube, if resistance or impedance coupling is used), or the audio amplifier of an existing receiver may be used, for tube economy, as perhaps only an extra 280 is needed, the rest of the tubes for the short wave tuner being taken out of sockets in the receiver. The connection then would be by a UY plug and cable lead (or UX, if the set detector requires such), the plate cable being the only one used.

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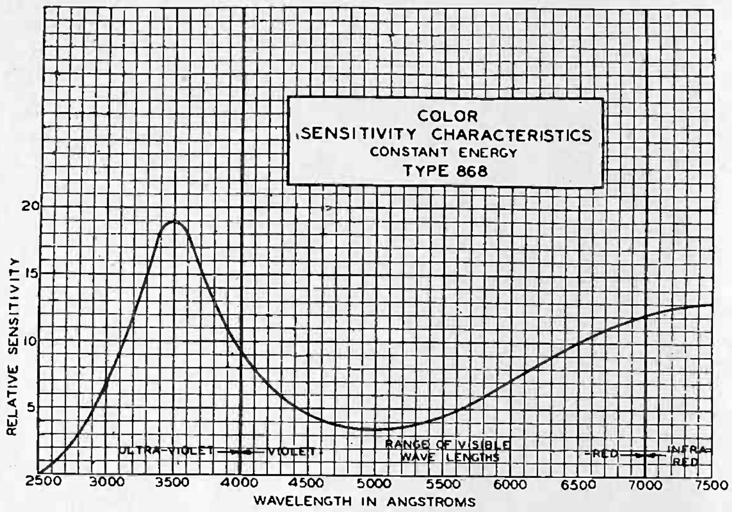
A New Phototube for H

Circuits for Using the Cell

By Willi



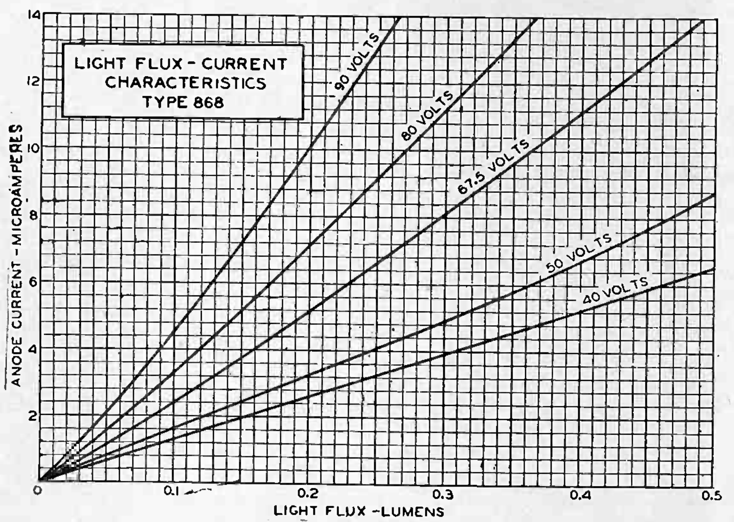


Fig. 1
Color sensitivity characteristic of the new Type 858 phototube.

Fig. 2
Light flux-current characteristic of the Type 868 phototube.

A NEW phototube, the 868, has been announced by RCA and Cunningham. This new tube is designed for use as light sensitive cell in home talking movie reproduction of the sound-on-film type and for many other applications where a light sensitive cell is required.

The new cell is of the caesium type and is sensitive throughout the entire visible spectrum, as well as in the ultra-violet and the infra-red. Its high sensitivity in the red and infra-red makes this cell particularly valuable when the source of light is in incandescent lamp, which is rich in the lights of longer wavelengths.

In Fig. 1 is a reproduction of the color sensitivity characteristic of the new cell, the curve having been taken under conditions of constant light energy entering the cell. As will be noted, the sensitivity is zero at 2,500 angstrom units, which is far into the ultra-violet. Then as the wave-length increases the sensitivity increases rapidly up to 3,500 angstrom units, where it reaches a maximum. Then it falls gradually to 5,000 angstrom units, where it reaches a minimum. This is in the blue-green region of the visible spectrum. As the wave-length increases still further the sensitivity increases again and reaches another maximum somewhere in the infra-red region.

Explanation of Variation

The increase in the sensitivity as the wave-length decreases beyond 5,000 angstrom units is due to the fact that short waves are more active photo-electrically than the long waves, just as the shorter waves are more active photographically than the long waves. The rapid drop in the sensitivity beyond 3,500 angstroms is undoubtedly due to the absorption of the light by the glass of the tube, as ordinary glass will not pass ultra-violet light. When it is necessary to utilize the ultra-violet in phototubes it is customary to use a quartz tube. For the same reason quartz lenses are used in photography by ultra-violet light.

The rise in the sensitivity characterized beyond 5,000 angstrom units is due to the peculiar responsiveness of the caesium coating on the cathode. When other alkaline metals, such as sodium and potassium, are used on the cathode, the maximum sensitivity falls at shorter frequencies, the sodium placing it near 6,000 angstroms and the potassium placing it in the violet.

Light Flux-Current Characteristic

In Fig. 2 are several curves showing the variation in the photo-electric current with light flux entering the 868 cell. They are for five different anode voltages. It will be noticed that the curves are very nearly linear, especially for the lower anode voltages. The linearity indicates that the tube will not introduce any distortion in the output of the cell and that the current is proportional to the quantity of light that enters the cell.

There is practically no time lag between the light entering the cell and the current and for that reason the cell is applicable to cases where the light fluctuates with extreme rapidity. It is rapid enough to follow faithfully the high audio frequencies in sound movie reproduction and also to follow the variations of light encountered in scanning a scene for television.

Rating and Characteristics of the Phototube

Anode supply voltage, maximum	90 volts
Anode current, maximum	20 microamperes
Static sensitivity	45 microamperes per lumen
Dynamic sensitivity at 1,000 cycles	40 microamperes per lumen
Dynamic sensitivity at 5,000 cycles	38 microamperes per lumen
Gas amplification factor	Not over 7.
Load circuit resistance	0.1 to 5 megohms
Maximum overall length	4.125 inches
Maximum diameter	1 3/16 inches
Window diameter	0.9 square inches
Bulb	T-8
Base	Small four prong
Cathode surface coating	Caesium

The sensitivity characteristics were taken with a Mazda projection lamp as the source, operated at a filament temperature of 2,870 degrees Kelvin, and one megohm load resistance in the test circuit. The sensitivity varies with the type of light because the color sensitivity curve is not uniform and because the energy distribution of the light depends on the type of lamp and on the temperature at which it is operated. The phototube has a small quantity of gas in the envelope, as this increases the sensitivity.

Definition of Units

Many terms which may not be familiar to radio fans have been used in this description of the new phototube, and for that reason it will not be out of place to define them.

An angstrom is a unit of length which is used for expressing very short lengths, especially those of wave-lengths of light. There are 100 million angstrom units in one centimeter, or ten billion in one meter. Hence a wave 5,000 angstrom units long is 0.0005 centimeter long.

Ultra-violet light is light having shorter waves than the shortest visible violet light wave. **Infra-red** light is light having waves longer than the longest visible red light.

Anode has the same sinificance in the phototube as it has in the thermionic vacuum tube. It is the positive or electron gathering element. **Cathode** also has the same significance, being the electron emitter.

Static sensitivity is the sensitivity measured with extremely slow changes in the light, or so slow that capacity effects have no chance to affect the current.

ne Talkies and Television

gested, Operation Explained

. Jaffe

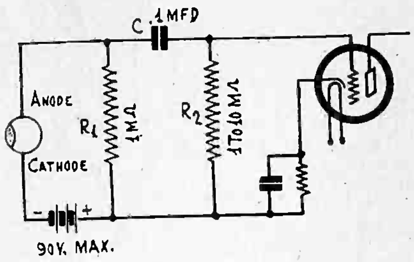


Fig. 3
A method of coupling the phototube to a thermionic amplifier when a separate battery is used in the phototube circuit.

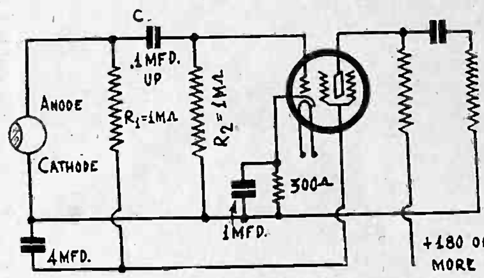


Fig. 4
The votage used on the amplifier tubes may be used to actuate the phototube if the circuit is arranged in this manner.

Dynamic sensitivity is the sensitivity measured with rapidly varying light.

The difference between static and dynamic sensitivity is the same as the difference between static and dynamic amplification of a thermionic vacuum tube.

Light flux, or **luminous flux,** is the quantity of light energy. The **lumen** is the unit of luminous flux. It is the light flux through one square centimeter on a sphere one meter in diameter when a source of unit intensity is located at the center of the sphere. The source of unit intensity is the standard candle. There is another definition of the lumen which makes it 10,000 times greater. This is the light flux from a source of unit intensity that flows through unit solid angle.

Practical Circuit

In Fig. 3 is a tpical circuit connecting a phototube and a vacuum tube amplifier. R1 is the load resistance on the phototube, in this case one megohm. C is a stopping condenser to isolate the grid from the high voltage and R2 is the usual grid leak. If the voltage drop in R1 is suitable for bias on the tube that follows it is not necessary to use C and R2, but the drop not only depends on the voltage of the battery in series with the load resistance and the phototube, but also on the light flux that enters the cell.

Suppose that the voltage in series with the tube is 40 volts and the load resistance is one megohm. If the flux that enters the cell is 0.2 lumen, the current is 2.6 microamperes, according to Fig. 2. The drop in R1 is then 2.6 volts, which would be satisfactory for a screen grid tube of the 224 type, or for almost any screen grid tube with the other voltages on the tube as usually recommended. With 90 volts in the phototube circuit and the flux the same as before, the drop in R1 would be 10 volts, which would be suitable for a 227 tube. Thus it is practical to choose such anode voltage and flux that would make the bias correct for almost any amplifier tube without the use of C and R2.

In case it is desired to use the same source of voltage for the phototube as for the amplifier tubes, the stopping condenser and grid leak should be used. Then R1 should be connected to B plus just as any plate coupling resistance, provided that the voltage does not exceed 90 volts. The return of R1 could be connected to the screen of an amplifier tube, on which the voltage is usually 90 volts or less. Fig. 4 shows a suitable circuit.

How Circuits Work

The manner in which the light values are converted into equivalent electric values can be explained by means of the curves in Fig. 2. Suppose we apply a voltage of 67.5 volts in series with a one megohm resistor and the phototube and that we arrange the components as in Fig. 4. Let the normal intensity of the light flux entering the phototube be 0.2 lumen and let this vary between 0.1 and 0.3 lumen. The light fluctuation amplitude, therefore, is 0.1 lumen. When the flux is 0.1 lumen the photo-electric current is 2.4 microamperes. The voltage drop in R1 is then 2.4 volts. At 0.2 lumen the current is 5.2 microamperes. Hence the change of 0.1 lumen changes the current 2.8 microamperes. The corresponding change in the voltage drop in R1 is 2.8 volts, which is the amplitude of the signal voltage resulting from the light variation.

On the other side we have a current of 8.1 microampere when the light flux is 0.3 lumen. Hence the change in the current due to a change in the light of one lumen is 2.9 microamperes. The corresponding change in the voltage across R1 is 2.9 volts. It will be noticed that the amplitude on increase is very nearly the same as the amplitude on decrease, the difference being only 0.1 volt.

This signal voltage would be sufficient to load up a screen grid tube. However, in the reproduction of home talkies it is not likely that such wide fluctuation in the light flux is possible. Hence the output voltage would be much less, and this would have to be compensated for by additional amplification in the electrical stage of the signal.

Volume Control Trouble

THE volume control in my set consists of a 500,000 ohm potentiometer in the grid circuit of the first audio tube. When the potentiometer is at full-on position everything is all right, but just so soon as I turn the control at all, using less resistance, I hear a howl, and no signal.—E. F. W., Seattle, Wash.

The potentiometer is defective. Try another one, or replace it with a fixed resistor to confirm the diagnosis.

Change in Amateur Phone Bands to Cut Interference

Considerable reduction of interference now caused by amateurs with aviation services will be brought about by changes in regulations for amateur operation, approved by the Radio Commission. Under the new plan, amateur telephone bands will be changed from 3,500-3,550 kc to 3,900-4,000 kc and from 14,100-14,300 to 14,150-14,250 kc.

