JULY 16th 1932

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RADIO WORLD
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The First and Only National Radio Weekly
Eleventh Year—538th Issue

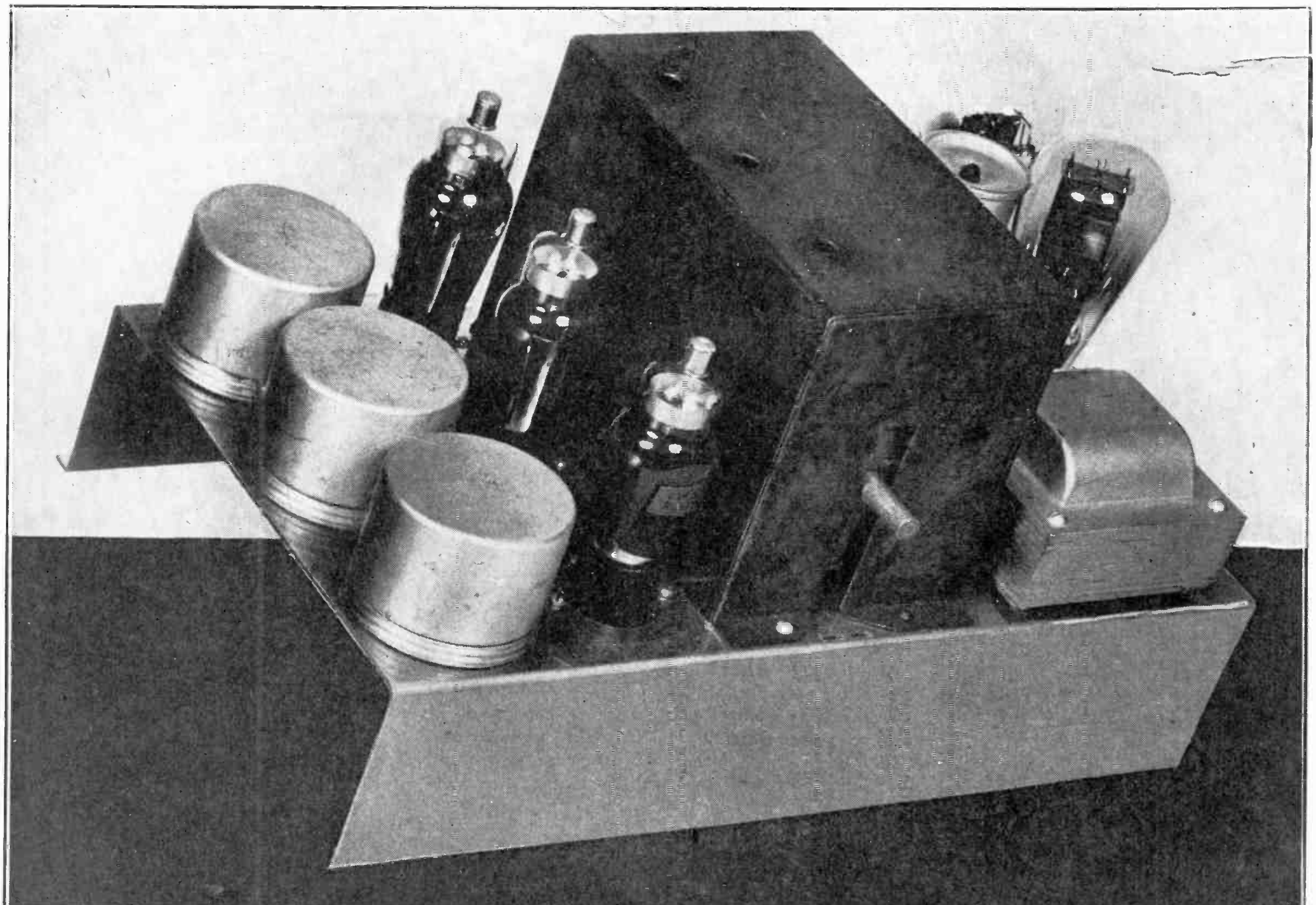
ULTRA-FREQUENCY SUPERHETERODYNE

Choice of Power Tubes

The 57 as a Detector

Vacuum Tube Voltmeter

NEW TUBES IN A T-R-F SET



Popular T-R-F Set, 6 Tubes, including 57 and 58. See pages 12 and 13.

Newest Polo Auto Set, With Tubes, Only $30—

BY far the biggest value in automotive radio today is the latest product of Polo Engineering Laboratories, the Road King, using six of the automotive tubes, including pentode push-pull output. Its performance is of the highest type—DX actually received in your automobile and with all the convenience of remote control tuning.

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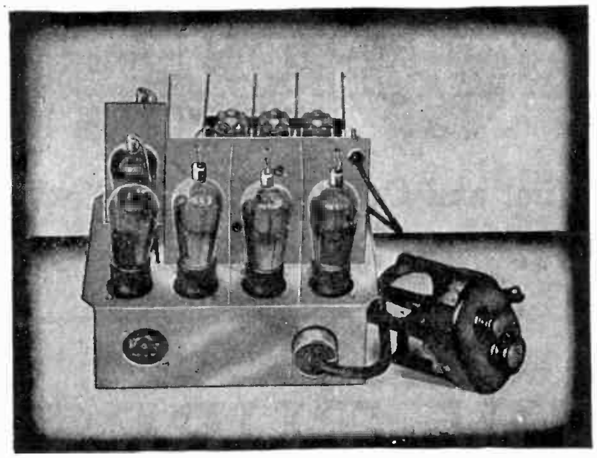

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7-Tube Superheterodyne (With Tubes) $26

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An Ultra-Frequency Set
Superheterodyne for from 3 to 10 Meters
By Einar Andrews

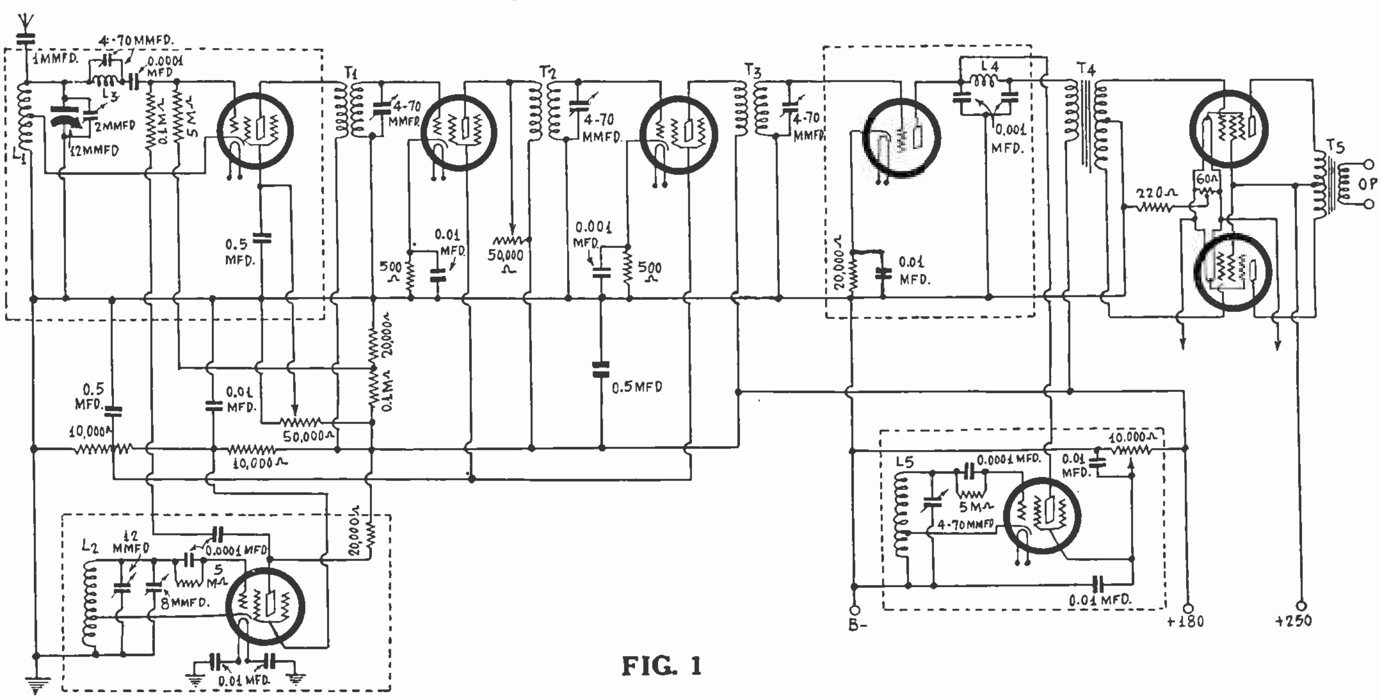


FIG. 1

SUCCESSFUL reception below 10 meters requires exceptional circuit design. We have such a design in the National 3-10 meter superheterodyne, the circuit of which appears as shown in Fig. 1. On the whole, of course, it is a conventional receiver, but in certain details it differs widely from other receivers. Let us call attention to just a few of the fine points of the design.

In the first place we have a very small condenser, only 1 mmfd., in the antenna. That such a small condenser does not completely shut out the signal is due to the facts that the frequencies to be received are very high and that the tuned circuit below the condenser has a high resonant impedance. At 60,000 kc. or 5 meters, the impedance of the 1 mmfd. condenser is only 2,650 ohms. Even a moderately selective circuit has a resonant impedance many times higher than this, and the circuit used in this set is exceptionally selective.

Eliminating Dead Spots

The main reason for using the small antenna condenser is to prevent dead spots due to harmonics of the antenna natural period. It does this effectively. It does not, however, prevent a dead spot at the natural period, but no antenna would be used that had a natural period anywhere near the frequencies covered by this tuner. An antenna 15 or 20 feet high is all right. Another reason for using the small condenser is to improve the selectivity, which it does by loosening the coupling.

Another feature of the set is that the input to the mixer, which is the first tube, is regenerative. The tube is hooked up in the same way as the oscillator, and the only reason that it does not oscillate is that it is not allowed to, only to regenerate. The regeneration is controlled by means of the potentiometer in the screen circuit of the tube, which varies the screen voltage.

The detector has several other noteworthy features. One unusual fact is that a positive bias is used on the grid. The cathode is returned to a point of lower potential than the grid leak. the difference being the drop in a 20,000 ohm resistor. This arrangement is used because a greater sensitivity was obtained with a positive bias than with the usual zero bias.

We said "usual zero bias" because the detector is of the grid leak and condenser type. This, too, is unconventional in an ultra short-wave set. But there is a good justification for the use of grid leak and condenser detection. Note the combination of L3 and the 4-70 condenser across it, a trap circuit tuned to the intermediate frequency. It prevents the intermediate frequency signal, the product of the detector, from short-circuiting through the low impedance of L1. It acts somewhat the same way as if a high value grid leak were used in the same position, but it is effective at the intermediate frequency only, whereas a resistance would be equally effective at all frequencies. Hence we have selection at the intermediate frequency in the grid circuit of the first tube.

It Amplifies

Since we have leaky condenser detection the first tube is also an amplifier at the intermediate frequency. Without L3 and the condenser across it there will be very

(*Continued on next page*)

(*Continued from preceding page*)

little to amplify either in the first detector or subsequently. A choke alone would serve to prevent shorting of the i-f but then no signal could get to the grid. The condenser must be used.

Novelty in Circuit

The use of the high impedance trap in the grid circuit is novel. The use of an audio choke coil in place of the grid leak has been described for audio demodulation, but the use of a tuned circuit at high frequencies has not been used before, it is believed. Incidentally this tuned trap is put on the high potential side so that it will not pick up signals having the frequency of the intermediate nor static and similar disturbances. The small coil L1 is quite effective in shorting out such disturbances.

The oscillator is a Hartley in a modified form for heater type tubes and is especially suited for short waves.*

The coupling between the oscillator and the mixer departs somewhat from the conventional. The plate of the oscillator and the grid of the mixer are tied together with a high resistance and a small condenser, connected in series. This is called electron coupling.

All the intermediate frequency transformers are the same. There are three of them. Only the secondaries are tuned and the primaries are oversized in order to prevent excessive selectivity. While it is best to get ready-made transformers, the experienced amateur can make his own. The coils are wound on 1.25 inch diameter forms with 100 turns of No. 28 wire for the primaries and 50 turns of No. 30 double silk covered wire for the secondaries. The secondaries should be wound on first and the primaries on top, with a layer of good insulation between the two windings. Wind the two in the same direction and make the two low potential ends, from the signal point of view, start together. The primaries will extend beyond the secondaries, since there are more turns.

The Second Detector

The second detector is of the grid bias type, utilizing a 27 type tube. A 20,000-ohm bias resistor and a 0.01 mfd. condenser are used in the cathode lead. In the plate circuit is a low pass filter consisting of two 0.001 mfd. condensers and a 500 microhenry choke coil. This choke should be of the lattice-wound type.

For the reception of code signals a beat frequency oscillator is needed, and this is another Shiepe oscillator, almost identical in wiring to the high frequency oscillator. The oscillator coil L5 should be wound on 1.5 inch low-loss tubing with 80 turns of No. 28 double silk wire, the tap being placed near the center or a little closer to the ground end.

The frequency of oscillation is varied by means of a 4-70 mmfd. variable condenser and the intensity of oscillation by a potentiometer, which controls the screen voltage.

The frequency is adjusted so that the beat between it and the intermediate frequency has the desired audio tone, say 500 cycles per second. This should be done when the i-f amplifier is adjusted to exact resonance and when a signal of this frequency is coming through. After this adjustment has been made the beat oscillator may be used as a resonance indicator, because when the beat has the 500 cycle note the circuit is tuned exactly. However, there are two settings at which the tone will be the same. One will be louder, and that is the correct one. The tuning of the beat note oscillator need not be touched after the first adjustment. When the beat is not needed it may be stopped by stopping the oscillation by means of the potentiometer.

The beat frequency oscillator and the second detector are coupled simply by being tied together. This might appear to be close coupling, but the 0.001 mfd. condenser from the plate to ground makes the coupling rather loose. It is just sufficient to give out a good audio tone when code is being received, or when any continuous carrier is being received. Incidentally, the beat frequency can be used as an aid in tuning in broadcast and television or other modulated waves. The oscillator is stopped as soon as the station has been tuned in.