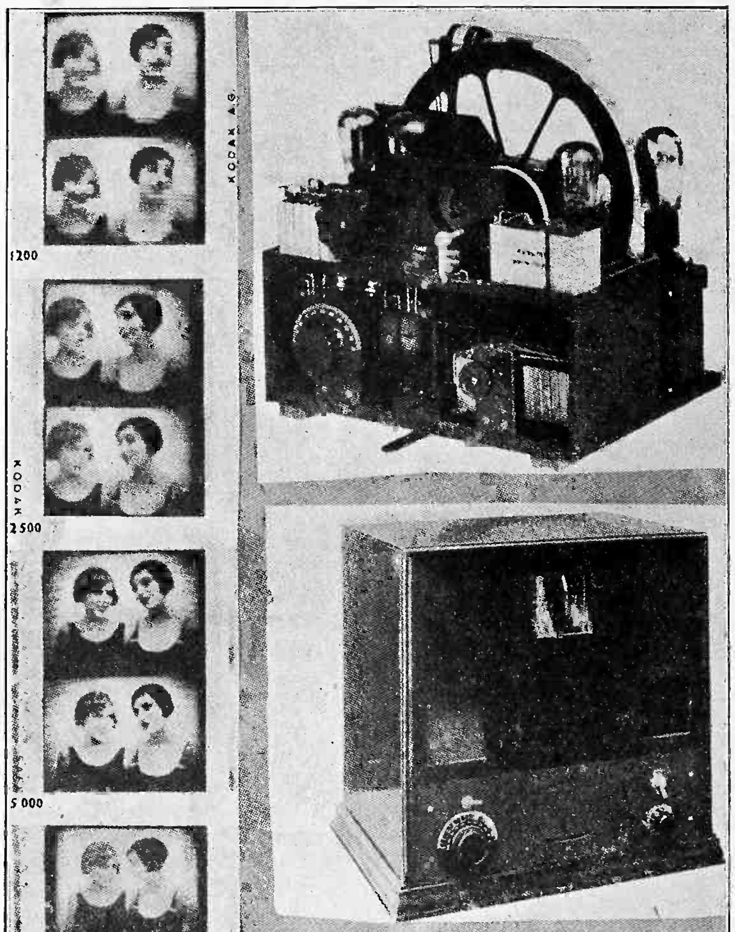
Amateur radio telephone operation in these bands will be permitted only when operators hold licenses of the grade approved by the Secretary of Commerce for unlimited amateur radiotelephone operation.

The new plan was first submitted to the Commission in May, 1931, by the American Radio Relay League, but was at that time disapproved by Albert Reiss, representing the Amateur Radiophone Association. But the Commission has received a telegram from Mr. Reiss stating that his association now approves the recommendations suggested by the League, and asking that his request for a hearing on the case should be withdrawn.

Germany Favors Ultra

Source of Light a Prese
Advance—Tests

By Heinrich Wirt



German Post Office's official photographs.

Increase in number of picture points improves the definition (left). The numbers of points used are given. Top right shows a television receiver chassis, center right, the cabinet view. Lower right shows a wheel containing a large number of mirrors set at different angles, used for reassembling the picture points on the screen into a picture. A point source of light is used. D is a diaphragm to confine the light beam.

Berlin, Germany.

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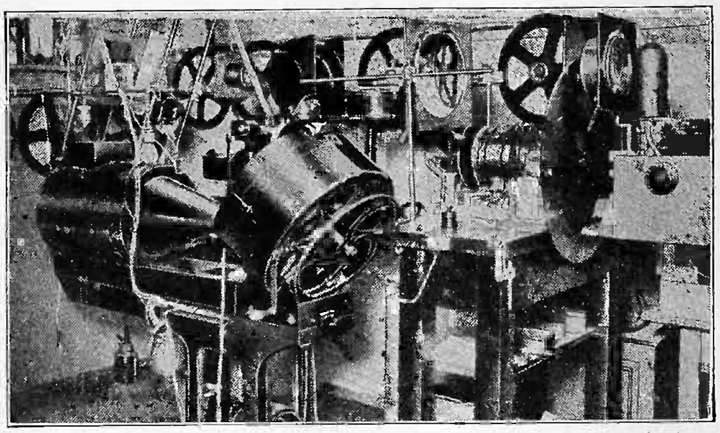

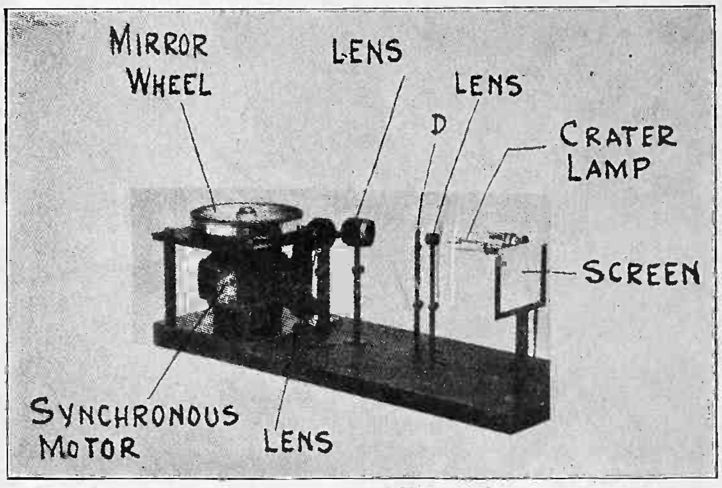

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Beam Modulation

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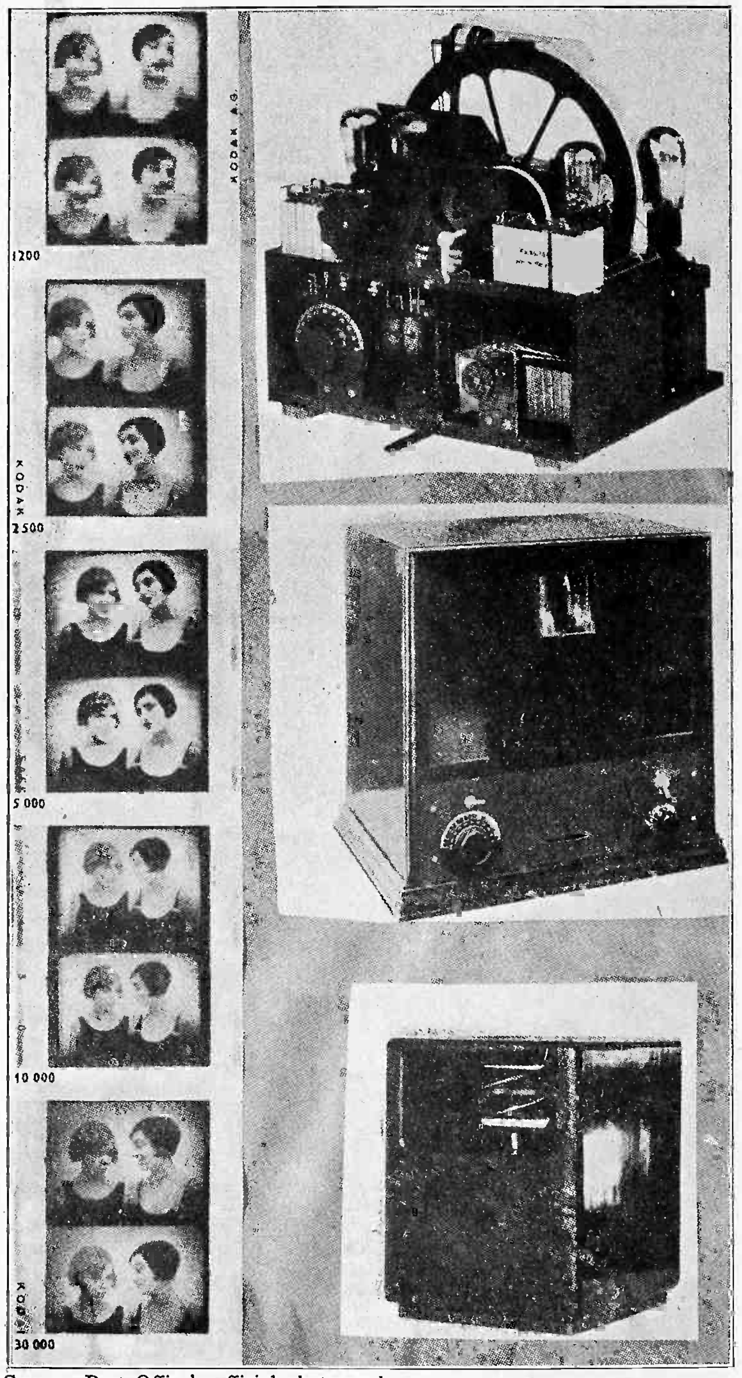

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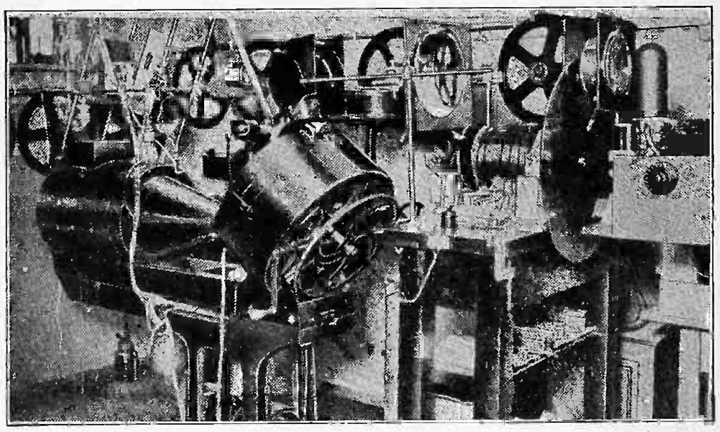

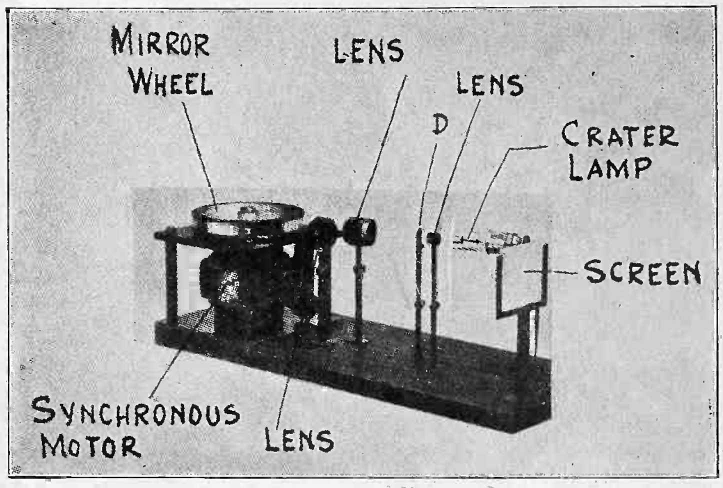

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The Effect of Grid

It Introduces High Minimum Ca

By Bru

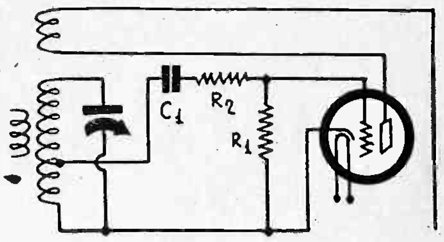

FIG. 1
In this simple oscillator the grid current introduces a large minimum capacity and also instability of frequency.

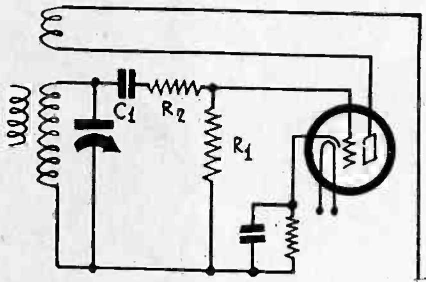

FIG. 2
The use of a stopping condenser and grid leak reduces grid current, stabilizes the frequency, and cuts capacity.

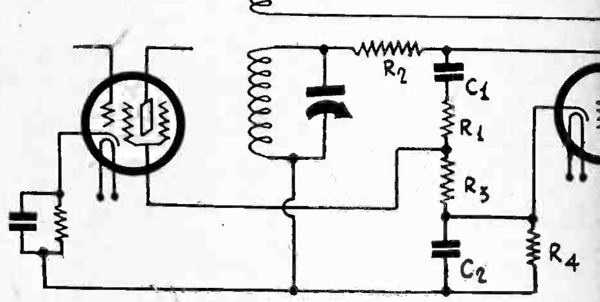

FIG. 3
The effect of the grid leak and stopping condenser in this circuit is the same as that shown in Fig. 2.

The grid h a tap on the mize the c able gri

THE effect of grid current on the performance of receivers is not generally given the consideration it deserves. This is especially true in the case of oscillators in superheterodynes and grid leak detectors. The amplitude of oscillation in most ordinary oscillators is limited by the grid current and at times this current is high, as will be appreciated when it is remembered that grid dip meters operate on grid current.

When grid current flows the grid to filament, or cathode, resistance is low, and this resistance is directly across the tuned circuit ahead of the tube. This decreases the selectivity of the circuit and also the sensitivity of the receiver. Another effect is to increase the effective capacity of the circuit, and this increase at times is quite large. One place where the increase in capacity is especially large and troublesome is in oscillators. When an attempt is made to connect the oscillator condenser on the same control as the r-f condensers, the increased capacity appears as a very high minimum capacity in the circuit which in many cases renders impossible the padding of the oscillator so as to track.

Value of Grid Resistance

It is often assumed that the grid to cathode resistance is infinite. But this assumption is valid only when the bias is so high that at no part during the input voltage cycle the grid assumes a positive value. This condition may be met in amplifiers but in oscillators it is difficult to satisfy. F. B. Llewellyn of Bell Laboratories has shown that for simple oscillators the ratio of the plate resistance to the grid resistance is very nearly equal to u-1, where u is the amplification constant of the tube. Suppose we have an oscillator in which the tube is a 227 type, which has a mu of 9. The plate resistance is then eight times larger than the grid resistance. The plate resistance of this tube is approximately 10,000 ohms and therefore the grid resistance would be only 1,250 ohms. This is far from negligible when connected across a tuned circuit. Undoubtedly, the mean value of the grid resistance during a cycle is somewhat higher than this even under the worst conditions. Indeed, it would have to be considerably higher or the circuit would not oscillate.

If we put a resistance R across a capacity C which is a part of a tuned circuit in which the inductance is L, the resonant frequency is diminished by an amount depending on the ratio of L/C and on the square of the resistance. If F is the resonant frequency of the circuit when the resistance is across C, Fr the resonant frequency when there is no resistance across the condenser, and if $n = L/CR^2$, then $F = Fr\ (1 - n)^{1/2}$. If n is greater than unity the oscillation is imaginary, which means that no oscillation will occur if n is larger than unity.

Typical Values

In many tuners the inductance of the coil is 245 microhenries. If this is to tune just to 1,500 kc, the minimum capacity in the circuit should be 46 mmfd. The ratio L/C is therefore 5.32 times a million and the square root is 2,310. The resistance across the condenser must not be less than this. Let us suppose that it is 5,000 ohms and that oscillation still occurs. The value of n i then 0.462. Therefore $F = Fr\ (1 - 0.462)^{1/2}$ or 1,110 kc. Thi frequency reduction would be brought about by adding 38 mmfc to the tuning condenser without the resistance across it. Tha is, the grid resistance in this case adds 38 mmfd. to the minimun capacity. Let us see what it adds to the maximum capacity.

If the tuning inductance is 245 microhenries and the maximun capacity is 350 mmfd., the lowest frequency is 543 kc. In thi case the ratio L/C is 0.7 times a million. Hence n = 0.028 anc F turns out to be 535 kc. This is only a reduction of 8 kc, whicl is brought about by a change in capacity of 10.5 mmfd. There fore the resistance across the tuning condenser introduces more capacity at the high frequency end of the tuner than at the lov frequency end. It is equivalent to adding a certain small capacity across the tuning condenser.

Effect of Grid Leak

A resistance connected across the tuned circuit externally ha the same effect as the internal grid resistance. For example when we connect a grid leak from the grid to the cathode, thi resistance is directly across the tuning condenser and it is ir parallel with the grid resistance. If there is a large condense in series with the grid leak the case is not materially changed because the condenser would have to be extremely small before it would affect the situation. If the resistance is connected from the grid to the top of the tuned circuit the effect is entirely different for in that case the resistance increases the effective resistance across the tuned circuit.

Although a grid leak connected from the grid to the cathode decreases the shunt resistance, it may still be used to advantage and to increase the grid resistance at that. If there is a condenser in series with the grid return and if the leak is the only conductive path from the grid to the cathode, the grid current cannot rise to as high values as before. As soon as grid current begins to flow a steady voltage drop is established across the leak and this will buck the tendency for the grid to go positive. In fact, if the grid is of the order of quarter megohm or higher the grid cannot go positive by more than a small fraction of a volt and the internal grid resistance remains so high that the external shunt practically determines the resistance across the tuned circuit. When this shunt is 250,000 ohms or more the increase in the effective capacity is very small.

Series Connection of Leak

The leak can just as well be connected in series with the grid lead and in this case it will be just as effective in limiting the flow of grid current and it will be still more effective in holding the tuning condenser capacity to its proper value. Therefore in an oscillator, as well as in a detector, the grid leak and condenser should be connected in parallel with each other and in series with the grid lead, except when for special requirements it is necessary to depart from the rule.

The treatment of the oscillator so that no grid current flows,

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acity and Frequency Instability

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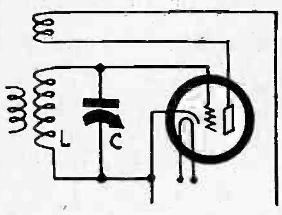

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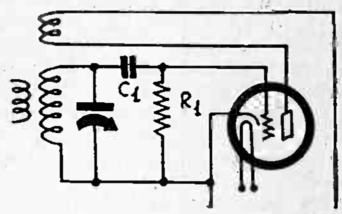


FIG. 5
The methods of stabilization used in Figs. 2 and 4 have been combined. A series resistance R2 has been introduced.

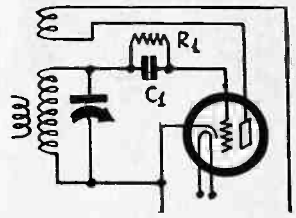


FIG. 6
Grid bias on an oscillator tube is advantageous. The treatment illustrated here improves the oscillator.

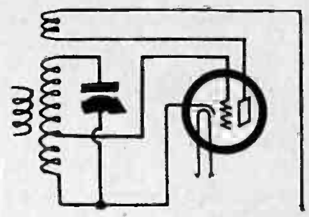


FIG. 7
Grid current is limited by R2, which also limits the amplitude. A method of virtually constant coupling.

or so that there is a minimum shunt resistance across the condenser, becomes of first importance when designing superhetrodynes in which the tuning condensers are put on the same control. As a first condition, the oscillator inductance must be less than the inductance in either r-f circuit. Assuming the same minimum capacity in the oscillator and in the r-f circuits and an intermediate frequency of 175 kc, the oscillator inductances should be 80 per cent. of the inductance in the r-f circuits. If the minimum capacity in the oscillator is less than the minimum in the r-f circuits, it is always possible to add enough to make them equal, which is a better procedure than to change the inductance.

If the minimum capacity in the oscillator circuit is greater than in either r-f circuit it is not always possible to make the oscillator track with the other circuits. If the inductance of the oscillator be reduced until the oscillation frequency is 175 kc higher than the signal freqency when the tuning condensers are set at minimum, there will not be enough inductance at the lower frequency end of the dial. Instead of calling for a series condenser here to make the oscillator frequency right it would be necessary to add an inductance. But, of course, this could not be done, for it would throw the adjustment out everywhere else.

Padding Problems

When the minimum capacity of the oscillator is too high, the best that can be done is to make the series padding condenser infinite, that is, to short circuit it, and then adjust the inductance when the condensers are set at maximum until the oscillator frequency is 175 kc higher than the signal frequency. If the minimum capacity should happen to be just right, the padding obtained by this method would not be far out anywhere, but if it is still too high there would be no tracking at the high frequency end. It is absolutely necessary to decrease the minimum capacity in the oscillator circuit, or there is little hope of getting good tracking throughout.

The addition of a resistance in series with the resonant circuit is effective in reducing the added capacity effect for three reasons; first, it adds to the resistance in shunt with the condenser; second, it tends to prevent the grid from going excessively positive and hence to keep the grid resistance high, and third, it limits the amplitude of the oscillation which in turns prevents the grid from going very much positive. Of course, if this series resistance is too high, oscillation will not occur. Hence the choice is a compromise.

Typical Oscillators

In Fig. 1 is a tuned grid oscillator of the simplest type, in which L and C are supposed to determine the frequency of oscillation. As a matter of fact, the frequency generated will be much lower than the natural frequency of L and C. There is no bias on the grid and for that reason the operating point is at zero bias. The oscillation swings the voltage both positive and negative about this value, and during the positive swing the grid resistance is very low. This circuit can be improved somewhat by using the regular grid bias resistance called for by the tube when it is used as an amplifier. But even this does not reduce the effect of the grid resistance sufficiently for many purposes.

The credit in Fig. 2 is an improvement over that in Fig. 1 in that grid current is prevented by the stopping condenser C1 and the grid leak R1. The grid voltage cannot swing far positive now because as soon as grid current begins to flow the drop in R1 will buck it. Therefore R1 will maintain the grid voltage near zero during the positive swing of the oscillating circuit. This circuit can also be improved by applying a negative bias. In this case grid current will only flow during a small part of the signal swing, and the current that does flow will be kept down by the grid leak.

Series-Connected Leak

The circuit in Fig. 3 is an improvement over that in Fig. 2 because in this case the grid leak is connected in series with the grid resistance. As far as the limitation effect is concerned it is the same in both circuits for the same value of grid leak. It is true that the stopping condenser to a large extent nullifies the effect of R1, but it has a corresponding effect in Fig. 2.

Another method of reducing the effect of the grid resistance is illustrated in Fig. 4. In this case the grid is connected only across a portion of the tuning coil. The grid resistance, therefore, whatever it may be, is connected across only a part of the tuned circuit rather than across the whole. The effect of the grid resistance is correspondingly reduced. The effect can be reduced still further by treating the circuit as in Fig. 5, in which the coil is tapped just as in Fig. 4 and in addition the grid condenser and leak stabilizer is used. In Fig. 5 it is not really necessary to use the tap on the coil because if the resistance R2 is chosen high enough the same effect will be obtained. The grid connection would then be made to the top of the tuned circuit as in Fig. 6. In this circuit the effect of the grid resistance is still further reduced by using a grid bias.

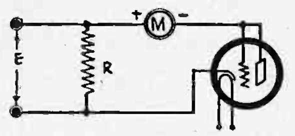
More Computations

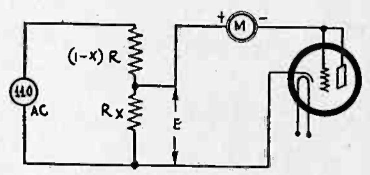
Let us see what the effect of the grid and external resistance may have on the frequency of the oscillator in Fig. 6. Let us assume that R1 is 100,000 ohms, that R2 is 5,000 ohms, and further let us assume that the grid current is limited so that the resistance is not more than 10,000 ohms. The effect of C1 may be neglected. The resistance of 100,000 ohms in parallel with 10,000 ohms is 9,900 ohms. This is in series with R2, which is 5,000 ohms. Hence the total resonance across the tuning condenser is 14,900 ohms. Now if the inductance of the coil is 245 microhenries and the capacity at minimum is 46 mmfd., the value of n in the formula given previously is 0.024 and therefore the frequency is 1,484 kc, a reduction of 16 kc. This is equivalent to adding a capacity of nearly 1 mmfd., which is quite negligible. And the conditions assumed were extreme at that.

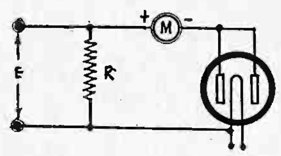
Measuring the Out

A Diode Rectifier or Vacuum

By Burton







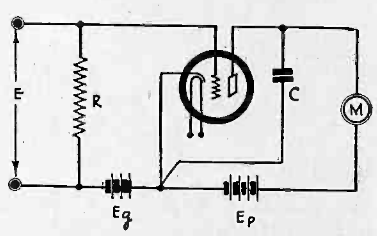


FIG. 1 (top left)

An output meter in which a diode made of a three element tube is used as rectifier and a milliammeter is used as deflection indicator. R should have the value of the best load resistance of the output tube.

FIG. 2 (top right)

When the voltage to be measured is higher than that covered by the calibration of the output meter, a fraction of the output voltage can be measured as indicated here.

FIG. 3 (bottom left)

A 280 type rectifier can also be used if connected as in this manner. There is virtually no difference between this circuit and that in Fig. 1.

FIG. 4 (bottom right)

One of the best ouput meters is that based on the grid bias detector. The bias Eg is adjusted until the reading on the meter M is very small or just zero when R is short circuited.

IT is frequently asserted that a certain change in a circuit increases the volume 100 per cent. Perhaps it does, but who can tell? Perhaps the change is only 5 per cent., or maybe it is as much as 500 per cent. If the ear is the sole judge, one guess is as good as another and all the statement can mean is that there has been an increase in the volume.

The only way to express numerically whether there has been an increase or a decrease is to measure the output before and after the change, either in absolute or in relative units. To do this we need an output meter of some kind.

Any detector may be converted into an output meter provided that we calibrate it. This detector may be a diode, a grid bias detector, a crystal, a copper oxide rectifier, or any other.

In Fig. 1 we have a simple diode rectifier made of a three element heater type tube. The alternating voltage E to be measured is connected across a resistance R, which is then connected to the tube in the manner indicated. The rectified current will be indicated by the direct current milliammeter M. For every value of E there will be a definite reading on the meter M and that reading will be a measure of the voltage. If we have an alternating current voltmeter we can connect this across R and different voltages may be impressed. Thus we can get a calibration curve between the alternating voltage impressed and the reading on M.