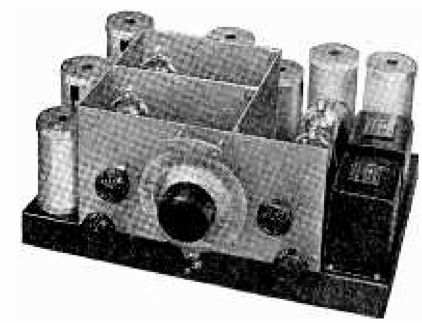


FIG. 2
A top view of the eight-tube National short wave superheterodyne the diagram of which is shown in Fig. 1.

Volume Control

The output of the second detector is fed directly into a stage of push-pull utilizing pentodes. There is ample output from the detector to load up these pentodes without overloading the detector. Therefore a strong signal is assured. The rising frequency characteristic of the pentode partly compensates for the loss of high frequencies due to sideband cutting.

The principal volume control is a 50,000 ohm variable resistor across the primary of the second intermediate frequency transformer. But the volume may also be varied with the regeneration control, which is also a 50,000 ohm unit. The control of oscillation in the beat frequency oscillator provides a means of varying the intensity of the heterodyne note in code reception.

Connected between each side of the heater circuit and ground is a condenser of 0.01 mfd. These two condensers are shown near the oscillator but of course they apply to all the heaters since they are connected in parallel. These condensers serve to eliminate tunable hum.

Tuning Coils

It is recommended that the tuning coils be obtained ready made. They are not easy to make because the material on which they are wound is difficult to machine. It is the low-loss R-39 substance which has been developed especially for short wave work. However, for those who wish to make their own coils the winding data are given in the table herewith. The diameter of the form is one inch and it is threaded to wind eight turns to the inch. All windings are of No. 18 enameled wire.

COILS WINDING DATA

Meters	*No. of Turns* *Ant.*	*Osc.*	*Tap, Turns from Bottom* *Ant.*	*Osc.*
3.75—4.5	1	0.75	0.25	0.25
4.5 —5.5	2	1.5	0.375	0.375
5.5 —6.5	2.875	2.375	0.375	0.5
6.5 —7.5	3.75	3	0.5	0.625

It will be noticed that each coil covers one meter or less. This is due to the fact that the tuning condensers are extremely small. But although the wave coverage is small, the frequency coverage is wide, considering the number of channels in each band. Thus the smallest coil covers a frequency band of 13,333 kilocycles, which is about 15 times wider than the entire broadcast band. It is clear that small tuning condensers and a very good vernier dial are essential to separate the stations.

* "Radio Frequency Oscillator," by E. M. Shiepe, RADIO WORLD, March 26th, 1932.

A Power Amplifier

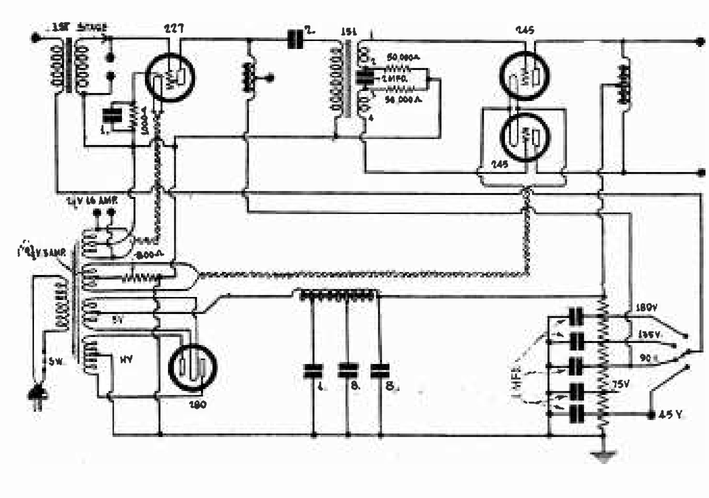
There is a demand for an audio frequency amplifier that is capable of delivering a strong undistorted signal. Sometimes these amplifiers are needed for amplification of the pick-up from a phonograph record, sometimes for amplification of the output of a microphone, and sometimes for use with a radio tuner. An amplifier of this type should have two stages, one a single sided stage and another a push-pull output stage. It should also have its own power supply and this should be arranged so that the voltage from it can be used for other purposes when required. In the figure below is the diagram of such an amplifier and power supply. It contains one 227 tube, two 245s and one 280 rectifier.

The use of an audio frequency choke and a large stopping condenser in the plate circuit of the 27 prevents saturation of the push-pull input transformer and thus improves the quality of the output. Another feature that helps to maintain good quality is the filter circuit in the secondary of the transformer. It consists of a 2 mfd. condenser between the two halves of the secondary and a 50,000 resistor in the return of each side.

The input to the first tube is arranged so that the signal may be obtained either from a radio tuner, when the first transformer is used, or from a phonograph or a microphone, when the two binding posts in the grid circuit are used and the switch opens the connection to the transformer.

Either a centertapped choke can be used in the output circuit or a push-pull. A choke is shown in the diagram. If the loudspeaker is provided with a transformer its terminals may be connected between the plates of the tubes, the center tap on the speaker, if any, being ignored.

Class A push-pull output, the familiar type of circuit. It, too, has a driver stage. The secondary of the push-pull input transformer, if center-tapped, may have tap to grounded B minus, ignoring the resistor-capacity filters.



A Detector-Oscillator Tube

Each Grid Separately Biased in New Valve

By Einar Andrews

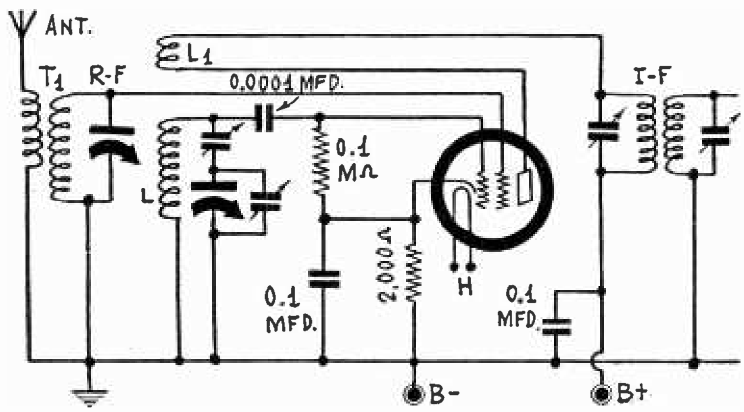


FIG. 1.
A circuit in which a Wunderlich double grid tube is used as oscillator and mixer by using one grid for oscillation and the other for carrier input.

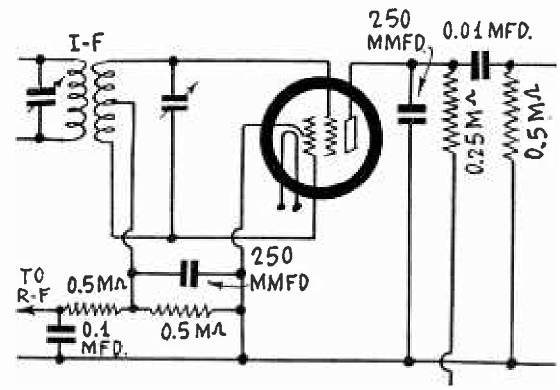


FIG. 2
In this circuit the Wunderlich double grid tube is full wave detector, audio frequency amplifier, and automatic volume control.

IN THE MAY 14th issue we published the characteristics of the Wunderlich double grid tube and gave some applications, particularly to full-wave detection and automatic volume control. But the tube has many other possibilities. In Fig. 1, for example, it is used as a combined oscillator and detector suitable for a superheterodyne. One grid is used for the radio frequency signal and the other for the oscillator. The common plate is used in the regular manner for the tickler and the primary of the first i-f transformer.

An advantageous feature of the tube is that the two grids are entirely independent so that each can be treated in the manner best suited to its function. If we disregard the grid connected to the top of the r-f circuit what we have left is just an ordinary oscillator with the i-f transformer connected in its plate. We have the usual condenser arrangement for padding, the usual stopping condenser and grid leak. It will be noticed that the grid leak returns to the cathode of the tube, as is usually the case. Hence, the only bias on the oscillator grid is that due to the grid current through the leak.

Adding the Second Grid

Now let us suppose that the second grid is connected to the top of a radio frequency tuner, as it is in the diagram. We may need a different bias on the grid to effect best detection, and this bias we can obtain from a resistor in the cathode lead below the return of the grid leak. In the figure this bias resistor is marked 2,000 ohms. However, this may not be the optimum value.

The two grids are identical in as far as they can be made so in production on a large scale. They are not only identical but they will have an identical effect on the plate current provided they are biased the same. In this case neither the steady bias nor the variable bias values, that is, the signal, are equal. Hence they will have somewhat different effects on the plate current. When both are negative together by the maximum amount the plate current will be least. When both are negative together by the least amount, the plate current will be maximum. The rate of variation in the plate current will depend on the difference between the two frequencies impressed, or the plate current will vary at the intermediate frequency. Hence there will be something for the i-f tuned circuit to work on.

The coupling between the two circuits will be close, but not in the sense of two ordinary coupled circuits. The so-called electron coupling will be close but the magnetic coupling will be zero, assuming that the two coils are carefully shielded from each other.

Overloading

If the oscillator is allowed to oscillate unrestrictedly the r-f grid will have little effect on the plate current and we shall have a case of overloading before we put any r-f signal into the tube. Hence we must restrict the oscillation. This can be done by using a small stopping condenser or by using a low value of grid resistance, or by both methods. For this reason the stopping condenser suggested is only 0.0001 mfd. and the grid leak resistance is 100,000 ohms. If we restrict the oscillation too much the oscillator might stop. Hence we have to find a combination of grid condenser and leak that will give a satisfactory output. Of course, the needed combination depends on the tickler and its coupling to the tuned winding L as well as on the plate voltage applied.

A possible method of varying the volume is to vary the grid bias resistance for the r-f grid. By increasing this resistance the operating point for this grid will move in the direction of lower plate current. The output will therefore decrease. However, although the grids are independent their effects on the plate current are not, or there would be no detection. It may be, therefore, that if the bias on the first grid is increased that the oscillation will stop. But before this happens the oscillation will gradually decrease and this will help to control the output. This reduction in the oscillation is due in part to the reduction in the plate current by the bias on the first grid and in part to the fact that the effective plate voltage is decreased by increasing the bias resistance.

The Second Detector

In Fig. 2 we have a Wunderlich tube in a full wave rectifier and amplifier, together with an automatic volume control. The extreme terminals of the secondary circuit of the i-f transformer are connected to the two grids and center-tap of the winding is connected to the load resistance, which is half megohm. The two grids, acting in parallel, receive the audio frequency voltage developed across the load resistance and the 250 mmfd. filter condenser. This detector is nothing but a grid leak and condenser detector with the leak and the condenser placed on the ground side of the tuned circuit. The steady drop in the load resistance, after it has been filtered for audio frequencies by means of the left 0.5 megohm resistor and the 0.1 mfd. condenser, is used for automatic control bias.

If the circuit in Fig. 1 and that in Fig. 2 are joined together with a 58 type amplifier tube, and if a power tube is added to Fig. 2, we would have a complete superheterodyne, except for the B supply. Counting that we would have a 5-tube superheterodyne with diode detection and automatic volume control.

The Output Circuit

In the output circuit of the second detector there is a double frequency component present and for that reason there should be a by-pass condenser as usual. This double frequency component develops across the load resistance and is due to lack of perfect filtration. There is also another effect. In respect to the radio signal the two grids are always at opposite potential. When the upper grid is positive the lower is negative. They are always 180 degrees out of phase. For that reason the two grids together would have no effect on the plate current, as they would neutralize each other, provided the voltages were always equal in maximum value. This is not quite the case, for in one grid current flows and in the other no current. The grid that happens to be drawing current will be at a lower potential because of the drop in voltage in one-half of input winding. There is no drop on the inactive grid. Therefore there will be a slight carrier frequency component in the plate circuit in addition to the double frequency component. This is the case even if the tube and the transformer are perfectly balanced. The carrier component is very weak because the current drawn through the high load resistance is small.

OUTPUT CIRCUITS UNDER RE

IN

By Capt. Peter

LAST season, in the smaller sets, the '47 was the most popular power tube, because of its great sensitivity. The voltage amplification factor is 90, the second highest of all the power tubes, the 238 being first with 100, but that is an automotive tube. The coming season shows an abrupt change. The Class A amplifier is still being used generally, but the Class B enjoys some favor, too, and both are gaited to quality rather than mere sensitivity at any expense. Therefore the '47 tube, and any other a-c pentode output tubes for home use, are likely to be put in the background.

The object of the change is one of tone quality. There are two schools of thought. The first is that a better tube than the '47 should be used, even though the sensitivity is less, for the distortion should be reduced. Thus Class A amplifiers, using single-sided or true push-pull '45's, will be in some sets, the Class B amplifier, using 46's in the output, will be featured in other sets.

The second school of thought looks particularly to the tone quality on extremely large quantities of sound, allowing some second harmonic distortion at low sound levels, but hardly exceeding that at the extremely high sound levels, where the Class A amplifier is likely to distort.

Class A versus Class B

There is by no means an agreement on what type of output circuit and tubes should be used, as can be seen. Undoubtedly where terrific voltage swings to extremely high levels are to be countenanced the Class B amplifier has its just merits. Against the preliminary level of Class B distortion, for low signal strength, one might argue in favor of the Class A amplifier that the volume control for home use would be adjusted to comfortable volume, and that situation would not require Class B service. Yet there are volume levels of sound used in the home, as when dancing, that afford an advantage to the Class B amplifier, as well as some passages in symphonic music.