Using Fixed Voltage

If we do not have an a-c voltmeter but only a source of high voltage, say 110 volts, we can still calibrate, provided that we have different resistances of known value. This is illustrated in Fig. 2. The voltage across all of R is always 110 volts, or whatever we have. Let us connect the tube across a portion Rx of the total resistance. The input E to the tube is then the drop in Rx, and by simple proportion we have $E = 110x$. This holds, provided that the value of R is small compared with the resistance of the tube, a condition not difficult to meet. Since x may have any value from zero to unity, we have a means of impressing any known voltage from zero to 110 volts. For accurate work we should know the exact value of the line voltage but for comparative work we may assume it to be 110 volts. The values of the two resistances Rx and $(1-x)R$ may be measured with a battery and the meter M, or with an ohmmeter. Note that the sum of the two resistances is always equal to R. That is, R is a potentiometer of fixed resistance and we only tap it at different and known points.

After we have calibrated the meter, that is, after we have found a reading on M for every value of E, we can use the instrument for measuring output voltages. Incidentally, the resistance used should be non-inductive. This does not mean, however, that a wire-wound resistance such as those used in voltage dividers cannot be used.

Instead of using a three element tube, a 280 rectifier tube could be used just as well. The connection of this tube is shown in Fig. 3. The plates of the tube are tied together. Of course, it is necessary to provide a suitable filament voltage for this tube, just as this is necessary when any other tube is used as rectifier.

Grid Bias Detector

A grid bias detector can also be used for measuring output. One circuit of this type is illustrated in Fig. 4. Here E and R have the same significance as in the preceding circuits. Eg is a bias voltage which places the operating point of the tube where detection or rectification is good. This voltage is best provided by a small battery. The bias should be adjusted so that the plate current is about 0.1 milliampere when the signal voltage E is zero. As a voltage is impressed across R the plate current will increase, and this increase is a measure of the alternating voltage E. If the voltage to be measured is high, the bias may be increased until the plate current is practically zero when no a-c voltage is impressed. The increase in the plate current is then practically the same as the current itself, so that the reading on M is a measure of the alternating voltage. This instrument can be calibrated in just the same way as the preceding circuits. Condenser C may not be necessary but if it is used it should be about one microfarad.

Using A-C Milliammeter

In case an alternating current milliammeter is available, this can be used for measuring the output of a receiver. A suitable circuit for this is shown in Fig. 5. The tube shown in this circuit is the power tube of the set. Ch is a choke coil of high inductance value, say 30 henries or more. C is a stopping condenser of large capacity, say 4 mfd. or more. R is a resistance which should be adjusted to the proper load resistance of the power tube. For a 245 it should be 4,000 ohms and for a 247 it should be 7,000 ohms. The range of the alternating current milliammeter should be suitable to the tube involved, or to the signal that will be obtained.

The output power in this case is the product of the current squared and the resistance R. Suppose that the current is 5 milliamperes and the resistance is 7,000 ohms. The power then is 175 milliwatts. Since the maximum undistorted output of this tube, that is, the 247, may be of the order of 5 watts, the current that may be expected is 26.7 milliamperes. An a-c galvanometer having a maximum deflection of 115 milliamperes, a common instrument would be suitable for this circuit. This meter is not calibrated in milliamperes but the scale is divided into 100 divisions and the deflection is proportional to the square of the current. Thus relative values of power are obtained by multiplying the deflection by the resistance R. Or, since the resistance for any one tube remains constant, the relative power is proportional to the deflection. For this reason this instrument is very convenient for measuring relative power output. If the deflection is twice as great in one case as in another it can be said that the volume in one case is twice that in the other.

Matching Impedance

It is assumed that the signal consists of a pure tone of steady amplitude. If the output from a broadcast signal is measured the output will vary continually. This applies to the other output meters as well.

When measuring output with any one of the circuits in

put of a Receiver

Tube Voltmeter May Be Used

Villiams

Figs. 1 to 4 the load resistance on the output tube should be equal to the optimum load resistance for the tube involved. This can be provided by making R in each case equal to the output resistance of the tube. If it is not practical to make it as high as this condition demands, R may be made smaller and a series resistance connected between the tube and the calibrated voltmeter. Then only a portion of the output is measured directly. Fig. 2 illustrates this arrangement, which is applicable to all the circuits. R in this case should be equal to the optimum load resistance of the tube but Rx may be only a small fraction of this.

Suppose, for example, that R is 7,000 ohms and that Rx is 1,000 ohms. Then E will be 1/7 of the total voltage. Suppose we have calibrated the output meter on 110 volts when Rx is 1,000 ohms and R is 7,000 ohms. Then any other voltage impressed across the whole R will be divided in the same ratio, that is, 1 to 7. To get the total output voltage of the tube we would multiply the voltage indicated by the meter by seven. The circuit in Fig. 6 shows an arrangement suitable for a 247 pentode output. The rectifier terminals would be connected across E. The condenser in series with the load resistance is used to prevent direct current from entering the voltmeter circuit. While the condenser is specified at 4 mfd., a larger one could be used to advantage, especially when the frequency of the tone is low. For the standard test frequency of 400 cycles per second 4 mfd. is large enough.

Copper Oxide Rectifier Meter

Copper oxide rectifier meters often come with an internal resistance of 4,000 ohms. Such a meter will give directly the output voltage when connected, through a large condenser, across the output of a 245 type amplifier, assuming that there is no other load on the amplifier. A meter of this type is rather limited in its application, but of course it is always possible to connect an external multiplier resistance when the required load resistance is higher than 4,000 ohms.

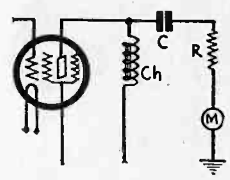
One of the best output meters is the grid bias detector shown in Fig. 4. This has virtually an infinite resistance and is therefore an ideal voltmeter. The resistance R in this circuit should be made equal to the load resistance of the tube, and no other load should be used on the tube. In case the output voltage is too high for the rectifier tube, the grid circuit of the detector can be connected across any part of R. For example, suppose the calibration of the voltmeter covers only a range of 10 volts and the output voltage may be of the order of 100 volts, in that case the grid circuit of the tube should be connected across only 1/10 of R, and each value should be multiplied by 10.

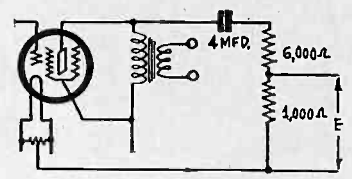
The meter in Fig. 4 can also be used to measure the voltage across the voice coil of a dynamic speaker. In this case R is omitted and the grid circuit in connected directly across the voice coil. The voltage developed across the voice coil, even for fairly large values of output, will be low. Hence it is advantageous to have the meter calibrated over a low voltage range, say from zero to 10 volts. But the voltage across the voice coil will not give the power delivered to the speaker unless the current in the voice coil is measured at the same time the voltage is measured. For comparative values at one frequency it is sufficient to regard the square of the voltage as the power. This will give correct relative output values, provided that the frequency does not change.

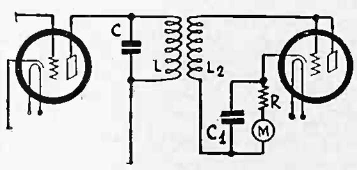
Keeping Direct Current Out

Whenever a rectifier voltmeter is connected to an output tube it is necessary to eliminate direct current, and this may be done with a large stopping condenser as suggested. It can also be done with a transformer. A condenser is the simpler and more reliable.

In case it is desired to study the radio frequency amplification only a diode detector operating on the carrier can be used. One way of doing this is illustrated in Fig. 7. A coil L2 is coupled to a coil L, which forms a part of a tuned circuit. The carrier current in LC will induce a voltage in L2 and this will cause a direct current to flow in the diode circuit. C1 is a by-pass condenser used only to improve the detecting efficiency and R is a meter to limit the rectified current until it is suitable to the meter M used. To limit the power taken from the tuned circuit M should be a sensitive milliammeter, say 0-1 milliampere. The deflection on M will follow the mean amplitude of the current in the tuned circuit and will indicate the effect of changes in the radio frequency







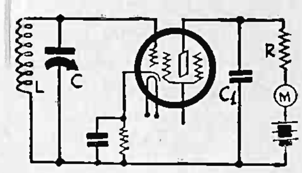


FIG. 5 (top left)
The direct current must be kept out of the output meter and one way of doing this is shown in this circuit. In this particular case M signifies a thermo-coupled type of meter, but the a-c voltage across R may be measured with one of the preceding meters.

FIG. 6 (top right)
The output voltage may be measured by measuring the value of a known fraction of it as in this case, where E is 1/7 of the total.

FIG. 7 (bottom left)
The carrier voltage may be measured with a diode rectifier by this method.

FIG. 8 (bottom right)
The regular rectifier in the receiver can also be used for measuring the carrier voltage by connecting a milliammeter in the plate circuit of the detector. The increase in the reading on M due to the signal is a measure of the signal intensity.

amplifier. For example, it will show whether the amplification is increased or decreased by changes in grid bias, plate voltage, filament voltage, degree of coupling, change of coils, and so on. It will also show changes in signal intensity due to fading and other effects.

It is not necessary to set up a separate tube for observing this change when a grid bias detector is used, because the detector tube itself can be used as the rectifier. How this is done is shown in Fig. 8. The tube here is supposed to be the regular detector and LC is the tuned circuit ahead of it. R is the coupling resistance and C1 the regular by-pass condenser. The only thing that need be done is to insert a 0-1 milliammeter M in the plate circuit as indicated. This may be either above or below the coupling resistance. It is not advisable to insert the meter by plugging a circuit tester into the socket.

If the detector has been adjusted for best detecting efficiency a signal voltage impressed on the control grid in the regular way will increase the plate current. The increase as indicated by the meter is a measure of the strength of the signal.

Source of Signal

It is not practical to depend on broadcast stations for the source of signal except when a rough estimate of the output is desired, because the output changes continually, both when the audio component and the carrier are measured. When measuring radio gain it is best to have an unmodulated carrier, obtained from a laboratory oscillator, or a carrier modulated with a tone of constant amplitude. Likewise, when studying the output of the audio amplifier, it is best to have a tone of constant amplitude and frequency, which can also be supplied by a laboratory oscillator. Suitable oscillators have appeared several times in RADIO WORLD, the latest thing in the Jan. 2nd., 1932, issue.

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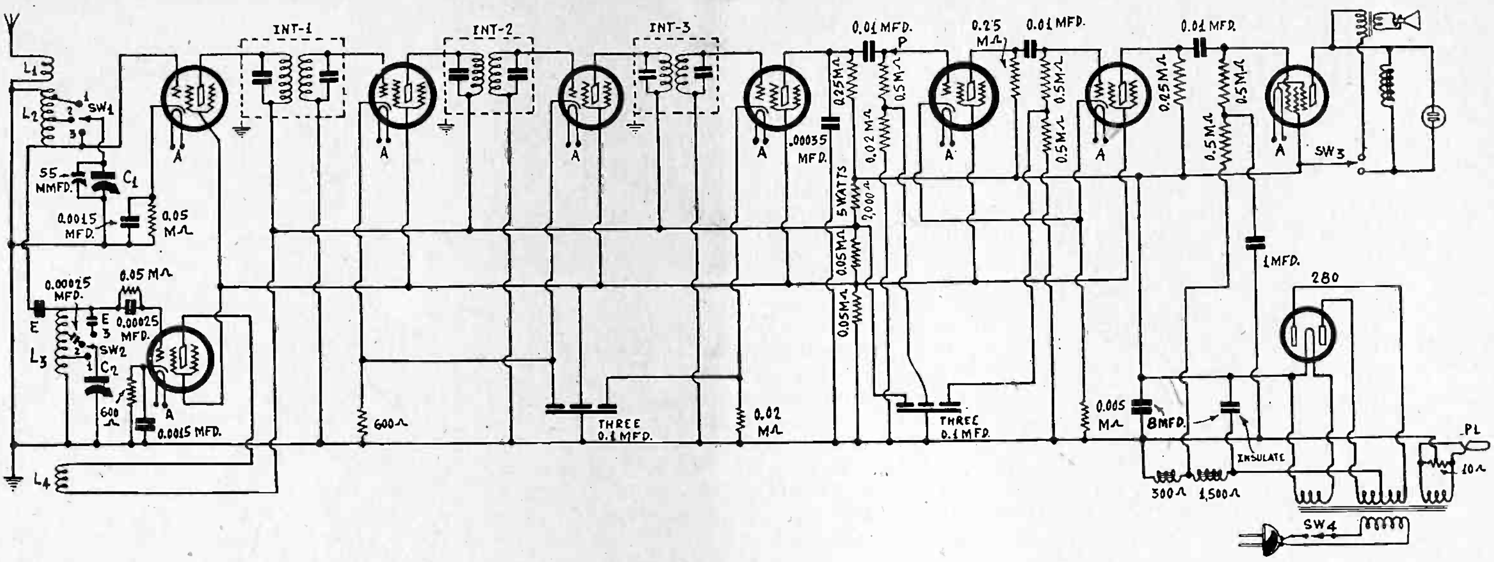


FIG. 981

Short-Wave Superheterodyne

PLEASE show a stabilized three stage resistance coupled audio amplifier, working into a pentode output tube, with television terminals, the amplifier preceded by a short wave superheterodyne that will also tune in regular short wave stations, besides television.—H. D. G., Beacon, N. Y.

The requested circuit is shown in Fig. 981. If single control of tuning is to be used, at least a modulator trimmer is advisable, and the padding may be done in the oscillator circuit as shown. It is not known what intermediate frequency you will use, but assume, since you want short-wave reception only, that it is 1,600 kc. Then the condenser E in the oscillator circuit is a 20-100 mmfd. equalizer set at a maximum, and the other padding condenser may be 0.00025 mfd. The coil data then would be, for the modulator, L1 = 20 turns, L2 = 45 turns tapped at fifth and tenth from the grounded end, and for oscillator, L3 = 25 turns tapped at 5th and 12th from the grounded end, L4 = 17 turns. The stabilization of the audio amplifier is effectuated by using resistor-capacity filters in the three grid circuits and also by using a common biasing resistor of 0.005 meg. (5,000 ohms) in the first and second audio stages. This resistor introduces negative feedback that aids in the elimination of motorboating. The switch, SW-3, puts speaker or neon lamp in circuit. The output choke coil is 30 henries. The intermediate frequency transformers should have plate condensers out of circuit when the transformers are being peaked, and then a signal tuned in and grid condensers adjusted for maximum response. Then the grid condensers are disconnected, the plate condensers connected, and the plate condensers adjusted for maximum response. Then the grid condensers are re-established without further test. The response will be a little less, but there will be a band pass filter intermediate tuner.

* * *

Battery Resistance Compensation

IN constructing a meter board I have made suitable arrangements for testing voltages and currents, both a-c and d-c, and now I am stumped regarding the resistance measurement. I have made provision for a 4.5 volt battery, with series resistor, and would like to know how to compensate for the voltage difference as the battery ages, so that the resistance measurements will be right even when the battery is old.—H. D. E.

As the battery ages or is used, the resistance of the battery increases. Therefore, if you use a potentiometer or other device to alter the voltage it will be only in the direction of reduction, unless the resistance calibration is made in the first instance for less than 4.5 volts the potentiometer will do no good. Also, since added resistance, due to the battery, is actually the cause of the changing condition, whereby the voltage seems to be different, the potentiometer or other device is mostly a means of kidding yourself by making the meter seem to read zero resistance at full-scale. The no-load voltage across the battery is actually the same all the time, the current drain simply making the battery resistance readable on the resistance scale. That is, when current flows, the resistance effect shows up as if it were a battery voltage diminution. Compensation might be possible if the current were constant, but such constancy can not exist except by confinement to one particular reading. We recommend, therefore, that you omit all efforts at compensation. Then as the battery resistance increases, that resistance can be read on the scale, and deducted from the apparent reading. Or, if you will replenish the battery so soon as its resistance becomes readable, you will be playing safe, also.

* * *

Measuring Device

AT present I have a set analyzer that I built and it is rendering excellent service. Now I desire a separate device that will measure voltages and currents, both a-c and d-c, and that will measure also resistance, 0-10,000 and 0-100,000 ohms, and capacity from 0.1 mfd. to 10 mfd. Can some provision be made for measuring the capacity of electrolytic condensers?—O. T. Malone, N. Y.

We are working on a device that will measure 10 volt, 100 volt and 250 volt ranges, a-c and d-c, also 1, 10 and 100 milliamperes d-c and 1 ma a-c, with 0-10 volts and 0-100 volts output meter measurements, and by connection to the 110 volt a-c line capacities in the range you state. The device will not measure the capacity of electrolytic condensers, however, because a-c can not be applied to them. A rectifier would have to be built in, and that you can include, if you desire. The output meter will have an impedance adjuster for voice coil measurements, that is, so the meter can be used, if desired, at the voice coil. The meter output impedance will be 7,000 ohms, which makes it serviceable for pentodes. A single meter will be used. It has a built-in rectifier. Watch for the article concerning the construction of this valuable measuring device.

* * *

Cross-Modulation

HAVING built a small a-c set, five tubes, I am surprised at the sensitivity. However, the selectivity is not as good as it might be. Sometimes a powerful local can be heard faintly when another powerful local 50 kc removed is tuned in. This, I believe, is called cross-modulation. I have a standard hookup, using the full B voltage on the plates of the r-f tubes, some 250 volts, with volume control in the common cathode circuit of the two r-f tubes. The detector is a 224, the output tube a 247, and the rectifier a 280.—J. K. S., Roanoke, Va.

Put a 5-watt resistor, of 2,000 to 3,000 ohms in series with the common plate returns of the r-f tubes, that is, interconnect the plate returns, and interpose the resistor from the joint to maximum B plus. Then the B current for the r-f tubes will flow through the resistor, and the B voltage will be dropped to below 200 volts. Put a fixed condenser of 0.0005 mfd. or higher capacity from the plate returns to ground. Be sure that you have a sufficiently large value of limiting resistor in series with the volume control. Up to 1,000 ohms may be used. It is not uncommon to encounter cross-modulation when the plate voltage is too high on the r-f tubes, especially when the screen voltage is held virtually constant. Use of such resistor is shown in Blueprint No. 627, which otherwise conforms to your circuit.

TRADE MOVES FOR STANDARDS IN TELEVISION

Working toward early and orderly development of television, recommendations of television frequency assignments and engineering standards are being made by the Radio Manufacturers Association to the Federal Radio Commission for consideration at the International Communications Conference next May in Madrid. The engineering proposals were drafted at a recent meeting of the television committee, of which D. E. Replogle is chairman, and were transmitted to the Radio Commission at Washington by Dr. C. E. Brigham, chief of the association's engineering division.

Summary of Proposals

Chairman Replogle has issued the following summary of the television engineering proposals:

"From data secured it is apparent that the present television wavelength assignments are inadequate to give satisfactory television broadcasting service.

"1st—Because of interference between stations at distant points.

"2nd—Because of phantom images and fading set up by reflections of television signals from the Heaviside layer. These reflections arrive at a different time from the ground wave of the transmitting station, which causes several images to appear and shift back and forth except in areas close to the broadcasting stations. These are quite annoying and when present entirely upset the detail of the received pictures.

"3rd—The narrow channels of 100 kc, while wide in comparison with voice channels, are still too narrow to permit satisfactory picture transmission.

"4th—In the spectrum assigned to television there are too few channels to assign to sufficient television stations adequately to supply one city without considering the many cities that will want service. This has become quite apparent and there has been a definite search for other channels in the ether not now occupied that can be used for television.

Spurred by Conference

"This search for new channels during the past year has brought to light sufficient data to make necessary the calling of a special meeting of the television section of the general standards committee to consider the request for television bands that can be expected to meet requirements in this art for the next five years. It was necessary to make these requirements at this time because of the start of the International Radio Conference in Madrid, Spain, next Spring, which will set the various international radio channels for the next five years.

"At the committee meeting the following television interests were represented: Radio Corporation of America, Jenkins Television Corporation, Philadelphia Storage Battery Co., U. A. Sanabria, Baird Television Corporation of England, Short-wave & Television Labs., Radio Pictures, Freed Radio & Television Corp., Stromberg Carlson Telephone Manufacturing Co. and the Kolster Radio Company.

Want to Use Higher Frequencies

"After a presentation of the facts the following recommendations were made to the Federal Radio Commission through the engineering committee:

"1st—The desirability of securing continuous band from 35 to 80 megacycles exclusive of the amateur band (56 to 60 megacycles).

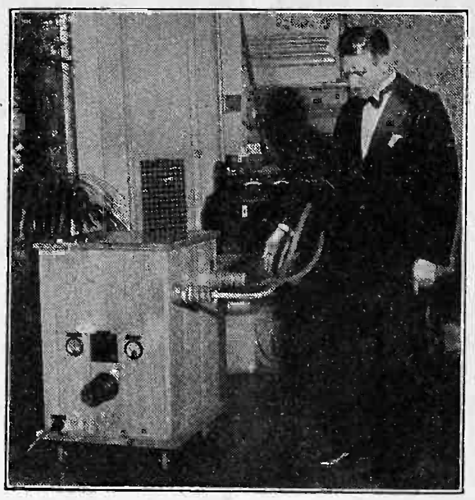
"2nd—That sound be permitted on channels assigned for visual broadcast when and only when accompanying visual programs.

"3rd—That a channel width of 2,000 kc. be allowed for experimental television transmission because of the width of the sideband necessary to convey pictures of adequate detail and because of the space required for the synchronizing signal and associated sound programs and for a wide band between adjacent television channels to allow for inaccuracy in the maintainance of television transmitter frequency and to permit the easier construction of high fidelity receiving sets for television and sound.

Calls Recommendations Important

"These recommendations are considered of greatest importance. They show first the trend of television development for the next few years, namely, toward the use of the shorter waves hitherto believed unusable and for the possibilities of sight and sound broadcasting. The discussion at the meeting also revealed the fact because of the non-interference of the transmitted wave on these frequencies, it will be possible to pass hundreds of transmitting stations throughout the United States without objectionable interference."

FEVER MACHINE



(Acme)

The treatment of rheumatism by short-wave radio was discussed during a symposium on electricity in modern medicine before the Science Forum of the New Electrical Society at the Engineering Auditorium in New York. A portable electric artificial fever producing machine constructed as a short-wave radio transmitter was exhibited by Albert B. Page (above).

FINDS SIGNAL STRENGTH UP 400 PER CENT.

Washington.

Dr. Harlan T. Stetson, director of the Perkins Observatory of Ohio Wesleyan University, before a meeting of the American Astronomical Society recently announced the results of his latest observations on the relation between sun spots and radio reception.

Corroborates Himself

These agree with his former conclusions based on data collected in Cambridge, Mass.

His latest data were collected at Delaware, Ohio, by nightly observation of the signal strength from WBBW, Chicago, Ill., about 300 miles distant. During the past year, he stated, the sun spots have decreased about 50 per cent. and at the same time the improvement in the signal strength has been about 400 per cent. Since the results obtained in Ohio and Massachusetts are the same, although the distance between the observation points and the direction of wave travel was different, Dr. Stetson concluded that the effect is general.

Effect of Meteors

A. M. Skellett, of the Bell Laboratories in New York, presented another paper on the effect of meteors on radio. During the period of Leonid meteor showers in August and November there was considerable interference with transatlantic reception of short waves, and during the height of the meteor shower connection with England was impossible. Mr. Skellett stated, however, that the meteors may not been been responsible because during the same time there was a considerable magnetic disturbance. Mr. Skellett's theory is that as the meteors enter the atmosphere they ionize the air and so change the position of the Kennelly-Heaviside layer.

A THOUGHT FOR THE WEEK

ROY McCARDELL'S good old Jarr Family is once again attracting the wide attention of our public. Mr. McCardell, a recognized humorist of the American school, made the Jarr Family popular with millions of newspaper readers during the years when his amusing characters lived through the medium of his syndicated contributions to our big dailies. Now Julia Nash and Charles H. O'Donnell are heard over the air in a new Jarr Family series of humoristics. This is a Forhan's program and is being offered over WOR at 7:45 P.M. three times a week. Miss Nash and Mr. O'Donnell are noted players who have appeared successfully in vaudeville for a number of years. They belong to the division known as Big Time and their advent on the air in connection with the Jarr Family is an important event in broadcasting; as note the important time assigned them—7:45 P.M. A nation-wide hookup is being arranged for their activities.

RADIO WORLD
Title Reg. U. S. Pat. Off.
The First and Only National Radio Weekly
Tenth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.
Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; J. Murray Barron, advertising manager.

Kaleidoscope

A vertical antenna is like oxygen to fading short wave signals. Commencing right now the short wave always will be more literally up in the air.

* * *

Radio telephone communication has taken on a wide variety. There are available the aircraft to ground interconnection while the airplane is in motion and the radiotelephone mutual convenience for sailing liners with fixed shore points anywhere. The thickest conversation can be transmitted so as to be understandable.

—A. B.

Ohmite Manufacturing Company, 636 North Albany Avenue, Chicago, announces the publication of a new stock list, Bulletin No. 10, which illustrates and describes Carbohm and Wirohm resistors. The Bulletin lists seventy-five different values of carbon resistors in both 1 watt and ½ watt sizes, as well as 42 different values of wire-wound resistors.

Code of Ethics Backed by Board

Washington

The Federal Radio Commission issued the following:

"The Commission believes that the American system of broadcasting has produced the best form of radio entertainment that can be found in the world.

"This system is one of which is based entirely upon the use of radio broadcasting stations for advertising purposes. It is a highly competitive system and is carried on by private enterprise. There is but one other system—the European system. That system is governmental. Under that system, broadcasting is conducted either by the government or by some company chartered by the government. There is no practical medium between the two systems. It is either the American system or the Europan system.

"The principal objection to programs under our system arises out of the kind of advertising that is allowed to be made a part of them.

"The Commission recognizes that the industry is young, that many policies must grow out of experience, and that some stations today are making efforts to constantly raise the standards of broadcasting, but the problem cannot be solved by a few stations.