On the economic score it must be admitted that the Class B system, as recommended by the tube manufacturers, costs more, because there must be a driver stage and it must be coupled to the output tubes with a special transformer of low leakage reactance (primarly tightly coupled to secondary) and the secondary must have a low d-c resistance, for grid current will flow in the power tube circuits. Also the wattage output will vary considerably, hence a stable rectifier and suitable filter must be used, the rectifier being a mercury vapor tube (82 or preferably 83) and the rectifier having a low d-c resistance choke coil as well as a fairly good bleeder through the voltage divider. Besides, the d-c resistance of the high-voltage secondary of the power transformer must be low, for the d-c flows through this as it does through the filter choke.

Driver for the '45

Those who will not use Class B will find themselves going back to the '45, although the word "back" does not signify any retrogression. Far from it. At optimum d-c voltage values the '45 takes a bias of 56 volts negative, so will stand a heavy load on the grid circuit, and if the plate voltage is boosted some more, the bias may be still further increased sufficiently to prevent the normal steady plate current through the tube from exceeding 40 milliamperes. The only trouble with the '45, if it may be called trouble, is the low mu, 3.5, compared to 90 for the '47. The '47 was used to obtain large volume of sound, although the input to the tube was low, as from two stages of t-r-f and a negative biased detector, but a voltage amplification of 13.8 may be obtained with resistance coupling, using the 56 as driver, so an extra stage of audio will produce an amplification of half that of the other circuit, with its '47 output tube, but with far greater quality, and besides with capability of standing a much stronger input. On some local stations the '47 will overload fast, and the distortion is particularly annoying, whereas even a single '45 output tube may be operated in nearly all localities in a six-tube t-r-f set without danger of overload. Besides, the 56 is a semi-power tube of sorts, taking 13.8 volts negative bias, or standing an input not much less than that of the '47, or the plate voltage may be raised and the bias raised so the plate current will not exceed 5 ma, and then the bias requirements would be about the same (16.5 volts negative).

High Impedance Load

The plate resistance of the power tube is another consideration. When this resistance is high it becomes almost impossible to provide a sufficiently high impedance load for the plate circuit, for it has to be a coil, usually the primary of an output transformer. Now, the a-c plate resistance of the '47 is 35,000 ohms, and the ohms load recommended is 7,000. Nor is this the maximum example, for the '38, although an automotive tube not used generally in a-c circuits, has a plate resistance of 102,000 ohms, recommended ohms load 13,500. The problem is to attain load values of 7,000 and 13,500 ohms.

By having a sufficiently high impedance tone quality is improved because the low-note reproduction gets a good chance of coming through, where as mismatched impedances cause severe attenuation of the low notes, and indeed poor quality throughout. Take the '45, plate resistance 1,670 ohms, recommended ohms load, 4,600. These figures are for the maximum d-c voltages as given on tube characteristic charts. As the bias is made more negative and the plate voltage more positive the plate resistance declines, but the change should not be made beyond the maxima of the characteristics as cited unless the plate current is kept within bounds. It is the current through the tube that may damage the tube, rather than the voltage used. Limiting the current this way stops the rapidity of the reduction of the plate resistance.

The 46 As Single Output

In the category of power tubes the 46 should not be overlooked. It has a voltage amplification factor of 5.6. Therefore, if this tube were used in a 6-tube t-r-f set instead of the '45, at maximum d-c voltage conditions for all tubes compared, the product of the mu factors of the 56 and the 46 would be 73.6, whereas the '47 alone would be 90, or the product would be 0.8 that of the '47 alone, the difference being hardly enough to be noticed by the ear. However, the 46 would not stand as great a wallop as the '45, as the bias would be 33 volts negative for the 46 compared to 56 for the '45.

Therefore conflicting considerations arise. They are sensitivity and voltage handling capacity. The sensitivity may be considered as the amplification factor, the voltage handling capacity as the power output. On this score the '47 has its 90 mu and 2.5 watts output, whereas the '45 has its 3.5 mu and 2 watts output, and the 46, single-sided Class A, its 5.6 mu and 1.25 watts output.

However, the bias should not be neglected, as it is a measure of what input a-c the tube will stand without overloading, whereas the power output relates to the output it will stand without overloading. The higher the negative bias required, the more favorable the circumstances. There is no fixed relationship, no standard basis of comparison, for the figure of merit for the power tube is still in dispute.

Mutual Conductance

If mutual conductance is given consideration, that is merely an inverse rating of the plate resistance, and as we have seen that lower plate resistances are desirable from one viewpoint, we find that the mutual conductance then will be higher, and a high mutual conductance is regarded favorably. So take the mutual conductances: '46=2,380, '45=2,100, '47 =2,500 micromhos.

Once we get beyond the voltages normally used we come to the '10, infrequently used as a power tube in receivers these days, and the '50. The '10 requires up to 425 volts for plate, 39 volts negative bias additional. The '50 rating, at maximum, is 450 volts and 84 volts, respectively.

The power output for the '10 is 1.6 watts and that of the '50 is 4.6 watts. But for home use 2 watts is all-sufficient.

Besides the single-sided circuits there is push-pull in its two forms, Class A, the standard we've been familiar with for so long, and Class B. It is characteristic of Class B that the bias for the tubes can not be self-bias, because of the sharp and sudden changes in current. So the 46 tubes were designed to be worked for Class B at zero bias, to get around this difficulty, and zero bias, normal steady value at no signal, means positive bias whenever there is any signal. This no doubt accounts for threshold distortion.

Equal to Push-Pull

By correct voltage application and selection of proper load constants the action of Class B amplifiers can be about the same as that of true push-pull, and, as stated, very severe volume exactions may be made without increasing the distortion beyond the threshold value found at weak signal input, whereupon the very loud passages are much better handled than with a Class A amplifier, provided, however, the tests of both are made with the volume control at full-on position.

It will be recalled that the first publicity regarding Class B amplifiers had to do with battery-operated circuits, the reason for Class B operation being that so much greater power handling capacity was introduced, despite relatively small output

VISION

MOVE FOR BETTER QUALITY

V. O'Rourke

tubes, that the system was thoroughly worth while. But there was a difference. Those battery-type Class B amplifiers were worked with the power tubes at a high negative bias, nearly at plate current cutoff, so that the signal swung the bias in a positive direction, but would not likely swing it to a point where grid current would flow.

This condition was attained by introducing a negative bias about twice as great as that used for normal Class A amplification. This seems to be the preferable way to work a Class B amplifier, does not dispense with the driver stage necessarily, but does eliminate grid current and the special transformer. It is confidently expected that systems will be developed for using the high-negative-bias Class B amplifiers in a-c sets, even though an extra tube may be needed.

Choice of Power Tubes

Coming down to actual circuits, we can see a use for the '47 in a very modest receiver, where speaker volume on few tubes is the principal requirement, so that if a stage of t-r-f and a grid leak detector are used, the sole audio tube may be the '47, so with rectifier there would be four tubes total This is simply tangible proof of that sufficient volume for speaker operation is obtainable with four tubes, including rectifier.

If another stage of t-r-f is added, making two t-r-f and detector, then the detector may be of the negative bias type, e.g., 57 with 6 or 7 volts negative bias, a resistor plate load and around 250 to 275 plate volts applied, but a '47 still would be required for sufficient sensitivity. Therefore the choice lies between the '47 alone and a driver stage of audio, say a 56 resistance-coupled, with a '45 output tube, or, a satisfactory situation, a 56 output tube, single-sided Class A, producing more volume than the '45 but standing less gaff.

Superheterodynes

For especially high-powered receivers true push-pull may be used, either '45's or 46's, or even '50's. If the '56 or any other tubes are used as Class A push-pull, the power handling capability is at least doubled, and therefore push-pull would be excellent for superheterodynes, using '45's or 56's. However, the five-tube super is in the same class as the six-tube t-r-f set as to power tube requirements, and does not need push-pull.

Use for Pentode

Only high-powered sets need Class B amplification, especially superheterodynes, and then only if one accepts the requirement of tremendous volume of sound with the imposition there must be no more distortion then than at low signal levels.

When it comes to battery-operated sets, Class B is advantageous, because of the low plate voltage at hand and also other considerations of economy having to do with B and A current drain. And as for the pentode, in sets where there must be very high sensitivity because of small pickup, or amplification at r-f, such as auto sets, the pentode still has an advantage, since it is more important to get enough speaker volume to be able to hear the stations tuned in than it is to eliminate third harmonic distortion from the signals of stations that can not be heard.

POWER AMPLIFIERS IN NUMERICAL ORDER

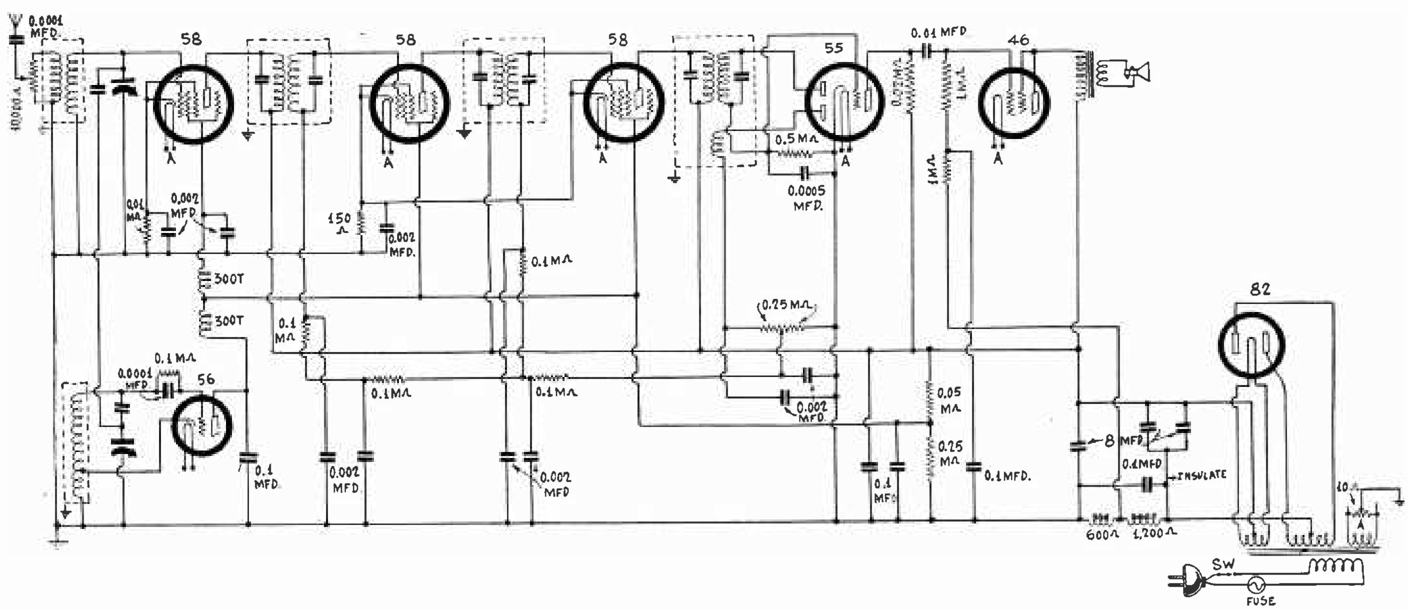
Type Number	Purpose	Base	Type Cathode	Rating: Filament (or heater) Volts	Rating: Filament (or heater) Amperes	Rating: Filament (or heater) Supply	Plate Max. Volts	Screen Max. Volts	Plate Supply Volts	Negative Grid Bias Volts: D C on Fil.	Negative Grid Bias Volts: A C on Fil.	Screen Volts ( ) = Current	Plate Current Milliamp.	A C Plate Resistance Ohms	Mutual Conductance Micromhos	Voltage Amplification Factor	Ohms Load for Slated Power Output	Power Output Milliwatts
46	Power Amplifier †Class A	UY	Filament	2.5	1.75	A C or D C	250	...	250	31.5	33	...	20	2380	2350	5.6	6400	1250
46	Power Amplifier ††Class B	UX	Filament	2.5	1.75	A C or D C	400	...	400	0	...	...	200 peak				1300 per tube	
112-A	Power Amplifier	UX	Filemtnt	5.0	0.25	A C or D C	180	...	135 180	9.0 13.5	11.5 16.0	... ...	6.2 7.6	5300 5000	1600 1700	8.5 8.5	8700 10800	115 260
120	Power Amplifier	UX	Filament	3.3	0.132	D C	135	...	90 135	16.5 22.5	... ...	... ...	3.0 6.5	8000 6300	415 525	3.3 3.3	9600 6500	45 110
171-A	Power Amplifier	UX	Filament	5.0	0.25	A C or D C	180	...	90 135 180	16.5 27.0 40.5	19.0 29.2 43.0	... ...	12.0 17.5 20.0	2250 1960 1850	1330 1520 1620	3.0 3,0 3.0	3200 3500 5350	125 370 700
210	Power Amplifier	UX	Filament	7.5	1.25	A C or D C	425	.	250 350 425	19.8 27.0 35.0	22.0.. 31.0 39.0	... ...	10.0 16.0 18.0	6000 5150 5000	1330 1550 1600	8.0 8.0 8.0	13000 11000 10200	400 900 1600
231	Power Amplifier	UX	Filament	2.0	0.130	D C	135	...	135	22.5	...	...	6.8	4950	760	3.8	9000	150
233	Power Amplifier	UY	Filament	2.0	0.26	D C	135	...	135	13.5	...	135(3.5)	14.5	50000	1350	70	7000	650
238	Power Amplifier	UY	Filament	6.3	0.3	D C	135	135	135	13.5	...	135(2.5)	9.0	102000	975	100	13500	525
245	Power Amplifier	UX	Filament	2.5	1.5	A C or D C	275	...	180 250 275	33.0 48.5 54.5	34.5 50.0 56.0	... ...	27.0 34.0 36.0	1900 1750 1670	1850 2000 2100	3.5 3.5 3.5	3500 3900 4600	780 1600 2000
247	Power Amplifier	UY	Filament	2.5	1.75	A C or D C	250	250	250	15.0	16.5	250(7.5)	32.0	35000	2500	90	7000	2500
250	Power Amplifier	UX	Filament	7.5	1.25	A C or D C	450	...	250 350 400 450	41.0 59.0 66.0 80.0	45.0 63.0 70.0 84.0	... ...	28.0 45.0 55.0 55.0	2100 1900 1800 1800	1800 2000 2100 2100	3.8 3.8 3.8 3.8	4300 4100 3670 4350	1000 2400 3400 4600
841	Power Amplifier Class A	UX	Filament	7.5	1.25	A C or D C	* 425	... ...	425 1000	5.8 9.2	... ...	... ...	0.7 2.2	63000 40000	450 750	24 26	250000 250000	... ...