Responsibility Is General

"There is not a single station that can escape responsibility. A heavy responsibility rests upon all chain companies. To-day, approximately 550 persons, firms or companies hold licenses which give them the right to use the air to its maximum capacity for radio broadcasting purposes. There are 123,000,000 people in the United States wholly dependent upon these few persons for their radio entertainmnt. Thir rights in this new art cannot be denied. And if their share of this form of entertainment can be received only at the expense of advertising statements or claims which are false, deceptive or exaggerated, or at the expense of programs which contain matter which would be commonly regarded as offensive to persons of recognized types of political, social and religious belief, then they are justified in demanding a change in the system.

"The good will of the listener is the station's only asset, and, therefore, this problem first should rest with the licensees of stations. The problem should not be taken out of their hands until they have had full opportunity to make the necessary corrections. If they decline the opportunity, or seizing it, fail, the matter should be treated with proper legislation.

Recommends Ethics Code

As an aid and a guide in the matter, the Commission commends to the licensee of each radio broadcasting station for his most serious consideration the following code of ethics which has been adopted by the National Association of Broadcasters. The Commission believes this code to be fair and just to the broadcaster and to the listener, and that it is an avenue by which the industry can regulate itself.

CODE OF ETHICS

"1. Recognizing that the radio audience includes persons of all ages and all types of political, social and religious belief, every broadcaster will endeavor to prevent the broadcasting of any matter which would commonly be regarded as offensive.

"2. When the facilities of a broadcaster are used by others than the owner, the broadcaster shall ascertain the financial responsibility and character of such client, that no dishonest, fraudulent or dangerous person, firm or organization may gain access to the radio audience.

"3. Matter which is barred from the mails as fraudulent, deceptive or obscene shall not be broadcast.

"4. Every broadcaster shall exercise great caution in accepting any advertising matter regarding products or services which may be injurious to health.

"5. No broadcaster shall permit the broadcasting of advertising statements or claims which he knows or believes to be false, deceptive or grossly exaggerated.

"6. Every broadcaster shall strictly follow the provisions of the Radio Act of 1927 regarding the clear identification of sponsored or paid-for material.

"7. Care shall be taken to prevent the broadsacting of statements derogatory to other stations, to individuals, or to competing products or services, except where the law specifically provides that the station has no right of censorship.

"8. Where charges of violation of any article of the Code of Ethics of The National Association of Broadcasters are filed in writing with the Managing Director, the Board of Directors shall investigate such charges and notify the station of its findings."

Television Not Ready, Says Aylesworth

By M. H. Aylesworth

President, National Broadcasting Company

Various interests already have placed television apparatus on the market. The broadcasting of television programs has been undertaken by others. But from the National Broadcasting System viewpoint, television is not yet ready for the general public.

While the company takes cognizance of the work being done in the receiver field, it does not believe that the time has arrived yet for visual broadcasting on a regular program basis.

And so, during 1931, N. B. C. engineers have continued their studies of television problems as applied to the sending of television signals, conducting numerous tests and investigations that must lead eventually to the inauguration of public television service on a high plane.

The television researches are being conducted by N. B. C. engineers from several points. Television transmitters have been operated at the Times Square Studio, in the R. C. A. Building, and more recently from the lofty top of the Empire State Building. The broadcasts are not intended at this time for the general public or even the television experimenters at large. They possess no entertainment value. Their sole purpose at this time is for the study of television transmission problems, particularly the influence of steel buildings on the propagated waves. The company aims to prepare a solid foundation for the healthy development of practical television in the future.

Every effort is being bent in this direction.

Station Sparks

By Alice Remsen

Echoes of Erin

(For Joe White, "The Silver Masked Tenor," WEAF every Friday, 2:30 p.m.

OH, the lovely hills of Erin—
I see them in my dreams!
The echoing hills of Erin,
Where golden sunlight gleams!

With a silver lake below them,
And green upon their breast,
And in their hair the fir-trees,
By winds of God caressed.

Oh, the echoing hills of Erin,
Are calling now to me,
But the lovely hills of Erin
I never more shall see.

—A. R.

* * *

Listen in to the Sweet Voice of Joe White singing those lovely Irish songs as only he can sing them. It takes an Irishman to put the longing and feeling, the pathos and sweetness into an Irish song. Such songs as "Killarney," "Kathleen Mavourneen" "The Minstrel Boy"—I love them all. They are truly songs that will never die—and Joe White is a past master in the art of putting them over.

* * *

Columbia Has Signed the "Original Radio Girl," Vaughn de Leath, and I am very glad to hear it, because now, probably, Vaughn will get the exploitation break she so richly deserves. Vaughn has plenty of personality on the air, a sweet voice and her own method of delivery, Columbia should have no difficulty in selling her very quickly to a commercial sponsor.

* * *

Arthur Tracey, "The Street Singer," who has been featured over the Columbia System for the past few months, will begin the new year with two new engagements. He will join the Pillsbury Pageant program, and also open at the Cafe de la Paix with Jacques Renard's orchestra. Knew the boy would make it sooner or later.

* * *

The Latest Station to Join the Columbia Broadcasting System is WMBD, Peoria, Ill. This makes ninety stations under the Columbia banner. Station WMBD is assigned to the 1440 kilocycle (208.2 meter) wavelength, and will take the full schedule of Columbia's sustaining programs.

* * *

Mildred Hunt Is The Latest N.B.C. singer to go over to Columbia. Mildred is signed to sing blues on the new Frostilla program, with an orchestra under the direction of clever Harry Salter. This program has several novel features, introducing comedy and an unconventional manner of weaving commercial announcements.

* * *

The National Broadcasting Company Has Signed Alice Joy, who jumped to radio stardom over night, on the Prince Albert program. Alice was formerly known as Frances Holcomb and under that name had a rather difficult time, (as a great many of us have had) convincing radio exec's that she was worth exploiting. But as nothing succeeds like success, Alice is now signed exclusively. Jolly good luck to you, dear girl!

* * *

The New Chesterfield Program Over WABC plans to give the radio listeners "Music That Satisfies"—a very good slogan, but one that gives us pause for reflection; is it possible to satisfy, even with music? I doubt it—but giving credit where credit is due, must say that Chesterfield tries and succeeds in a great measure; for when you hear the name of Nat Shilkret you are pretty certain to hear good music, while Alex Gray's name brings with it an excellent reputation as a songster. Each week-night at 10:30 p.m., WABC.

* * *

Now Comes Edgar Wallace With His Mysteries to give us more thrills on the Eno Crime Club programs. The Eno broadcasting activities will be extended to two nights, Tuesdays and Wednesdays, 9:30 to 10:00 p.m., WABC, when the thrillers will be given in two episodes.

* * *

The Glorious Contralto Voice of Delphine March never sounded so well as it did in "Mon Coeur Souvre A Ta Voix," from "Samson and Delilah," which she sang during the Bamberger Little Symphony concert, under the direction of Philip James, on the evening of December 26, over Station WOR. She sang with dramatic intensity, excellent interpretive ability and sweetness of tone.

* * *

Members of the Civic Light Opera were guest artists on the Footlight Echoes program, over WOR on Sunday, December 27. They gave a Gilbert and Sullivan program. Howard Marsh, though handicapped by a heavy cold, sang very well. He knows the microphone, and would be a very valuable man for a commercial sponsor, inclined toward musical comedy. Frank Moulan was a delight. His diction is perfect and his droll personality inimitable. Ruth Altman possesses a gorgeous contralto, with a fine depth and range; and the quaint little Japanese primadonna, Hitzi Koyke, did remarkably well in the "Kiss Duet," from "The Mikado," with Howard Marsh.

* * *

Sidelights

LEONARD JOY, N.B.C. musical director, is giving away his old phonograph records. . . . FRANK BLACK, N.B.C. director and arranger for the Revelers Quartet, earned his first cash singing at funerals and weddings in Philadelphia. . . . HELENE HANDIN, N.B.C. actress, was once a school marm at Woods Cross, Utah. . . . RAY PERKINS received a letter recently addressed to "The Clown Quince of Radio." . . . JAMES MELTON, N.B.C. tenor, stands six feet two and one half inches in his socks. . . . EDWIN M. WHITNEY once herded sheep on the slopes of the Rocky Mountains. . . . FRANK LUTHER, one of N.B.C.'s star tenors, has been a farm hand, singing evangelist, light opera singer and a New York night club entertainer. . . . LEIGH LOVELL, the Dr. Watson of N.B.C.'s "Adventures of Sherlock Holmes," was once a producer of Shakesperian plays in dear old London. . . . BOB HARING, Columbia conductor, of portly figure, has been on a diet since the New Year. . . . IRENE BEASLEY always wears a huge stone ring. . . . TONY WONS has brought out another edition of his scrapbook. . . . "THE STREET SINGER'S' first movie-short, "The Russian Lullaby," is playing on Broadway. . . . THEODORE FISHBERG, who plays the viola in Carl Fenton's orchestra, is also a member of the New York Philharmonic Symphony Orchestra. . . . HOWARD BARLOW wrote the beautiful musical signature used by Columbia for its "Stand-by" music. . . . ITO GUIZAR is busy learning to speak English. . . . ARTHUR JARRETT is 24 years old. . . . PETER DIXON received a new contract as a Christmas present from his sponsor. . . . VERA BRODSKY, WOR pianist, was a protege of the former Crown Prince of Germany. . . . MARY OLDS says that American men are becoming Continental in their manners. . . . BETTY VANDEVENTER "stop-watches" all her own programs. . . . VERONICA WIGGINS always carries a pocket full of dimes. She distributes them to apple-vendors, but never takes the apples. . . . NELSON EDDY, WOR violinist, is going to economize this year by using last season's resolutions all over again.

* * *

COMIC CUT

"Drink," said a prohibitionist friend of Richard "Sherlock Holmes" Gorden" is the greatest curse of the country. It makes you shoot at your wife." "Perhaps," replied Gordon, "but it also makes you miss her."

* * *

YOUNG CANADIAN PIANIST IN PIANO RECITAL

Harold West, young Canadian pianist, heard frequently over the air, gave a brilliant recital on the evening of December 15, at the Hotel Barbizon, under the management of the National Music League.

He opened with Brahms' Sonata, F sharp minor, Opus 2, and showed remarkable technique and expression, especially in the Andante movement.

His second group featured Chopin and proved that Mr. West thoroughly understands the use of the pedal. He did not over-emphasize—particularly was this noticeable during the Prelude in G sharp minor.

Rachmaninoff was represented by the colorful Etudes Tableaux, E flat major and B minor; Debussy by the graceful Reflets dans L'Eau; and Liszt, by his brilliant Rhapsody No. 13.

Modest and unassuming, the young pianist responded to enthusiastic applause and graciously gave several encores. His thorough musicianship, artistic expression and brilliant technique should carry Harold West far upon the road to musical success.

* * *

BiographicalBrevities

About Arthur Jarrett

Arthur Jarrett was born in Brooklyn, Ridgewood section. Both parents were stage professionals in the dramatic line, his grandfather playing "heavies" with Sothern. Arthur made his stage debut at the age of five, as the Indian boy in "The Squaw Man." His mother still has his regalia. Learned to play the ukulele when he was six. Jimmy Duffy taught him. The late Joe Schenck, his godfather, gave him vocal lessons. Today he plays six musical instruments and does Joe proud with his voice.

Toured vaudeville circuits throughout the country with his father and mother. Between vaudeville engagements he attended Public School 9 in Brooklyn. Clara Bow, Helen Twelvetrees and Dolores Costello were among his classmates. Earned his football letter at Erasmus High. At Brooklyn Prep he starred in three major sports. He picked up pin money by entertaining at various functions. Ambitious to be a lawyer, he matriculated at Fordham, but finally landed in the pit orchestra at the Coliseum Theatre. Wanted to be a radio announcer, applied for a job and was hired by a New York station, but when the musical director discovered he could play six instruments he advised Arthur to become a professional musician. He did. Joined Ted Weems' orchestra at Reading.

(Continued on next page)

STATION SPARKS

By Alice Remsen

(*Continued from preceding page*)

Pa., in 1927. Played the banjo and vocalised. Became popular for his "counter melodies." Was with Ted Weems for over three years. Joined Station WBBM as vocal soloist. A week later he received his first commercial date. Soon his sponsored broadcasts grew to six weekly. He began to attract a large following in Chicago. Was allotted three afternoon programs weekly over the Columbia chain.

Received offer from Gus Van to take the place of the latter's partner, and Arthur's godfather, Joe Schenck. Returned to New York, formed a team with Gus, but after while he tired of vaudeville and hurried back to Chicago and radio. One afternoon several Columbia officials in New York caught his program. Wires were immediately dispatched for him to come East. Commercial obligations confined him to Chicago until the latter part of November. Then he came to New York. His singing with Freddie Rich's orchestra is now gaining him increasing audiences. He is really a lyric tenor; refuses to be called a crooner. Is 24 years old, tall, broadshouldered and blue-eyed; weighs 185 pounds. Favorite tune is "Little White House at the End of Honeymoon Lane." Possesses a voice with sixteen note range, and sings two octaves—from middle to high C. Is a bachelor. Has a penchant for dogs and soft felt hats—also Italian cooking. Actually admires other ontstanding soloists on radio—which is unique in itself.

* * *

Frank J. Novak, Jr.

Frank J. Novak, Jr., the popular young orchestra leader, is a very elusive gentleman. After receiving several requests for his biography, I trailed him until I finally ran him down, but even that didn't do me any good. He was too modest to tell me anything about himself. At last I found his lifelong friend in the person of Gordon B. Clarke and painlessly extracted a few facetious facts about Frankie: In Chicago, on September 17, 1900, a boy was born to Mr. and Mrs. Frank J. Novak. They called him Junior. His Dad was a Chicagoan, but his mother was a Czechoslovakian, maiden name Elizabeth Czerny, a direct descendant of the Etude manufacturer, Carl Czerny, and so, before he was able to talk, Frankie could bat out a rhythm on his cereal bowl with the spoon —and did he make music! Anyhow his parents took him seriously and started to teach him music at the age of three.

At the age of four he appeared with a band in Chicago as a drummer boy. From then on nothing could stop him. By the time he was seven he was playing in concerts on bells, chimes and the violin, billed as Master Frankie Novak, the Most Versatile Junior Musician in the World.

1908 found him the official drummer boy of the Illinois Chapter of the Sons of the American Revolution. He, too, was a revolution, and still is.

Papa Novak ran a music store in Chicago and that gave Junior easy access to many instruments and with nothing else on his mind he learned to play them all. The shop was located in the international section of Chicago. Frankie overheard lots of languages, including Russian Polish, German, Bohemian, Slavish and occasionally English, so he learned them, including English.

When he was nine Frankie, with two transports bearing his instruments went across to Prague, where his uncle, Albert, V. Czerny, conducted the Bohemian National Conservatory of Music. There Frankie perfected his playing, especially on the piano, organ, violin and cello. He worked eight hours a day for four years. After all, an uncle can only put up with so much—so, Frankie was shipped back to the States in 1913. He went on concert tours throughout the West and Middle West; heard Guido Deiro, the accordionist, play one day and liked it, ran home and told Papa who reached up to a shelf and pulled down an accordion. In 1919 the saxophone rage was on—up went Papa's long arm again and down came a sax.

Novak, Jr., organized his first dance orchestra in 1920. In 1922, Ed Benson, big shot of the Chicago orchestra world, took him in hand and featured him with Paul Biese, Frank Westphal and Freddie Hamm. Later he re-organized his dance band and went into the Club Montmarte. In 1923 the family decided to move to Miami, Fla., so Frankie went along. He opened an office, went after the society biz——and got it. They liked him so much that the Miami Jockey Club lined him up in 1924 and kept him there for six consecutive racing seasons. He was at the Coral Gables Country Club and then came to New York. That was in 1930. Since then he has been heard via radio, at the Hotel St. George and on wax with Carson Robinson, Frank Luther, Lew Gold, with Victor, Columbia, Brunswick and others. He has a four-piece combination which is the biggest little band in the country. Piano, violin, guitar and bass viol primarily, but with Frankie in it—well it just stretches itself to what have you.

Frankie also has a sixteen-piece orchestra which has within it eight individual ensembles, each man doubling two or more instruments.

He is five feet seven in his shoes. He's a bundle of nerves and a pack of cigarettes. If you walk with him you run. He'd do well in a bunion derby. He's crazy about cheese blintzes. Recently signed the well-known life contract with a nonprofessional who has red hair. His ambition is to amass a fortune, not so much for himself as for a pet charity scheme. You'll hear him via the ether on three commercial accounts after the first of the year. His favorite sport is fishing off the Florida coast, where the poor little fish struggle with the big ones. He likes golf, too, and horseback riding, but is neither a bridge nor backgammon fiend.

* * *

SUNDRY SUGGESTION FOR WEEK COMMENCING JANUARY 10, 1932

Sun., Jan. 10: Footlight Echoes, WOR, 10:30 p.m.
Mon., Jan. 11: Ralph Kirbery, WEAF, 11:15 p.m.
Tues., Jan. 12: Minneapolis Symphony, WABC, 10:00 p.m.
Wed., Jan. 13: Sherlock Holmes, WJZ, 9:00 p.m.
Thurs., Jan. 14: Weaver of Dreams, WOR, 10:15 p.m.
Fri., Jan. 15: Singin' Sam, WABC, 8:15 p.m.
Sat., Jan. 16: Little Symphony, WOR, 8:00 p.m.

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.*

Ivan W. Brunk, East York St., Biglerville, Pa.
Cecil D. Brooks, 215 E. Magnolia Ave., Auburn, Ala.
Charles Horne, 5 Highland Ave., Houghs Neck, Quincy, Mass.
Kenneth McCarron (also catalogs), 445 N. 14th St., San Jose, Calif.
H. R. Brunelle, 163 Meadow St., Wilimansett, Mass.
Frank Conly (particularly mew products and developments) 986 So. Pennsylvania St., Denver, Colo.
J. H. Carlson, Registered Radiotrician, 1734 East 7th St., St. Paul, Minn.
Dave Alper, ——— 670 Rockaway Ave., Brooklyn, N. Y.
Howard Trumveller, 925 Union St., Port Huron, Mich.
Donald Felix Gardner, 310 Bard St., Port Huron, Mich.
H. LeRoy Vasbinder, 207 Westfield Ave., Elizabeth, N. J.
Bruno Formeister, 1713 Julian St., Chicago, Ill.
R. Cohan, 122 Sumner Ave., Brooklyn, N. Y.
Herbert C. Keppen, 302 Delaware St., Tonawanda, N. Y.
G. Hitzert (also short wave and television), 3729 Olive Street, St. Louis, Mo.
Isadore Stengler, 156 Christopher Ave., Brooklyn, N. Y.
G. L. Dosland, c. o. Dosland, Conner & Mayfield, Suite 1812-100 N. LaSalle St., Chicago, Il.
James G. Sheller, 75-77 W. Chestnut, Washington, Pa.
Kurt R. Zumhagen, 3609A No. 17th St., Milwaukee, Wis.
Harry M. Narloch, 3808 Augusta Blvd., Chicago, Ill.
S. Matthews, 1339 W. Washington Blvd., Chicago, Ill.
Lee W. Snyder, 205 Villa Esta Ave., Macon, Ga.
Charles Wolmer, 2539 Central Ave., Chicago, Ill.
J. C. Erney, 2625 Shaker Rd., Cleveland Heights, Ohio.
J. H. Weaver, 102 S. Husbond St., Stillwater, Okla.

TRADIOGRAMS

By J. Murray Barron

Just 75 feet east of West Street, at 89 Cortlandt Street, New York, is housed "the largest strictly radio book and radio magazine department in the world," reports Blan, the radio man. Back numbers to 1924 are in stock.

* * *

Thomaston 'Lab., Inc., 135 Liberty St., has issued literature on precision electric acoustic apparatus. Among the quality products manufactured are audio transformers, power transformers, chokes and condensers.

* * *

Paul A. Kaber, formerly television engineer for General Electric Company, is now director of School of Television, Inc. The advisory board includes V. A. Sanabria, Leo Beck, and D. W. West. Elmer M. Rave, former instructor, U. S. Signal Corps Radio School, is dean. The school specializes in television mechanics, with sessions in morning, afternoon, and evening at 360 Seventh Ave., New York City.

* * *

Uncle Sam will take over present Vesey Street headquarters of Wholesale Radio Service Co., Inc., for part of the site for a new Post Office in New York. Large daylight sales rooms and service laboratories will be opened by Wholesale at 100 Sixth Avenue, about March 1.

* * *

Rudolph L. Duncan, of Radio Training Schools, Inc., has issued a very complete and attractively illustrated booklet outlining the various radio courses, which include a sound picture course. The address is 326 Broadway, New York City.

* * *

R. C. A. Victor Co., Inc., Camden, N. J., reports they have some interesting information for established service men located throughout the United States who can handle the R. C. A. Antenaflex systems.

* * *

The Northeastern Sales Corp., 5 Union Square, N. Y. City, is adding to its line of television parts, lenses etc., and has a booklet.

* * *

The kiddies and their folks were treated to an unuslaly fine series of demonstrations of television at Stern's department store, New York City. At one time there was no regular program on, only station call letters being visible so William Starkenstein, in charge, unexpectedly phoned the National Broadcasting studio and explained the situation. A special program was sent out. Great surprise and appreciation was expressed at the remarkable clearness and detail. Even the children could follow the various changes, from faces to animals, as a man winding his watch. A See-All Television outfit was used in the demonstration. The pictures were projected about 8 x 10 inches.

BROADCASTING STATIONS BY FREQUENCIES

1370 KILOCYCLES—*218.7 Meters*—(Continued from last week)

WRBJ	Hattiesburg, Miss	Hattiesburg Broadcasting Co.	10W	Do.
WHBQ	Memphis, Tenn	Broadcasting Station WHBQ (Inc.)	100W	Do.
KGFG	Oklahoma City, Okla	Oklahoma Broadcasting Co. (Inc.)	100W	Shares with KCRC.
KCRC	Enid, Okla	Enid Radiphone Co.	100W / 250W-LS	Shares with KGFG.
WMBR	Tampa, Fla	F. J. Reynolds	100W	Unlimited.
KMAC	San Antonio, Tex	W. W. McAllister	100W	Shares with KONO.
KFJZ	Fort Worth, Tex	Margaret Meacham Hightower, Minnie Meacham Smith, and Mary Meacham, executrices of estate of H. C. Meacham, deceased.	100W	Unlimited.
KONO	San Antonio, Tex	Mission Broadcasting Co.	100W	Shares with KMAC.
KGKL	San Angelo, Tex	KGKL (Inc.)	100W	Unlimited.
KFLX	Galveston, Tex	George Roy Clough	100W	Do.
WGL	Fort Wayne, Ind	Fred C. Zeig (Allen-Wayne Co.)	100W	Do.
KGDA	Mitchell, S. Dak	Mitchell Broadcasting Corporation	100W	Do.
KFJM	Great Forks, N. Dak	University of North Dakota	100W	Do.
KWKC	Kansas City, Mo	Wilson Duncan, trading as Wilson Duncan Broadcasting Co.	100W	One-half time.
WRJN	Racine, Wis	Racine Broadcasting Corporation	100W	Unlimited.
KGAR	Tucson, Ariz	Tucson Motor Service	100W / 250W-LS	Do.
KRE	Berkeley, Calif	First Congregational Church of Berkeley	100W	Shares with KZM.
KOOS	Marshfield, Oreg	H. H. Hansetly (Inc.)	100W	Unlimited.
KFBL	Everett, Wash	Otto Leese and Robert Leese, doing business as Leese Bros.	50W	Shares with KVL.
KVL	Seattle, Wash	KVL, Incorporated	100W	Shares with KFBL.
KFJI	Astoria, Oreg	KFJI Broadcasters, Inc.	100W	Unlimited.
KGFL	Raton, N. Mex	KGFL, Inc.	50W	Do.
KUJ	Walla Walla, Wash	KUJ, Inc.	100W	One-half time (C. P. only).
WRAM	Wilmington, N. C.	Wilmington Radio Asso.	100W	
WJTL	Tifton, Ga.	Ogelethorpe University	100W	

1380 KILOCYCLES—*217.3 Meters*

WSMK	Dayton, Ohio	Stanley M. Krohn, Jr.	200W	Shares with KQV at night.
KQV	Pittsburgh, Pa	KGV, Inc.	500W	Shares with WSMK at night
KSO	Clarinda, Iowa	Iowa Broadcasting Co.	500W	Shares with WKBH.
WKBH	LaCrosse, Wis	WKBH (Inc.)	1KW	Shares with KSO.
KOH	Reno, Nev.	The Bee, Inc.	500W	Unlimited.
KQV	Pittsburgh, Pa.	KQV Broadcasting Co.	500W	

1390 KILOCYCLES—*215.7 Meters*

WHK	Cleveland, Ohio. T-Seven Hills, Ohio	Radio Air Service Corporation	1KW	Unlimited.
KLRA	Little Rock, Ark	Arkansas Broadcasting Co.	1KW	Shares with KUOA.
KUOA	Fayetteville, Ark.	University of Arkansas	1KW	Shares with KLRA.
KOY	Phoenix, Ariz	Nielsen Radio & Sporting Goods Co.	500W	Unlimited.

1400 KILOCYCLES—*214.2 Meters*

WCGU	Brooklyn, N. Y.	United States Broadcasting Corporation	500W	Shares with WFOX, WLTH and WBBC.
WFOX	Brooklyn, N. Y.	Paramount Broadcasting Corporation	500W	Shares with WCGU, WLTH, and WBBC.
WLTH	Brooklyn, N. Y.	Voice of Brooklyn (Inc.)	500W	Shares with WSCH-WSDA, WCGU, and WBBC.
WBBC	Brooklyn, N. Y.	Brooklyn Broadcasting Corporation	500W	Shares with WFOX, WLTH, and WCGU.
KOCW	Chickasha, Okla	Oklahoma College for Women	250W / 500W-LS	Unlimited.
WCMA	Culver, Inc.	General Broadcasting Corporation	500W	Shares with WBAA and WKBF.
WKBF	Indianapolis, Ind. T—Clermont, Ind.	Indianapolis Broadcasting (Inc.)	500W	Shares with WBAA and WCMA.
WBAA	West Lafayette, Ind.	Purdue University	500W / 1KW-LS	Shares with WCMA and WKBF.
KLO	Ogden, Utah	Pecry Building Co.	500W	Unlimited.