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

LINEAR DETECTION IS NOW
THE 55 WI

By Melchioı

A-C Short-Wave Set with 55 Tube



All new tubes in this 7-tube short-wave superheterodyne, including the 46 as a single-sided output tube. The 55 duplex-diode triode is second detector and automatic volume control.

IT is human nature to prefer the new to the old. Maybe that's why we see one circuit after another with all new tubes in it. Can it be that the old ones were so bad that there is no excuse for tolerating them at present, when we may select from among the new ones? No, the old tubes were not so bad. However, the new ones are better. Every tube in the circuit illustrated is better than its predecessor, except the 55, which is not out yet, but will be in some weeks, and that isn't better because there's nothing to compare it with—it is the first duplex-diode triode.

58 as Detector

Take the tubes, one by one, first the oscillator. It is the 56, a better, steadier oscillator than the '27, and requiring only 1 ampere instead of 1.75 amperes for the heater, other power conditions not much different. The 58 as first detector is the minimum-value cross-modulation tube of all times, and that means more selectivity, besides freedom from overload, for when the oscillator voltage is added to the signal voltage, on strong signal inputs, the sum would often overload a '24 or 57, its newer companion. The sum is taken, rather than the product, because this is a detector. How it happens that the 58 detects as a first detector but does not detect as a cross-modulation minimizer may occur to many as a pertinent question. The answer is that it performs its functions relatively. The detecting efficiency is sacrificed somewhat in favor of the killing off of cross-modulation and inter-modulation, at the same time some of the killer instinct is subdued, too, merely for fulfilment of detecting obligations. The main point is that it is a remote cutoff tube therefore is virtually beyond the possibility of overload in this position in this set.

The 58 as intermediate amplifier in the two stages needs no further explanation, as it is the best tube so far developed for this work.

Now comes the 55. This is an odd tube. It is expected that it will be housed in the same kind of a glass envelope as are the 57 and 58, dome shaped, you know. It is three tubes in one, or two tubes in one, depending on use. The one thing you can be sure of is that there is a single-tube function always devoted to the triode part, usually amplification at audio frequencies, to atone for the low sensitivity of the 55 as a detector (diode sections.) Though the sensitivity is low, it is almost impossible to overload the tube, and if the load resistance is high, then linear detection at once becomes practical. This is a type of detection wherein the output voltage varies directly as the input voltage, so the curve would be a straight line. Much talking has been done about linear detection but few are the receivers that have ever had it. The 55, however, opens possibilities. Here's hoping they will not be ignored.

Variable Bias

This tube is two diodes, if you will, so you may use the two sections separately, the only limitation being that the cathode is common to all three tubes in this one envelope. Very well. One diode is used as the second detector. Another the triode is used as first audio amplifier. The connection of grid to one side of the 0.5 meg. resistor couples the diode detector to the grid of the triode. Has the triode any bias. It has a negative bias equal to the voltage drop in the 0.5 meg., therefore the bias will vary. Let us hope it will vary from about 20 volts maximum, downward, as the lesser the signal amplitude the lesser the negative bias requirement for the triode. At least the bias will change with the carrier amplitude, and the change is, as noted, in the right direction.

But there is still another diode. What shall be done with it? The plate or anode could be tied to the anode of the other diode, but there wouldn't be much advantage in that. However, putting some extra turns on the intermediate transformer, in the slot between the separate windings, where there's plenty of room, we can pick off as much voltage as desired for actuating this remaining diode as an automatic volume control. Another high resistance load is required, to cathode, and provisionally it may consist of two 0.25 meg. resistors, joint to grid returns of the controlled tubes. It is not usual to control the first detector, too, and it is not shown in the diagram, but that innovation may be introduced by all who so desire. With the 58 as first detector the practice is all right.

The common cathode may be grounded, which is a fine thing, getting rid of the nuisance of a fixed bias of 20 volts negative for the triode, whereupon the cathode would be 20 volts above ground and require a lot of dexterity to avoid high starting bias—even positive in nature—on the controlled tubes, or awkward makeshifts. Here we can resort to utmost simplicity in a-v-c.

Remember, therefore, that there are two stages of audio, and that the triode of the 55 serves as the driver for the 46, used as Class A power output tube.

Coil Information

The 55 is one of the most interesting

EASY; TH HIGH RESISTOR DOES IT

Bradley

of the new tubes, present and expected, and while it is not in the hands of experimenters at present, that is only a matter of a few weeks and it is just as well to have circuits that use the tube, together with articles expounding such use. Since the tube will have a six-spring base the second detector temporarily, in this circuit, may be made a 57, with 50,000 ohms biasing resistor and 0.25 meg. plate resistor, the 55, when obtainable, slipped into the same socket.

Choice of Voltages

Due to the choice of resistance values the screen voltage is 100 when the plate voltage is 250. There is no resistor between the high voltage line and the leads to the plates of any of the tubes, which means that as much voltage is applied to these tubes as to the power tube. This is all right, provided the voltage on the 46 is not excessive. The voltage should be about 250 volts, or slightly more, measured from ground.

Those who wish to build a very good receiver with the new tubes may safely follow the diagram in Fig. 1 and use the values specified thereon. Most necessary data are given with the exception of the coils. Consider modulator for 350 mmfd. tuning condensers. The regular midget type coils are entirely satisfactory. They usually contain 127 turns of No. 32 enameled wire on a diameter of one inch. That is the tuned winding. The primary of each may contain from 25 to 75 turns. The wire used should preferably be thin, and No. 36 double cotton is often used. The primary as it is in the antenna circuit may be of heavier wire, however. It is necessary to put a layer of insulating fabric between these two windings and to make it about 1-32 inch thick. The primary should start near the ground end of the primary and should not extend any farther up than necessary to get the turns on.

Coil Shielding

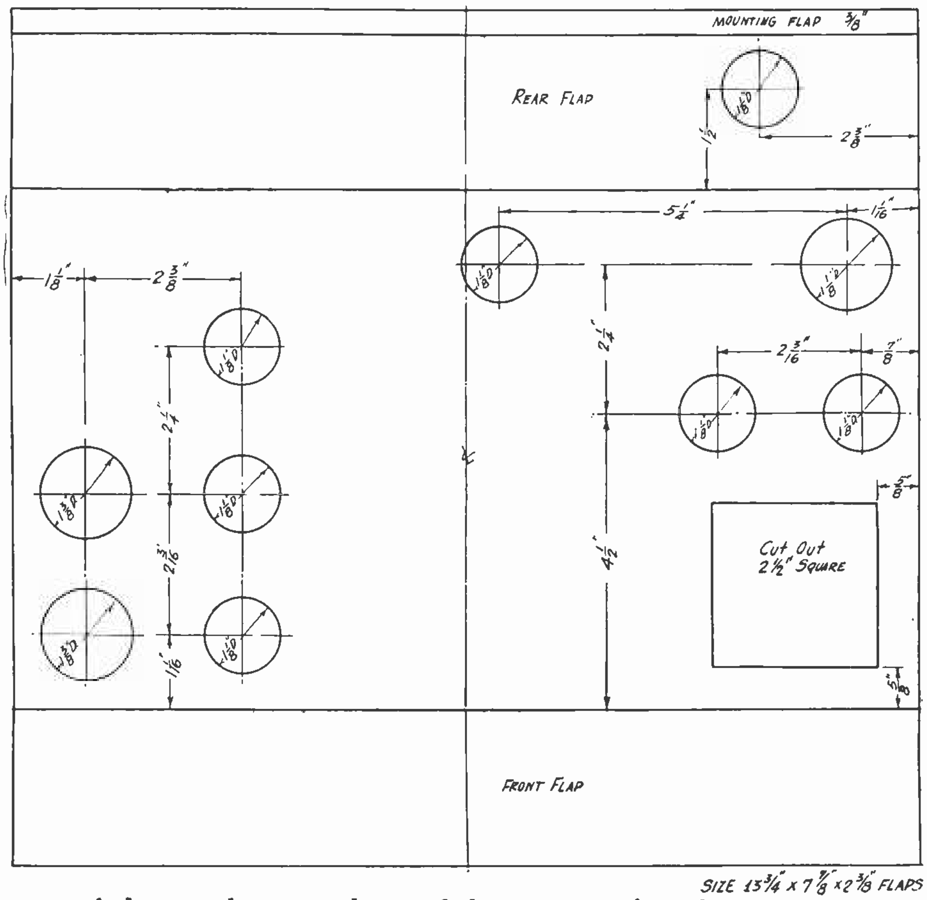
For 400 kc intermediate the oscillator has 91 turns tapped at about center. The padding condenser is 350-450 mmfd.

These coils should be mounted inside metal shields. The winding data are given for an aluminum shield measuring 2.625 inches high and 2.125 inches in diameter. If the shield is smaller, especially the diameter, the required turns will be greater, and conversely, if the shield is larger fewer turns will be needed. The shield should not be made smaller, and if it is larger the change in inductance is not great enough to make allowance for.

Those are the directions for broadcast use, coils permanently in place. However, for a short wave coverage, too, coil forms that cost only 15c each may be used. The diameter is 1.25 inches. The secondary of the antenna coil has 112 turns No. 32 enamel, primary as before, UX form used. The oscillator requires 85 turns tapped about center, and although there are only three connections (coil extremes and cathode) a 6-pin form is used so that another padding condenser is used for the first short-wave band, none for the other s-w bands. This condenser may be 0.001 mfd. The two padding condensers are tied to the stator and the other sides picked up one at a time, while lead to tube always goes to coil. The secondaries for antenna coil are 30, 10 and 4 turns, primaries tapped about ¼, No. 18 enamel. In the oscillator 25, 10 and 4, center-tapped.

Coupling Capacity

The condenser coupling oscillator and modulator is of small capacity. The connection is used as shown so that the small condenser can be firmly soldered to the stators of the two sections of the tuning condenser. A few micromicrofarads are all that are required and may be obtained by tightly twisting bell wire for the distance between the stators, one terminal of one lead connected to one stator, other terminal of other lead to other stator, so that opposite ends are open.



A layout that may be used for constructing the chassis.

The Seven Amateur Bands

with 'Phone and Picture Restrictions

GENERAL (C-W Telegraphy)

Kilocycles	Meters	Operator's License Required
1,715— 2,000	174.82 —148.9	Regular
3,500— 4,000	85.66 — 74.96	Regular
7.000— 7,300	42.83 — 39.98	Regular
14.000— 14,400	21.42 — 20.82	Regular
28,000— 30,000	10.708 — 9.994	Regular
56.000— 60,000	5.345 — 4.997	Regular
400,000—401,000	0.7496— 0.7477	Regular

'PHONE RESTRICTIONS

Kilocycles	Meters	Operator's License Required
1,875— 2,000	159.9 —149.9	Regular
3,900— 4,000	76.88 — 74.96	Unlimited
14,150— 14,250	21.18 — 21.04	Unlimited
56,000— 60,000	5.345 — 4.997	Regular

PICTURE RESTRICTIONS (Television, Etc.)

Kilocycles	Meters	Operator's License Required
1,715— 2,000	174.82 —149.9	Regular
56,000— 60,000	5.345 — 4.997	Regular

Note: All bands unrestricted as to continuous wave telegraphy. No 'phone permitted except as listed under "'Phone Restrictions," nor pictures, except as listed under "Picture Restrictions." Amateurs do not operate on individually assigned frequencies, but may use any frequency in the authorized bands.

SUPER RECEPTION WITH NEW TWO 46'S IN PUSH-P

By Brunsten

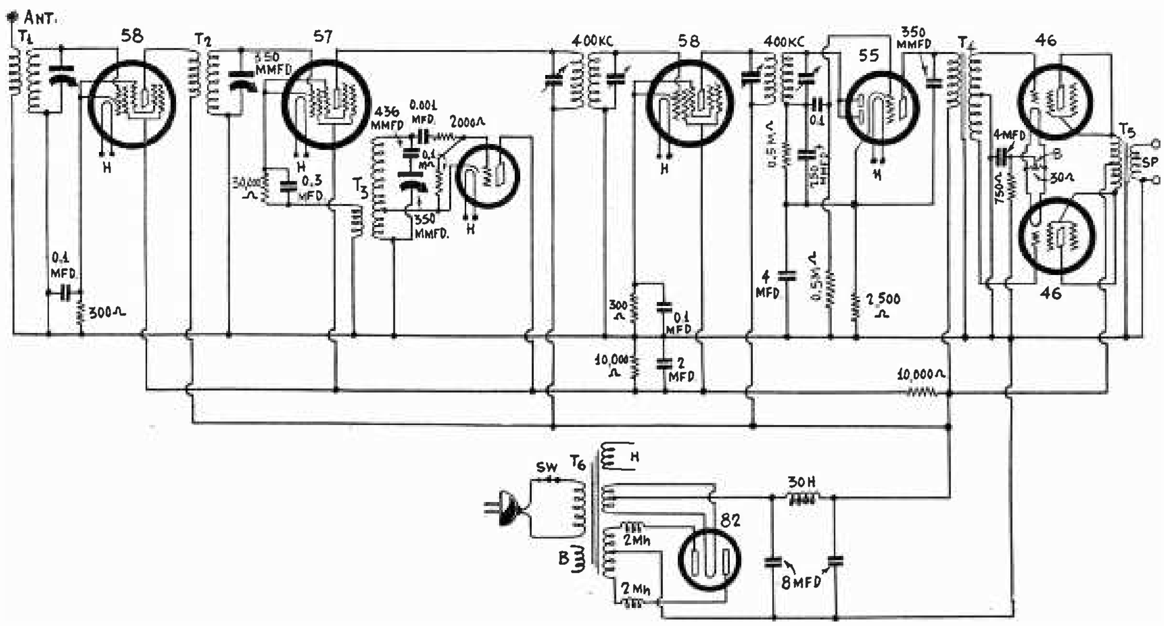


FIG. 1

In this eight tube superheterodyne the new tubes are used throughout. In place of the 55 the Wunderlich tube can be used. The 46 tubes are used as Class A amplifiers.

WHEN WE leave the midget receiver field we usually come to the eight-tube superheterodyne, a type that is capable of high sensitivity and selectivity and splendid power output. Many of these receivers have been built around the older tubes, but so far very few of them have been designed for the new tubes. But these tubes can be used greatly to improve the eight-tube super. We shall describe one that incorporates all new tubes, using two 46 tubes in push-pull in the output stage.

The first tube, an r-f amplifier, is a 58, the mixer is a 57, the oscillator a 56, the i-f amplifier a 58, the detector a 55, the output tubes, 46s, and the rectifier an 82. All these tubes with the exception of the 55 are obtainable but the 55 will not be ready until late in the Summer or early in the Fall.

Any one wishing to build a circuit like this and not having access to a 55 duplex diode triode need not be deterred because the Wunderlich double grid tube can be used in place of the 55 without a great deal of change.

The Diode Detector

In the 55 tube the two diode plates are tied together so that the rectifier is half-wave. The audio output of this diode is then applied to the grid of the tube, the coupling being resistance and capacity. Now if a Wunderlich tube is to be used one of the grids can be used as the diode anode and the other grid can be used for audio amplification. In the figure it is only necessary to regard the two plates tied together as one of the grids of the Wunderlich tube and the amplifier grid as the second grid in the Wunderlich tube. One style of Wunderlich tube comes with a six pin base, the same as the 55, so that a change in socket is not necessary. But the 55 has a cap for the control grid whereas the two grids in the Wunderlich tube occupy the positions of the two anode plates in the 55. The connections of the Wunderlich tube are simpler since it is not necessary to bring up a lead to the top of the tube.

The rest of the detector and amplifier circuit is the same for both tubes. A load resistor of 0.5 megohm is connected between the tuned circuit and the cathode and this resistor is shunted with a condenser of 250 mmfd. A stopping condenser of 0.1 mfd. is put between the negative end of the load resistor and the control grid, and a half megohm bias resistor is placed between the grid and ground. Thus for either tube the grid of the audio amplifier is biased by means of the resistor in the cathode lead. This is 2,500 ohms for the 55 and approximately the same for the Wunderlich tube.

The rectifier is half wave and therefore there will be a considerable signal component in the output. Hence a 350 mmfd. condenser is put between the plate and the cathode of the amplifier part of the tube. A 4 mfd. condenser is put across the bias resistor to reduce reverse feedback. In a midget receiver this condenser would be much too small to keep cost

LIST OF PARTS

Coils

- T1, T2—Two shielded midget type r-f transformers for 350 mmf. condensers
- T3—One oscillator coil
- Two 400, or 175, kc. intermediate frequency transformers, doubly tuned
- T4—One push-pull input transformer
- T5—One push-pull output transformer
- T6—One power transformer
- One 30-henry choke coil
- Two 2 millihenry r-f chokes

Condensers

- One gang of three 350 mmfd. tuning condensers
- Three 0.1 mfd. fixed condensers
- One 0.3 mfd. fixed condenser
- One adjustable trimmer condenser, 350-450 or 700-1,000 mmfd.
- One 0.001 mfd. fixed condenser
- One 250 mmfd. fixed condenser
- One 350 mmfd. fixed condenser
- Two 4 mfd. by-pass condensers
- One 2 mfd. fixed by-pass condenser
- Two 8 mfd. electrolytic condensers

Resistors

- Two 300 ohm bias resistors
- One 30,000 ohm bias resistor
- One 2,000 ohm resistor
- One 100,000 ohm grid leak
- Two 0.5 megohm grid leaks
- Two 10,000 ohm resistors
- One 2,500 ohm bias resistor
- One 750 ohm bias resistor
- One 30 ohm center-tapped resistor
- One potentiometer for volume control

Other Requirements

- Three six-pin sockets
- Three five-pin sockets
- One four-pin socket
- One line switch, mounted on volume control potentiometer
- Four grid clips
- Six tube shields (46s not shielded)
- One chassis
- One vernier dial for condensers

TUBES;
ULL PROVIDE GREAT OUTPUT

Brunn

down and also to save space. It is advisable to use a large value of capacity here even if it is necessary to use one of those small electrolytic condensers—small in a geometrical sense. That is, it should be a large capacity if it is desired to get the low notes in full strength.

Automatic Volume Control

No provision is made in the circuit for automatic volume control. But this is easily taken care of. We already have the negative voltage for it and all we have to do is to change a few connections to make use of it. Connect a 0.5 megohm resistor from the negative end of the loud resistor of the diode to the grid return of the i-f tube, and connect a condenser of 0.1 mfd. from the grid return to ground. This will control the amplification in the i-f amplifier. Similarly it can be controlled in the r-f amplifier by suitably connecting the grid return of that tube three another half megohm resistor to the grid return of the i-f tube. However, if this is done it is necessary to break the first tuned circuit with a 0.1 mfd. condenser between the coil and ground. It may be sufficient to control the i-f tube only so that it is not necessary to tamper with the first r-f tuned circuit.

The r-f and i-f amplifiers are practically identical with the exception of the tuners. Both use 58 tubes and both have 100 volts on the screens and 250 volts on the plates. In each the suppressor grid is connected to the cathode. Each also has a 300 ohm limiting bias resistor shunted with a 0.1 mfd. condenser. Due to the fact that the 58 is a very effective amplifier, it may be that the circuit will be unstable, especially as it may not be possible to eliminate all feedback. If instability is encountered, the bias resistance should be increased to 400 ohms, or even more.

Controlling the Volume

There is no provision made for manual volume control, but one should be put in. If both the r-f and i-f amplifiers are automatically controlled, the manual control may be placed in the input to the a-f amplifier. Instead of using a fixed 0.5 grid leak, a 0.5 megohm potentiometer could be used, in which case the control grid of the 55, or of the Wunderlich, should be connected to the slider. If only the i-f is automatically controlled, the manual control should be put in the antenna circuit. Connect a 10,000 ohm potentiometer between the antenna and the ground end of the first 300 ohm bias resistor, disconnecting this from ground, and then tie the slider to ground. If neither the r-f nor the i-f amplifiers are automatically controlled, connect the cathode returns of both tubes to the 10,000 ohm potentiometer.

The first detector employs a 57 tube in grid bias connection. The bias resistor is 30,000 ohms, and this is shunted with a 0.3 mfd. condenser. Below this combination of resistor and condenser is the pick-up coil, which, of course, is coupled to the oscillator transformer T3.

The oscillator employs a 56 and a Hartley circuit, the cathode being connected to a tap on the tuned winding. A 0.001 mfd. condenser is put in the grid lead and a 100,000 ohm grid leak from the grid to the cathode. Between the grid and the stopping condenser is a 2,000 ohm resistor, the function of which is to prevent excessive oscillation. In case blocking of the grid should occur, it may be stopped by reducing the value of the stopping condenser, by increasing the series resistance, or by decreasing the grid leak, or by a combination of these changes.

Explanation of Blocking

The remedies for blocking may be better understood if the phenomenon of blocking is explained. Suppose the circuit is oscillating violently. Grid current flows part of the time, that is, when the grid is positive. This current establishes a voltage drop across the grid leak, and the stopping condenser becomes charged to a voltage equal to the drop across the grid leak. The grid becomes more and more negative as the oscillation continues. A time comes when it is too negative for oscillation to continue and it stops. Gradually the condenser discharges through the leak and the grid assumes a voltage at which oscillation again can occur. The oscillation builds up slowly until again the charge has been built up, when it dies down and stops. This starting and stopping oscillation usually occurs at an audio rate. Hence blocking manifests itself as a high pitch squeal. Sometimes, however, it is so slow that the process can be followed. If there were no grid leak, the oscillation would continue until the condenser was charged, when the circuit would stop without returning to the functioning state. That would be true blocking, which we might call static.

If the leakage is rapid enough for a given intensity of oscillation, blocking will not occur. The rate at which intermittent blocking occurs, when it does, depends on the time constant of the grid leak and the stopping condenser, but not in a simple way. If the rate of blocking is slow, the time constant is much too large. If the rate is at a high audio rate, it is just a little too high. The time constant can be reduced either by reducing the stopping condenser capacity or the resistance of the leak. The series condenser increases the time constant and from this point of view is not desirable, but it also reduces the intensity of the oscillation, and for that reason it is effective in preventing blocking.

Oscillator Constants

The value of the series condenser in the oscillator is based on a tuning condenser of 350 mmfd. and an intermediate frequency of 400 kc. The inductance of the secondary, or tapped, winding of T3 is supposed to be 145 microhenries. This also assumes that the inductance in the secondaries of T1 and T2 is 245 microhenries.

If the intermediate frequency is 175 kc the inductance of the oscillator coil should be 196 microhenries and the series condenser should be approximately 900 mmfd. A condenser having a range from 700 to 1,000 mmfd. will do. For the 400 kc intermediate a condenser having a range from 350 to 450 is available. Oscillator coils for both 400 and 175 kc are commercial.

The Output Stage

The output stage contains two 46 tubes in push-pull, operated as Class A amplifiers, which is done by tying the suppressor grids to the plates and biasing the tubes as required. If a bias resistor is used for one of these tubes its value should be 1,500 ohms and therefore when two tubes are used the common bias resistor should be 750 ohms. While it is not absolutely essential that this bias resistor be by-passed in a push-pull stage, it will improve the circuit by putting a condenser across it, and it should not be smaller than 4 mfd. A much larger electrolytic condenser could well be used. The positive terminal of this condenser should be connected to the center tap of the 30 ohm resistor across the filament winding.

The quality of the output may be still further improved by putting a resistor across each half of the secondary of the input transformer. This should be either 0.25 or 0.5 megohm, and the two should be equal. On the output side is an ordinary push-pull output transformer matching the impedances of the two tubes and the speaker. The plate resistance of this tube is 2,380 ohms and is close enough to that of the 245 or the 171A that a transformer designed for these tubes may be used.

The B Supply

In the power supply an 82 tube is employed. Otherwise the rectifier and filter circuit is similar to those used in most sets before the era of the midget. The transformer has one 2.5 volt winding for the heaters and filaments of all the tubes except the 82. This winding should be capable of delivering at least 8.5 amperes, for this is the current required by the seven tubes.

The transformer should also have another 2.5 volt winding for the rectifier alone, and this should be center tapped. It should be capable of delivering a current of 3 amperes.

The high voltage winding should have a voltage each side of the center so that the output voltage will be 250 volts, or a little more. This is about the same as that required for cihcuits using 245 tubes in push-pull. Hence about the only difference in the transformer is that the rectifier filament winding be 2.5 volts instead of 5 volts.

A 2 millihenry choke coil is connected in each plate lead of the tube to remove high frequency disturbances resulting from the manner in which the 82 rectifies. These chokes and the tube should be shielded from the rest of the receiver in order to eliminate high frequency disturbances, but the shield must be ventilated by perforations in the material so that the tube will not overheat.

The filter consists of two 8 mfd. electrolytic condensers and one 30 henry choke.

The full output voltage of the rectifier-filter is applied to all the tubes except the oscillator. This has the same voltage on the plate as the 57 and the 58s have on the screens, namely, 100 volts. In order to make the screen voltage 100 volts, it may be necessary to lower the first 10,000 ohm resistance in the voltage divider, say, to 8,000 ohms. The first resistor is the one that is connected to the highest voltage point.

NEW MODEL OF THE POPUL
BETTER SENS

By Herman

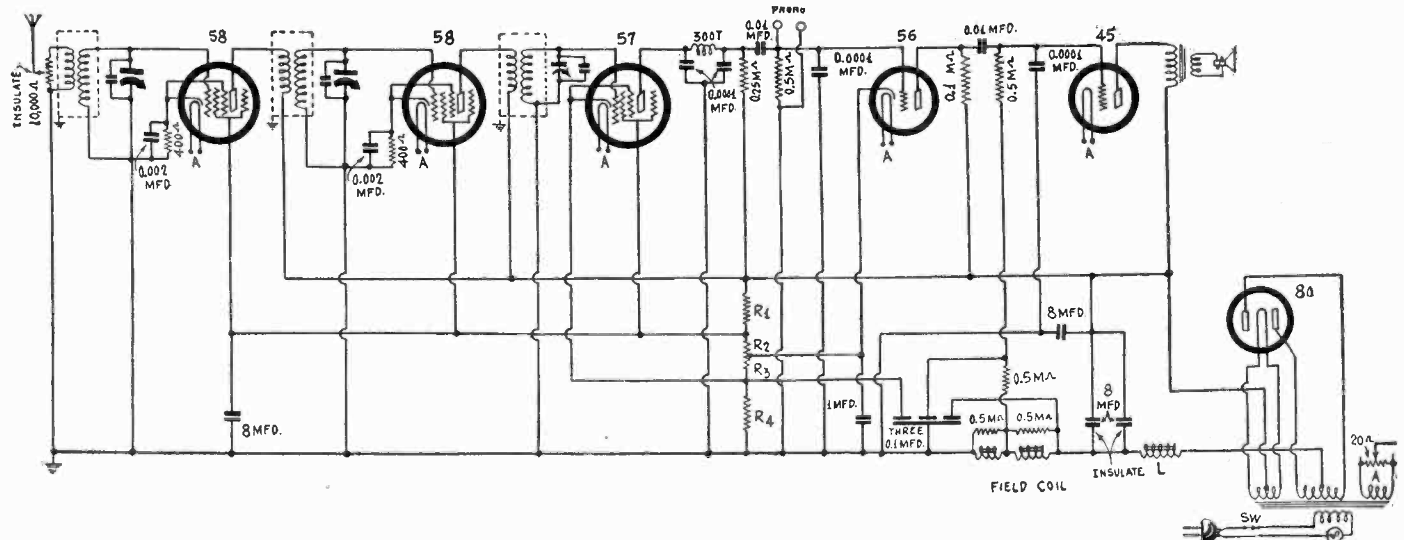


FIG. 1

The popular tuned radio frequency set of last season improved for inclusion of new tubes, and with an extra stage of audio. Tone quality is much better, so is sensitivity.