1410 KILOCYCLES—*212.6 Meters*

WRBX	Roanoke, Va	Richmond Development Corporation	250W	One-half time.
WBCM	Bay City, Mich. T—Hampton township, Mich.	James E. Davidson	500W	Unlimited.
KGRS	Amarillo, Tex	E. B. Gish (Gish Radio Service)	1KW	Shares with WDAG.
WDAG	Amarillo, Tex	National Radio and Broadcasting Corporation	1KW	Shares with KGRS.
WODX	Mobile, Ala. T—Springhill, Ala.	Mobile Broadcasting Corporation	500W	Shares with WSFA.
WSFA	Montgomery, Ala	Montgomery Broadcasting Co. (Inc.)	500W	Shares with WODX.
KFLV	Rockford, Ill	Rockford Broadcasters (Inc.)	500W	Shares with WHBL.
WHBL	Sheboygan, Wis	Press Publishing Co.	500W	Shares with KFLV.
WAAB	Boston, Mass.	Bay State Broadcasting Corp.	500W	
WHIS	Bluefield, W. Va.	Daily Telegraph	250W	

1420 KILOCYCLES—*211.1 Meters*

KGVO	Missoula, Mich.	Mosby's (Inc.)	100w	Daytime.
WTBO	Cumberland, Md	Associated Broadcasting Corporation	100W / 210W-LS	Unlimited.
WILM	Wilmington, Del. T—Edge Moor, Del.	Delaware Broadcasting Co. (Inc.)	100W	Do.
WPAD	Paducah, Ky	Pierce E. Lackey and S. Houston McNutt, doing business as Paducah Broadcasting Co.	100W	Do.
WEDH	Erie, Pa	Erie Dispatch-Herald Broadcasting Corporation	100W	Do.
WMBC	Detroit, Mich	Michigan Broadcasting Co.	100W / 210W-LS	Do.
WELL	Battle Creek, Mich	Enquirer-News Co.	50W	Unlimited.
WFDW	Anniston, T. Talladega, Ala	Raymond C. Hammett	100W	One-half time.
WJBO	New Orleans, La	Valdemar Jensen	100W	Do.
KGFF	Shawnee, Okla.	D. R. Wallace (owner KGFF Broadcasting Co.)	100W	Do.
KABC	San Antonio, Tex	Alamo Broadcasting Co. (Inc.)	100W	Do.
KXYZ	Houston, Tex	Harris County Broadcast Co.	100W	Do.
KFYO	Abilene, Tex	T. E. Kirksey, trading as Kirksey Brothers	100W / 250W-LS	Do.
WSPA	Spartanburg, S. C.	Virgil V. Evans, trading as The Voice of South Carolina.	100W / 250W-LS	Do.
KICK	Red Oak, Iowa	Red Oak Radio Corporation	100W	Do.
WIAS	Ottumwa, Iowa	Iowa Broadcasting Co.	100W	Do.
WLBF	Kansas City, Kans	The WLBF Broadcasting Co.	100W	Do.
WMBH	Joplin, Mo	Edwin Dudley Aber	100W / 250W-LS	Do.
WEHS	Evanston, Ill	WEHS (Inc.)	100W	Shares with WKBI and WHFC.
WHFC	Cicero, Ill	WHFC, Inc.	100W	Shares with WKBI and WEHS.
WKBI	Chicago, Ill	WKBI, Inc.	100W	Shares with WHFC and WEHS.
KFIZ	Fond du Lac, Wis	The Reporter Printing Co.	100W	Unlimited.
KFXY	Flagstaff, Ariz	Albert H. Scherman	100W	Do.
KGIX	Los Vegas, Nev	Los Vegas Radio Corp.	100W	Do.

(1420 *kilocycles continued on next page*)

BROADCASTING STATIONS BY FREQUENCIES—*Continued*

1420 KILOCYCLES—*211.1 Meters*—(Cont.)

KFXD	Nampa, Idaho	Frank E. Hurt, trading as Service Radio Co.	500W	Unlimited.
KGIW	Trinidad, Colo	Leonard E. Wilson	100W	Do.
KGKX	Sandpoint, Idaho	C. E. Twiss and F. H. McCann	100W	Do.
KGGC	San Francisco, Calif.	The Golden Gate Broadcasting Co.	100W	Shares with KFQU.
KXL	Portland, Oreg	KXL Broadcasters, Inc.	100W	Shares with KBPS.
KBPS	Portland, Oreg	Benson Polytechnic School	100W	Shares with KXL.
KORE	Eugene, Oreg	Frank L. Hill and C. G. Phillips, doing business as Eugene Broadcast Station.	100W	Unlimited.
WJMS	Ironwood, Mich.	Morris Johnson	100W	
WDEV	Waterbury, Vermont	Harry C. Whitehall	50W	
WAGM	Presque Isle, Me.	Aroostook Broadcasting Corp.	100W	
KFQU	Holy City, Calif.	W. E. Riker	100W	

1430 KILOCYCLES—*209.7 Meters*

WHP	Harrisburg, Pa. T—Lemoyne, Pa.	WHP (Inc.)	500W 1KW-LS.	ares with WBAK and WCAH.[85a]
WBAK	Harrisburg, Pa	Pennsylvania State Police, Commonwealth of Pennsylvania.	500W 1KW-LS.	ares with WHP.
WCAH	Columbus, Ohio	Commercial Radio Service Co.	500W	Shares with WHP and WBAK.[85a]
WGBC	Memphis, Tenn.	Memphis Broadcasting Co.	500W	Shares with WNBR.
WNBR	Memphis, Tenn.	Memphis Broadcasting Co.	500W	Shares with WGBC.
KGNF	North Platte, Nebr	Great Plains Broadcasting Co.	500W	Daytime.
KECA	Los Angeles, Calif	Earle C. Anthony, Inc.	1KW	Unlimited.
WFEA	Manchester, N. H.	New Hampshire Broadcasting Co.	500W	
WHEC	Rochester, N. Y.	Hickson Electric & Radio Corporation	500W	Shares with WOKO.[85a]
WOKO	Albany, N. Y. T—Mount Beacon, N. Y.	WOKO (Inc.)	500W	Shares with WHEC-WABQ.[85a]

1440 KILOCYCLES—*208.2 Meters*

WCBA	Allentown, Pa	B. Bryan Musselman	250W	Shares with WSAN.
WSAN	Allentown, Pa	Allentown Call Publishing Co. (Inc.)	250W	Shares with WCBA.
WBIG	Greensboro, N. C.	North Carolina Broadcasting Co. (Inc.)	500W	Unlimited.
WTAD	Quincy Ill.	Illinois Broadcasting Corporation	500W	Shares with WMBD.
WMBD	Peoria Heights, Ill.	E. M. Kahler (owner Peoria Heights Radio Laboratory.	500W 1KW-LS.	Shares with WTAD.
KLS	Oakland, Calif.	E. N. and S. W. Warner, doing business as Warner Bros.	250W	Daytime.

1450 KILOCYCLES—*206.8 Meters*

WBMS	Hackensack, N. J.	WBMS Broadcasting Corporation	250W	Shares with WNJ, WHOM, and WKBO.
WNJ	Newark, N. J.	Radio Investment Co. (Inc.)	250W	Shares with WBMS, WHOM, anud WKBO.
WHOM	Jersey City, N. J.	New Jersey Broadcasting Corporation	250W	Shares with WNJ, WBMS, and WKBO.
WKBO	Jersey City, N. J.	Camith Corporation	250W	Shares with WNJ, WHOM, and WBMS.
WSAR	Fall River, Mass	Doughty & Welch Electric Co. (Inc.)	250W	Unlimited.
WGAR	Cleveland, Ohio	WGAR Broadcasting Co.	500W	Do.
WTFI	Toccoa, Ga.	Toccoa Falls Institute	500W	Do.
KTBS	Shreveport, La	Tri State Broadcasting System (Inc.)	1KW	Do.

1460 KILOCYCLES—*205.4 Meters*

WJSV	Alexandria, Va. T—Mt. Vernon Hills, Va.	Independent Publishing Co.	10KW	Do.
KSTP	St. Paul, Minn. T—Westcott, Minn.	National Battery Broadcasting Co.	10KW	Do.

1470 KILOCYCLES—*204.0 Meters*

WLAC	Nashville, Tenn.	Life and Casualty Insurance Co.	5KW	Unlimited.
KGA	Spokane, Wash.	Northwest Broadcasting System (Inc.)	5KW	Do.

1480 KILOCYCLES—*202.6 Meters*

WKBW	Buffalo, N. Y. T—Amherst, N.Y.	WKBW (Inc.)	5KW	Unlimited.
KFJF	Oklahoma City, Okla	National Radio Manufacturing Co.	5KW	Do.

1490 KILOCYCLES—*201.2 Meters*

WCKY	Covington, Ky. T—Crescent Springs, Ky.	L. B. Wilson (Inc.)	5KW	Shares with WJAZ and WCHI.
WCHI	Chicago Ill. T—Batavia, Ill.	Midland Broadcasting Co.	5KW	Shares with WJAZ and WCKY.

1500 KILOCYCLES—*199.9 Meters*

WMBA	Newport, R. I.	LeRoy Joseph Beebe	100W	Unlimited.
WLOE	Boston, Mass. T—Chelsea. Mass.	Boston Broadcasting Co.	100W 250W-LS.	One-half time.
WNBF	Binghamton, N. Y.	Howitt-Wood Radio Co. (Inc.)	100W	Unlimited.
WMBQ	Brooklyn, N. Y.	Paul J. Gollhofer	100W	Shares with WLBX, WCLB, and WWRL.
WLBX	Long Island City, N. Y.	John N. Brahy	100W	Shares with WMBQ, WCLB, and WWRL.
WWRL	Woodside, N. Y.	Long Island Broadcasting Corporation	100W	Shares with WMBQ, WLBX, and WCLB.
WSYB	Rutland, Vt.	H. E. Seward, jr., and Philip Weiss, doing business as Seward & Weiss Music Co.	100W	Unlimited.
WKBZ	Ludington, Mich.	Karl L. Ashbacker	50W	Do.
WMPC	Lapeer, Mich.	First Methodist Protestena Church of Lapeer	100W	Do.
WPEN	Philadelphia, Pa.	Wm. Penn Broadcasting Co.	100W 250W-LS.	Do
WWSW	Pittsburgh, Pa.	William S. Walker	100W	Unlimited (C. P. only).
WOPI	Bristol, Tenn.	Radiophone Broadcasting Station WOPI (Inc.)	100W	Unlimited.
WDIX	Tupelo, Miss.	North Mississippi Broadcasting Corporation	100W	Do.
WRDW	Augusta, Ga.	Musicove (Inc.)	100W	Do.
KGFI	Corpus Christi, Tex.	Eagle Broadcasting Co (Inc.)	100W 250W-LS.	Unlimited.
KUT	Austin, Tex.	KUT Broadcasting Co.	100W	Do.
KGKB	Brownwood, Tex.	E. M., C. T., and E. E. Wilson, doing business as Eagle Publishing Co.	100W	Do.
KGIZ	Grant City, Mo.	Grant City Park Corporation	100W	Do.
KGKY	Scottsbluff, Nebr.	Hilliard Co. (Inc.)	100W	Do.
WKBV	Connersville, Ind.	William O. Knox, trading as Knox Battery & Electric Co.	100W 150W-LS.	Do.
KGFK	Moorehead, Minn.	Red River Broadcasting Co. (Inc.)	50W	Do.
KPJM	Prescott, Ariz.	A. P. Miller	100W	Do.
KXO	El Centro, Calif.	E. R. Irey and F. M. Bowles	100W	Do.
KDB	Santa Barbara, Calif.	Santa Barbara Broadcasters, Ltd.	100W	Do.
KREG	Santa Ana, Calif.	J. S. Edwards	100W	Do.
KPQ	Wenatchee, Wash	Wescoast Broadcasting Co. Ct.	50W	Do.
WMIL	Brooklyn, N. Y.	Arthur Faske	100W	

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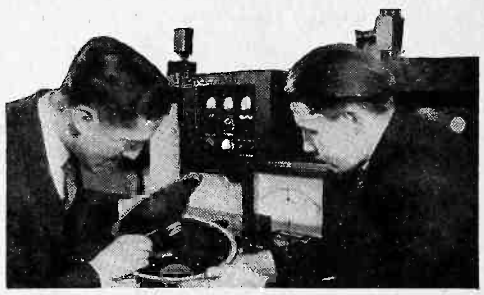

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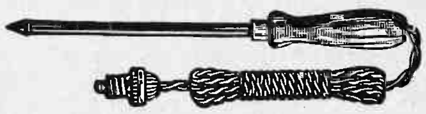

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