"HOW do the new tubes work?" is a frequent question. The answer is, they work very well. They are to be preferred to their predecessors. The r-f tubes, the 58's, amplify more, and the detector, the 57, is much more sensitive. Therefore careful shielding is necessary. Not only must the coils be shielded from one another but also the tubes in the tuner. For the 58 a special shield is made, with a removable top, which top so fits over the dome of the bulb as to be like a companion plate to the shield that is built inside the tube. A tiny condenser effect thus is present.

Unless these precautions are taken the set will squeal at radio frequencies, and in a t-r-f set at the higher frequencies when tuning, so that lack of proper shielding would have to be atoned for by introducing some losses, e.g., increasing the negative bias on the r-f tubes, removing primary turns from the two interstage couplers, or reducing the screen or plate voltages or both.

Improved Quality

It is well to maintain the screen voltage as high as recommended, around 100 volts, as the hum is less that way, due to the detector screen being on the same feed line. If full amplification is to be obtained from the 58's the negative bias should not be more than 4 or 5 volts, for 250 to 275 plate volts, although for stabilization due to insufficient shielding it may have to be 7 volts.

As for tone, because of the greater amplification the tone is better, or, there is enough kick to drive the speaker properly on low notes. In fact, using a '45 as output tube, the volume is about 75 per cent. of that obtained when the former r-f and detector tubes, '35 and '24, are used with a '47. This, of course, compares five-tube performance, but here we have an extra stage of audio, volume is greater than with the 5-tube '47 model, and quality is better. The third harmonic distortion of pentodes is rather large, although when one gets used to listening to it one does not notice it. The percentage may run from 7 to 15 per cent. Besides, third harmonic distortion can't be eliminated once it is there. The circuits used to-day may get rid of second harmonic distortion, but not third harmonic. In all receivers it is the goal to keep the second harmonic distortion under 5 per cent., and as for what percentage of third harmonic distortion can be tolerated, perhaps the fairest answer would be, "zero."

The circuit shown has much to commend it, has been built and tested, and is considerably superior to the small type receivers of last season.

Screen Voltage Effect

The cathode-voltage variation for bias control of volume has been eliminated and in its place a potentiometer used for altering the input to the receiver, leaving the d-c voltages constant, except so far as altered by the effect of the signal on the bias.

The reason is that unless a high current voltage divider is used, increasing the negative bias on the r-f tubes increases the screen voltage too much, as the plate current almost disappears, the screen current likewise, and there is hardly any voltage drop in the series resistor connecting to the B plus feed. Thus as the negative bias is changed, say from 3 to 30 volts, the screen voltage (to B minus) changes from 100 to 220 volts. Reckoned from cathode, as the screen voltage is actually the potential difference between the cathode and screen, the change is 93 volts, which is considerable. While it is true that the 58 may be operated, at somewhat reduced sensitivity, with screen and plate voltages the same, in that instance the sameness must be based on the screen voltage, rather than the plate voltage, in other words, 100 volts all around.

The volume control is therefore in a good position, and the only point that may be raised against it is that the signal input alone is cut down, and not the amplification, so that tubes noises are at maximum all the time, even when signal input is severely attenuated. While this is true, it is not serious. The tube noises do not run high in such a set. There are not many tubes and there is no oscillator to be modulated by shot effects. And the new tubes are less noisy.

Bias Voltages

Another point in favor of this type of volume control is that it permits shutting off the signal input completely. That comes in handy if you desire to tune through locals to a particular spot on the dial, without hearing the stations in between, and also when using the phonograph jack. The 10,000-ohm potentiometer should be wired so that when the a-c switch attached to it is open the arm is at ground. To hear anything the arm must be moved beyond the position of switch-closing.

The total voltage across the voltage divider may be 250 to 311 volts. Since bias for the power tube is taken off the field coil of a dynamic speaker, the full ground-to-B plus voltage is applied to the plate circuit of the output tube, and the bias is taken from the drop in the resistors across the field coil. However, if a total of 275 volts are available, the bias should be increased to 56 volts.

The detector, a 57, which supplants the '24, is very sensitive, as already related, but it does not take a very high negative bias. Around 6 volts negative may be used. This actually worked well under the conditions of 100 volts on the screen and 250 applied to the plate. The usual recommendation is 6 volts. The bias may be obtained from a cathode-to-ground resistor used separately, 10,000 ohms, or from a voltage divider, as diagrammed.

AR T-R-F SET; TIVITY AND TONE ENJOYED

3ernard

LIST OF PARTS

Coils

Three shielded radio frequency transformers, as described.
One 300-turn honeycomb choke.
One power transformer.
(Field coil and output transformer are part of speaker specified later).

Condensers

One three-gang 0.00035 mfd. tuning condenser, with trimmers and condenser shield.
Four 0.0001 mfd. fixed condensers.
Two 0.002 mfd. fixed condensers.
Two 0.01 mfd. fixed condensers.
One shielded block containing three 0.1 mfd. condensers.
Four 8 mfd. electrolytic condensers (may come two 8's to a can).
Three 0.1 mfd. in one case.

Resistors

One 20-ohm potentiometer.
Two 400-ohm pigail resistors.
One 10,000-ohm potentiometer.
One 0.25 meg. (250,000-ohm) pigtail resistor.
Four 0.5 meg. (500,000-ohm) pigtail resistors.
One voltage divider as in text, or high bleeder type (R1, R2, R3, R4).

Other Requirements

One flat type vernier dial with travelling light.
One chassis, 8x14x2⅝ inches.
Three six-spring sockets, two five-spring (UY) sockets, two four-spring (UX) sockets. The extra UY socket is for speaker plug connection as at rear wall of chassis.
Three knobs.
One dynamic speaker for single '45 output, with 110-volt d-c field coil, with output transformer built in.
Tubes: (2) 58, (1) 57, (1) 56, (1) 45 and (1) '80. The 82 mercury vapor rectifier may be used if the rectifier filament winding is 2.5 volts, as the '80 takes 5 volts.
One phono twin binding post.

The voltage divider method is better for tonal reasons if the bleeder through the divider is of considerable value, say, not less than 20 ma. Then the resistance values are low and the obstruction to low notes is less.

Optional Resistance Values

A total of around 20,000 ohms for the voltage divider may be used and the actual voltages measured with the usual meters, for there the current is high enough to enable such reading. The resistor wattage rating should be 50 watts. But if high resistances are used the voltages can not be accurately read by such meters, and will be greater than the apparent voltage. The values may be, top to bottom, R1, 100,000 ohms; R2, 50,000 ohms; R3, 5,000 ohms; R4, 5,000 ohms.

The 56 fits in very nicely for the first audio stage. The detector may put a heavy demand on the first audio tube, but this situation we meet with a tube biased negatively at about 9 volts. For transformer coupling, or any other coupling with low d-c resistance in the plate circuit, at 250 volts applied through the load, the negative bias should be 13.5 volts for amplification, but with 50,000 to 100,000 ohms in the plate circuit, the recommended optional values, the negative bias should be less, as stated.

Even if 56 volts negative bias are used on the power tube, the first audio can load it up on strong locals. The extra stage of audio makes this possible.

2 Watts Output

Also that extra stage gives you a wider choice of volume range, so that full input may be used for the very weakest stations, making them come in with the same comfortable volume to which strong locals are reduced by choice, anyway. The power tube, remember, is a '45, which has a power output at maximum voltages (275 and 56 volts respectively) of 2 watts. This is more than enough for home use.

The voltage used for power tube bias will depend on the plate voltage. The bias requirements are, for the following voltages from B plus maximum to ground: 180 (34.5), 250 (50), 275 (56). There is no way to measure the voltage with a meter unless the meter is electrostatic, for the current is too small through the resistors. It is less than 0.1 ma. However, the average characteristics of the '45 disclose that the plate currents for the above voltages, same order, are respectively 27 ma, 34 ma, 36 ma. We can measure the plate voltage and adjust the right-hand 0.5 meg. resistor until the prescribed plate current in the '45 alone prevails. The current will be a little too high perhaps, but by putting another high resistance in parallel with the right-hand one, experimenting with different values, the correct condition can be established.

The field will normally drop around 110 volts, if 1,800 ohms total, but the divided resistance method is used rather than a tapped field coil, so builders may use speakers they have, even if the resistance of the field is 1,500 or 1,200 ohms. The recommended experiment for power tube bias applies in all such cases. The '45 is simply used as a vacuum tube voltmeter.

R-F Filtration

The detector plate circuit is filtered to keep the radio frequencies out of the audio amplifier, for if they get in they may be amplified further to such an extent as to produce r-f squealing. The filter evidently is not sufficiently complete in resistance-coupled audio and therefore small condensers, harmless to audio frequencies, are put in parallel with the input to the audio tubes, to detour whatever remains of the r-f in the audio channel.

Across the field coil is a condenser of 0.1 mfd. This tends to reduce hum, if the inductance is such as to produce the result, but if not, the capacity will have to be changed until the desired effect is produced. The hum reduction by this means is small, but the little help is welcome in any circuit that amplifies the low audio tones well, as does this one. The grid circuit filter in the power tube circuit is more effective as a hum-reducer, but the two together put a really substantial damper on a circuit otherwise well-filtered at that, considering 16 mfd. at one end and 8 mfd. at the other, with 8 mfd. from screen to ground.

High Starting Drain

It is practical to put the 16 mfd. directly next to the rectifier, from B minus to B plus, but then the starting drain on the rectifier tube runs high. So an extra choke coil is shown, a so-called input choke, which to be really effective has to have substantial inductance, 20 henries, say. Tapped field coils may be used with 300-ohm section from B minus to the two 8 mfd. negatives, but if one end of the 300 ohms is connected to speaker frame this connection should be removed from the frame. If you have an extra choke, with low d-c resistance, you may use it in this manner, but the hum is not so low as by the other method, although the rectifier tube will last longer.

Note that the heater 2.5-volt secondary has its center grounded. The arm of a 20-ohm potentiometer is moved until the hum is least. This may not be the exact center of the potentiometer but it will be the electrical center of the secondary circuit, which is the important consideration.

Chassis Dimensions

The circuit is suitable for installation in a midget cabinet, or other table model cabinet, and also for console use. The chassis is approximately 14 inches wide and 8 inches front to back, front and rear flaps 2⅝ inches for high type tuning condensers, 3 inches for low type tuning condensers. The distance between condenser frame mounting brackets and the condenser center of the rotor shaft determines whether the condenser is of the "high" or "low" type. As there are only two types for broadcast use you can tell readily which one you have. The low type usually has a 2-inch distance from mounting bracket to center of shaft, the other about 2⅝ inches.

Arranging the coils front to back at left, tubes for r-f and detector next to them, the next position to right is for the tuning condenser, to be driven with a flat type dial. Then the audio and rectifier tubes are at right, as is the power transformer. The electrolytic condensers may be of the type that come two 8 mfd. to a can, and these may be mounted on the rear flap of the chassis, parallel with the chassis top, although of course below it.

Coils for 0.00035 Mfd.

Coil direction for 0.00035 mfd. capacity are: 1 inch diameter, No. 32 enamel wire. Wind 127 turns for the secondaries, put on three layers of insulating fabric and wind near the bottom of the coil a primary of 20 turns. Use top of secondary for grid connection and bottom of primary for plate or antenna connection, windings in the same direction. Enclose the coils in shields of not less than 2 inch diameter and ground the shields. Aluminum or copper should be used for shielding.

THE OFFICIAL DATA ON THE VARIETY

FULL-WAVE DETECTOR - DIODE-BIASED AMPLIFIER

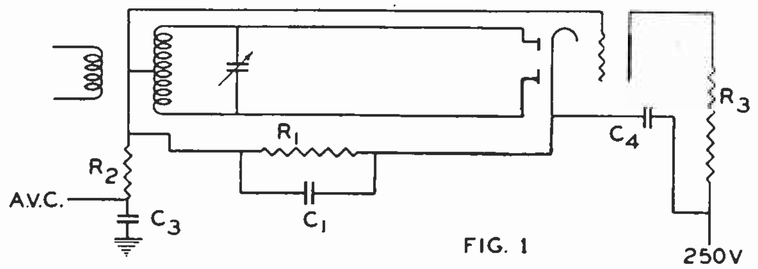


FIG. 1

FULL-WAVE DETECTOR - FIXED-BIAS AMPLIFIER

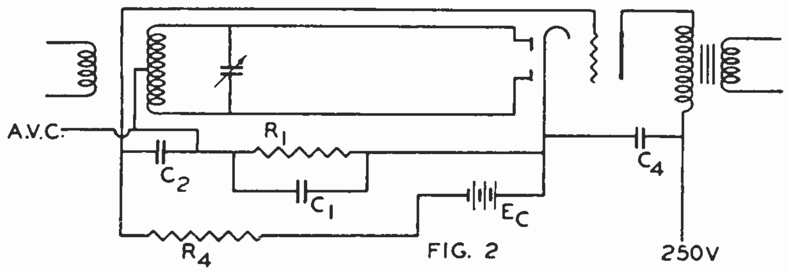


FIG. 2

HALF-WAVE DETECTOR - DIODE-BIASED AMPLIFIER

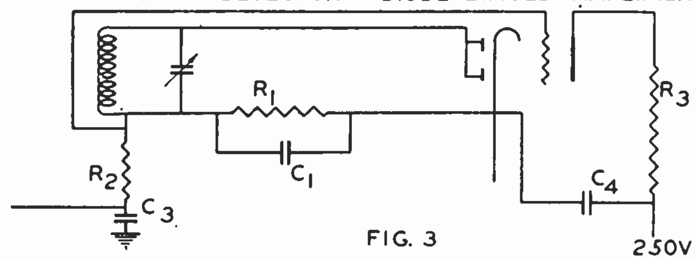


FIG. 3

HALF-WAVE DETECTOR - FIXED-BIAS AMPLIFIER

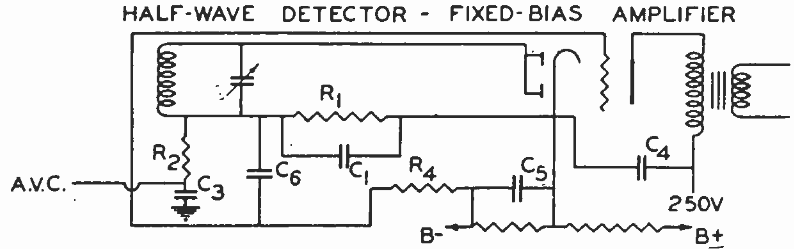


FIG. 4

HALF-WAVE DETECTOR - SEPARATE A.V.C. FIXED-BIAS AMPLIFIER

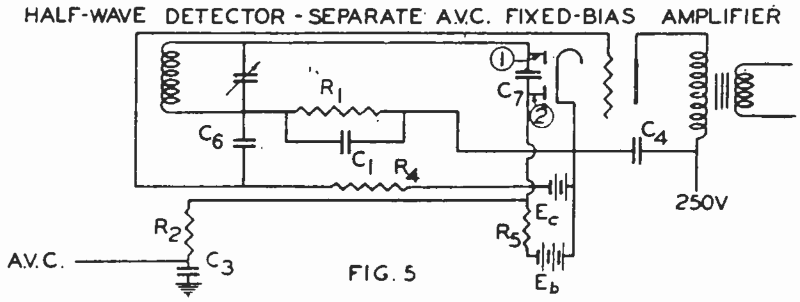


FIG. 5

Technical information on the 55 tube, as supplied by RCA Radiotron Company, Inc., and E. T. Cunningham, Inc., is published herewith in full, with their special permission:

THE 55 is an a-c heater type of tube consisting of two diodes and a triode in a single bulb. It is recommended for service as a combined detector, amplifier and automatic volume control tube.

In operation, the two diodes and the triode are independent of each other except for the common cathode sleeve, which has one emitting surface for the diodes and another for the triode. This independence of operation permits of unusual flexibility in circuit arrangement and design. For example, the diodes of this tube can perform at the same time the functions of detection and of automatic volume control with sensitivity control and time delay action confined to the a.v.c. circuit; while at the same time the triode may be used as an amplifier under its own optimum conditions.

The design of the 55 is characterized physically by the small overall size, the dome-top bulb, the rigidity of electrode assembly, the symmetrical arrangement of diode plates, and the separate terminals for each electrode.

Diode Detector Considerations

The simplest form of tube detector is the diode. Its action depends on the uni-directional passage of current between plate and cathode. In the direction opposite to that producing current, the resistance of the diode is extremely high while in the other direction its resistance is quite low. This means high rectifying efficiency.

The current flowing between plate and cathode through a low resistance current-measuring device depends not only on the applied signal voltage (at a fixed cathode temperature), but also on the tube resistance and follows approximately the relationship $i = k$ times the 3/2 power of the signal voltage. If the load resistance is made sufficiently high the effect of the tube resistance is negligible and the dynamic characteristic becomes linear. Since the diode resistance is low, the load resistance required to produce approximate linearity is conveniently obtainable. Under these conditions, the diode as a means of rectifying the incoming signal is particularly suitable because of its freedom from distortion.

Since the diode is a simple rectifier, it does not amplify. If increased voltage output is desired, an auxiliary amplifier stage is necessary.

Two diodes may be used for full-wave rectification or their plates may be connected in parallel (with decreased tube resistance) for half-wave rectification. With full-wave rectification, the circuit may be balanced for carrier input so that no carrier frequency is supplied to the grid of the following amplifier and no carrier frequency filtering is theoretically necessary. Half-wave rectification as compared with full-wave rectification provides approximately twice the signal output but requires carrier-frequency filtering.

Tentative Characteristics

Heater Voltage	2.5 Volts A-C or D-C
Heater Current	1.0 Ampere
Overall Length	4 9/32"—4 17/32"
Maximum Diameter	1 9/16"
Bulb	ST-12
Cap	Small Metal
Base	Small 6-Pin

TRIODE UNIT

Operating Conditions and Characteristics: (Class A Amplifier)

Heater Voltage	2.5 Volts
Plate Voltage	250 Volts Maximum
Grid Voltage	-20 Volts
Amplification Factor	8.3
Plate Resistance	7500 Ohms
Mutual Conductance	1100 Micromhos
Plate Current	8 Milliamperes
Load Resistance	20000 Ohms
Power Output (5% 2nd harmonic distortion)	200 Milliwatts

DIODE UNITS

Two diode plates are placed symmetrically around a cathode, the sleeve of which is common to the triode unit. Each diode plate has its own base pin.

Rating Conditions and Characteristics

With an applied d-c plate voltage of 10 volts, the space current per plate with no external load should exceed 0.5 milliampere.

Installation

The base of the 55 is of the small 6-pin type. Its pins require the use of a standard

55 TUBE; OF USES IS DIAGRAMMED

six-contact socket which may be installed to operate the tube either in a vertical or in a horizontal position. For horizontal operation, the socket should be positioned with its heater pin openings one vertically above the other. Base connections and external dimensions of the 55 are given in the drawing. The control grid connection is made to the cap on top of the tube.

The bulb surface temperature on the hottest part of the bulb under operating conditions should not exceed 150 F. as measured by a small thermocouple. Shield cans, if used, should provide sufficient ventilation to prevent the bulb temperature from rising above the recommended maximum value.

The heater is designed to operate at 2.5 volts. The transformer winding supplying the heater circuit should be designed to operate the heater at this recommended value for full load operating conditions under average line voltages. A transformer having primary taps is recommended so that adjustment may be made to give 2.5 volts to the heater for the particular line voltage at each installation.

The Cathode should preferably be connected directly to the midtap of the heater winding. This practice follows the recommendation that no bias be applied between heater and cathode, and that the resistance between them be kept as low possible in order to prevent hum in the circuit. When this practice is not followed, the heater may be biased negative with respect to the cathode by not more than 45 volts. If the use of a large resistor is necessary between heater and cathode in some circuit designs, it should be by-passed by a condenser of at least 4 mfd. or objectionable hum may develop.

Complete shielding of detector circuits employing the 55 is generally necessary to prevent r-f or i-f coupling between the diode circuits and the circuits of other stages.

In the case of full-wave detection, with circuits balanced to ground, shielding and i-f by-pass filters are not theoretically required. However, due to the practical difficulties of circuit balancing, their use is desirable. In the case of half-wave detector circuits, their use is always necessary.

Application

The 55 is recommended for performing the simultaneous functions of automatic volume control, detection, and amplification. This three-in-one feature is of decided practical importance to the set designer.

The application of this tube to receiver circuit design gives the engineer wide latitude in possible tube-unit connections. Since the 55 really consists of two diodes and a triode, each of these tube-units may be used in a circuit just as though it were in a separate bulb.

For detection, the diodes may be utilized in a full-wave circuit or in a half-wave circuit. In the latter case, one plate only or the two plates in parallel may be employed. The use of the half-wave arrangement will provide approximately twice the a-v-c voltage as compared with the full-wave arrangement.

For automatic volume control the controlling bias voltage may be obtained by either of two general methods. In one case, the required voltage is obtained from the detector circuit by utilizing the voltage drop caused by the rectified current flowing through a resistor in the detector circuit. In the other case, the required voltage is obtained by utilizing one diode for the sole purpose of automatic volume control. This letter method is of particular interest since it confines the sensitivity and time delay function to the a-v-c circuit. Time delay action is, of course, determined by the use of a resistance and condenser combination having the desired time constant. The sensitivity control action is determined by applying a negative voltage to the a-v-c diode plate of such a value as to accomplish the desired reduction.

For amplification, the triode may be employed in conventional circuit arrangements. Grid bias for the triode, depending upon circuit design, may be obtained from a fixed voltage tap on the d-c power supply or may be obtained by utilizing the variable voltage drop caused by the rectified current flowing through a resistor in the detector circuit. In this connection, it should be noted that the accompanying diagrams designate this latter arrangement as "Diode-Biased Amplifier."

The diagrams of Figs. 1 to 5 illustrate the application of the 55 to typical circuits. Fig. 1 shows full-wave detection and automatic volume control with the triode "diode-biased." R_1 is a resistor of the order or 0.5 megohm shunted by a condenser C1 of approximately 150 mmfd. for broadcast frequencies or approximately 600 mmfd. for usual intermediate frequencies. The load resistance R3 is not critical and may be about 100,000 ohms. The values of resistors and condensers having the same subscripts on all diagrams are of the same order of magnitude.

Fig. 2 shows a full-wave detection and automatic volume control arrangement with a fixed bias triode. R4 and C2 are approximately 0.5 megohm and 0.01 mfd. respectively.

Fig. 3 shows a half-wave detection and automatic volume control arrangement with the triode "diode-biased."

Fig. 4 shows a half-wave detection and automatic volume control arrangement with a fixed bias triode.

Fig. 5 shows an arrangement whereby one diode serves as half-wave detector, the other diode as automatic volume control tube, and the triode as an amplifier with fixed bias. The use of a voltage E_b for sensitivity control is also illustrated. Diode plate 1 serves as demodulator (detector) while diode plate 2 is used for a-v-c purposes.

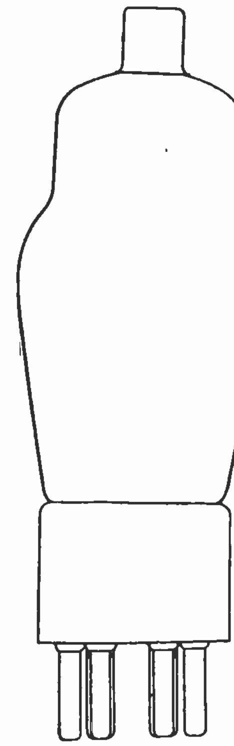
In the diagrams with fixed bias applied to the triode, transformer coupling has been shown. This arrangement, however, is not recommended for the "diode-biased" circuits.

AUSTRALIAN SYSTEM CHANGED

Canberra, Australia.

The state has taken over the control of broadcasting in this commonwealth, at least as far as the Class A stations are concerned, which are in the majority. The control has been vested in a non-political commission appointed by the government.

Advertising and the transmission of sponsored programs are prohibited. Local talent will be encouraged and the development of a national orchestra is one of the features of the policy of the commission.

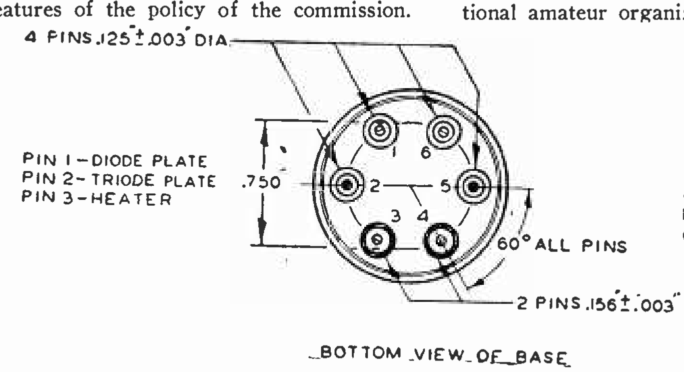


The appearance of the 55. This drawing is full scale. The cap is the grid connection for the triode amplifier. There are six pins at bottom, total seven outlets. See directions for identifying base pins in diagram below.

17,293 Contacts Made by Tennessee Amateur

The "QSO King" of amateur radio, Fremont F. Purdy, operator of amateur station W4AFM, at 1114 Poplar St., Kingsport, Tenn., claims the record of having established 17,293 two-way contacts with other amateur stations from August, 1929, through June, 1932. That means an average of about 17 contacts, or GSO's, every day, Sundays and holidays included, for the period of nearly three years.

Despite his unparalleled number of two-way communication, Purdy is an all-around amateur, finding time for the handling of amateur message traffic and friendly "rag-chewing" with the operators he contacts. He is an alternate net control station of the Army Amateur Radio System in Tennessee, and was prominent as a route manager of the American Radio Relay League, the national amateur organization.



BOTTOM VIEW OF BASE

ACCURACY WITH INEXPENS IN A-C

By J. E.

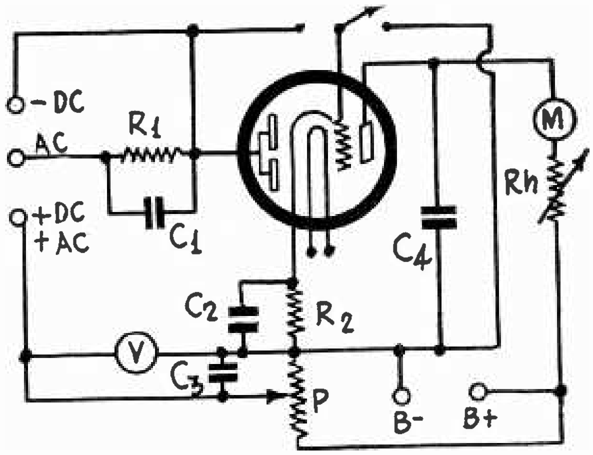


FIG. 1
This circuit can be used for measuring both a-c and d-c voltages. The d-c portion is static, or non-current drawing. The a-c portion draws a small current.

LIST OF PARTS

Condensers
C1, C2, C3—Three 0.05 mfd. mica dielectric condensers.
C4—One 0.1 mfd. fixed condenser.

Resistors
R1—One 5 megohm grid leak.
R2—One 1,000 ohm resistor.
Rh—One 0-50,000 ohm variable resistor.
P—One 25,000 ohm wirewound potentiometer.

Other Requirements
M—One milliammeter, 0-5 milliamperes or one more sensitive.
V—One voltmeter covering range of voltages to be measured.
One double throw single pole switch.
Five binding posts.
One grid clip if 55 is used.
One six pin socket.
One power supply, including one 2.5 volt winding.

THE DUPLEX diode triode or the Wunderlich double grid tube can be used advantageously in the construction of a vacuum tube voltmeter that will measure either alternating or direct voltages. The circuit arrangement of one such meter is shown in Fig. 1.

For steady voltages the meter is strictly static, or non-current drawing. For alternating voltages, however, a small current is drawn from the source, but this current is so small that it will not greatly affect the accuracy except in highly resonant circuits, in which the reading will be lower than the actual voltage.

Let us first describe the action of the steady voltage meter. The switch at the top of the tube is thrown to the right so that the grid is connected to ground. There will be a certain plate current, which will be indicated by the milliammeter in the plate circuit. This circuit is adjusted to some convenient value by means of the rheostat in the plate circuit. Any value will do, but one in which the needle points to a division on the scale is most convenient.

Connection of Unknown

Now throw the switch to the left. The unknown voltage is connected across the two extreme input terminals marked plus and minus, with the polarity as indicated. Now if the potentiometer P is set at zero, that is, with the slider on the ground side, the bias on the tube will be equal to the drop in R2 plus the unknown voltage. The current in the plate circuit will be less than it was when the switch was in the right position, for then the only bias on the grid was the drop in R2. Now as the slider on the potentiometer P is moved away from ground, that is, toward the positive end, the current in the plate circuit will increase because the bias is decreased. At some setting the current in the meter M will be exactly the same as it was when the switch was in the right position. At that adjustment the effective bias on the tube is only the drop in R2. The unknown voltage has been neutralized by the drop in the ground-to-slider portion of the potentiometer P. Hence the unknown voltage is equal to the voltage drop in this portion of the potentiometer. But there is a voltmeter V across this portion of the potentiometer and it indicates the voltage. The reading on V, therefore, is the unknown voltage.

The reason for using R2 is to insure that no current flows in the grid circuit of the tube at the point of adjustment. Since no current flows no current is taken from the source and the meter is a true potential meter. That is, it is a meter with an infinite resistance. The instrument can be used to measure correctly any voltage where a current-drawing instrument would give no reading at all or a reading only a small fraction of the actual potential.

Correction of Adjustment

It may be that the effective voltage on the plate will change during the adjustment, especially since the current drawn from the plate voltage source varies during the adjustment. To check any possible change in the plate voltage on the tube, the switch should be returned to the right position as soon as the first adjustment has been affected and the rheostat should be reset until the meter M reads the original value selected as a reference. Then P should be readjusted as before. The second adjustment should be correct for any change in the plate voltage occurring during this small readjustment is negligible.

Meter requirements are not stringent. The milliammeter M may be any current indicator coming within the plate current limitations of the tube. The plate current of the 55 is 8 milliamperes when the bias is zero and the plate voltage is 250 volts. For lower voltage and higher bias the current will be less. However, a meter having a maximum reading of 5 milliamperes should be all right. A meter covering the 0-1 milliampere range would be slightly better.

Limit of Instrument

The voltmeter V may be any voltmeter covering the voltage range to be measured. A 1,000-ohms-per-volt meter would be fine, but just as good results can be obtained with an inexpensive meter. About the only requirement is that the scale be legible. A meter having several scales would be advantageous if the instrument is to be used for measuring voltages of a very considerable range of values.

The voltage limit of the instrument is determined by the voltage across P, which is the same as the applied voltage on the tube. Of course, we are at liberty to use a higher voltage across P than on the plate of the vacuum tube. In fact, it might be well to use a low voltage on the plate, for its value is not important, and then use a higher voltage across P. But if the voltage across P is very high it will be difficult to make fine adjustments because a slight change in the setting will change the voltage a great deal. For this reason it would be well to have the voltage across P adjustable in steps, using a low voltage across it when low voltages are to be measured and a high voltage when high voltages are to be measured. The voltage across P should only be a little in excess of the voltage to be measured for best results.

It is possible to extend the range of the instrument by connecting a battery of known voltage in series with the unknown, and in the same direction as the drop in P. For example, if the drop in P is only 45 volts and we want to measure a voltage of 135 volts, we can connect a 90 volt battery in series with the unknown and measure the difference between the unknown and the 90 volts. Then to get the unknown voltage we just add 90 volts to the reading on V. If we have any doubt about the voltage we add, we can measure it first. It will be found that the voltage of even an old B battery will be about the same as it was when the battery was new. Hence we cannot measure the voltage of the battery with an ordinary voltmeter and assume that that is the correct voltage. It must be measured with a non-current drawing meter, like the one under discussion.

Measuring Alternating Voltages

When alternating voltages are to be measured we first rectify the alternating voltage and then measure the rectified and filtered voltage with the static meter just described. The unknown a-c voltage is impressed across the two terminals marked AC. The alternating current reaches the anode and cathode of the diode through condensers C1, C2 and C3. These condensers should all be large, and the lower

IVE METERS AND D-C TUBE VOLTMETER

Anderson

the frequency of the voltage to be measured the larger they should be. There is no upper limit to the capacity of any one of these condensers but there is a lower limit. We shall assume that the instrument is to be used for measuring radio and intermediate frequency voltages only and give the condensers that are suitable.

The a-c current that flows will be rectified and the rectified current will set up a d-c drop across the load resistance R1. The anode end of the load resistance will be negative with respect to cathode. Hence the left point on the switch is connected to the anode. The voltage drop due to this rectified current is measured with the static voltmeter in exactly the same way as steady voltages were measured.

There may be a zero error that must be taken into account in this case, for there may be a voltage drop across R1 even when no a-c voltage is impressed on the terminals. This should be measured with the a-c terminals short circuited. Then the unknown voltage should be impressed and a new reading taken. The difference between this reading and the zero error is the value of the unknown voltage.

Current Error

Since this a-c meter takes current it will cause a drop in the voltage in some cases, especially when it is connected to a highly resonant circuit. However, the power taken from the source can be made very small by using a high load resistance. Suppose, for example, that we make R1 a megohm. Then the resistance across the tuned circuit when the meter is connected is not more than 1 megohm. If the tuning coil is 245 microhenries and the Q of the circuit at 1,000 kc is 100, the voltage if 100 at first, becomes 86.6 with the one megohm across it. The voltage across the tuning condenser is proportional to the Q of the circuit and therefore the voltage is reduced by 13.4 per cent. If we make the resistance still higher the reduction will be less. And we can increase the resistance much more if we wish, because the value of the load resistance has nothing to do with the accuracy with which the d-c voltage across it is measured with the static meter. If we make it 5 megohms the reduction is only 3 per cent under the same conditions as before.

The voltage across R1 is not the root mean square voltage of the a-c. If R1 is infinite the voltage is equal to the peak value of the signal voltage. Of course, this cannot be reached. But with a high value of resistance it is possible that the indicated voltage is considerably higher than the root mean square value. This fact, however, is no excuse for using a low value of resistance to compensate for the loss in a tuned circuit. In the first place the resistance should be made so high that the power taken from the source is negligible. Then the meter should be calibrated so that the relation between the root mean square voltage across the AC terminals to the reading on the voltmeter V is known.

Dependence on Frequency

The calibration will depend on the frequency because of the use of condensers in the circuit, but the relation is not simple. As the signal must pass through condensers, the indicated value of voltage will be higher the higher the frequency. But due to shunt capacities there will be a reduction in the reading for the higher frequencies. Hence there will be a range where the sensitivity is greatest. If the series condensers are large enough and the meter is to be used for radio and intermediate frequencies only, there will be practically no change in the sensitivity over the range of frequencies that will be measured.

It is suggested that C1, C2 and C3 be mica dielectric condensers and that they be made not smaller than 0.05. Mica dielectric is suggested because loss in the condensers will increase the power drain on the voltage source, and mica condensers have the lowest loss of all condensers practical in this case.

When a-c is measured there will be an a-c component on the grid, and this will be amplified by the tube. Hence C4 is connected across the plate circuit.

Calibration of the a-c portion of the meter should be done with an a-c voltmeter operating at high frequency. If this meter draws current it does not matter. There is no commercial meter that is accurate at high frequencies, but one can be improvised using a thermocouple milliammeter and a resistance of known value. The resistance would be connected across the AC terminals and the thermocouple meter should be in series with it. An oscillator and a coil might be used as the source. The calibration arrangement is shown in Fig. 2. M is the thermocouple meter which measures the alternating current through the known resistance R and Rh is a rheostat for varying this current. The impressed voltage is the product of the ohmage of R and the current in amperes indicated by M.

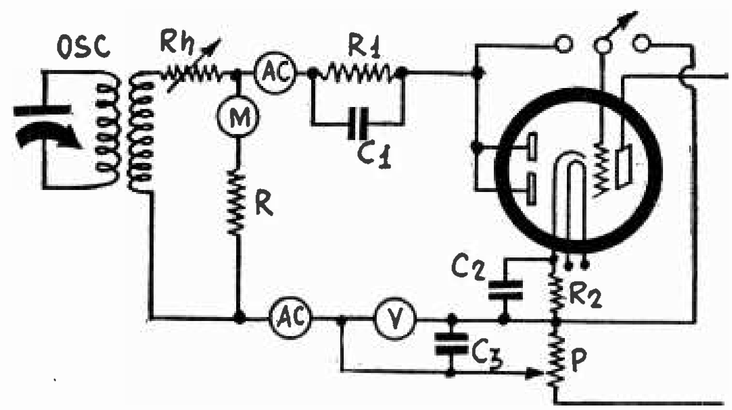


FIG. 2
This shows how the a-c voltmeter in Fig. 1 can be calibrated with the aid of an oscillator, a thermocouple milliammeter, and a known resistance.

Use of Dual Grid Tube

While the circuit diagram in Fig. 1 shows a 55 type duplex diode triode, a Wunderlich dual grid tube can be used just as well. In this case one of the grids is used for the static voltmeter and the other grid for the rectifier. The operation of both tubes is exactly the same in this circuit, the only difference being the connections to the grids and the diode plates.

Tube List Prices

Type	List Price	Type	List Price	Type	List Price
11	$3.00	'31	1.60	56	1.25
12	3.00	'32	2.30	57	1.60
112-A	1.50	'33	2.75	58	1.60
220	3.00	'34	2.75	'80	1.00
'71-A	.90	'35	1.60	'81	5.00
UV-'99	2.75	'36	2.75	82	1.25
UX-'99	2.50	'37	1.75	'74	4.75
'200-A	4.00	'38	2.75	'76	6.50
'01-A	.75	'39	2.75	'86	6.50
'10	7.00	'40	3.00	'41	10.00
'22	3.00	'45	1.10	'68	7.50
'24-A	1.60	46	1.50	'64	2.00
'26	.80	47	1.55	'52	28.00
'27	1.00	'50	6.00	'65	15.00
'30	1.60			'66	7.50

Paul S. Says This of Alice R.

Paul Sweinhart, show world authority, critic, journalist and all-round fine fellow, had this to say in a recent issue of Zit's, the theatrical newspaper.

ALICE REMSEN
SONGS
WABC
COMMERCIAL

Alice Remsen is one of the unforgettable voices of radio. Once you hear her, there is a warmth, a fervor, a fibre to her voice that lingers on with the listener long after her radio time has ended. Which probably accounts for the fact that she is the star of the "Evening In Paris" hour over this station. When we tuned in on her for these remarks, somebody in the next room stopped punching a typewriter long enough to say:

"That's Alice Remsen, ain't it?"

Which is not so grammatical, but highly complimentary, for it proves that Miss Remsen has that something, that kick, that "It" in her voice, which carries conviction and cements the tie between sponsor and the public which is the beginning and end of all radio broadcasting. Few there are who have it, fewer still who get it over. Miss Remsen has both. Once you hear her, she moves into your pleasant memories, the comfort and solace of hours to come. When caught for these remarks, Miss Remsen did two songs, "With Summer Coming On" and "In My Hideaway."

The 57 a Sensitive Detector

Keenest Response at 3.3 Volts Negative Bias

By Paul Erwin

THE 57, which replaces the '24, is a whiz-bang of a detector tube, for negative bias detection. It is of the sharp cutoff type, that is, the plate current cuts off over a small bias voltage range, which is another way of expressing its excellent detecting efficiency.

The recommended negative bias for the tube is 6 volts, at 250 plate volts applied through a coupling resistor of 0.25 meg, screen voltage 100 volts, "plate current to be adjusted to 0.1 ma with no signal input." Suppressor grid is tied to cathode.

Of course, the recommendation for the adjustment of plate current to 0.1 ma is not necessarily consistent with the requirement for 6 volts negative bias, since the applied plate voltage is specified at 250 volts. A little beyond 7 volts the plate current cuts off, so the specification of 6 volts for negative bias is probably on that basis, allowing a plate current swing of 0.1 ma.

Experimental Values

Different values of biasing resistors were tried. The plate current value is specified at 0.1 ma, therefore the current through the cathode series biasing resistor (which is the sum of the plate and screen currents) would have to be 0.13 ma. With 10,000 ohms biasing resistor this sum current was 0.33 ma, bias 3.3 volts. With various values of biasing resistors it was not quite practical in this manner to obtain just 6 volts, but the closest to it was 5.5 volts with 50,000 ohms, the current being 0.11 ma, which is close enough.

However, other values of biasing voltage were tried, with a sensitive milliammeter in the cathode circuit. Thus, as stations were tuned in the needle would move upward. When the bias was 3.3 volts negative the needle change was relatively greater, indeed the needle swung to almost the extremes of the scale. This denoted greater detecting efficiency.

However, one important consideration is to make the bias as high as possible, consistent with detecting results of a good order, while not reaching plate current cutoff. Then the detector will stand a stronger a-c input (signal) than if the bias were lower. With 10,000 ohms as biasing resistor, at 0.33 ma, the sensitivity was greatest, but of course other considerations might make the higher bias (6 volts) advisable. It is well to remember, however, the difference that improves sensitivity.

Application to Circuit

Take as an example a tuned radio frequency set of modest proportions. Primaries may be cut down so that the signal voltage on the detector will be less, but the selectivity will be greater. The lowered input to detector would make practical the use of the lower bias for the 57, with greater sensitivity, somewhat atoning for the reduction in primary turns. Then there would be two stages of audio, a first stage as essential driver, and a husky output tube, such as the '45.

As the voltages stated 5,000 ohms will give detection, but 10,000 ohms will give somewhat better sensitvity, while values beyond 10,000 ohms will give less sensitivity, albeit at better quality where the input to detector is of a high order.

It should be borne in mind that avoidance of detector overload is a serious consideration and that even 6 volts negative bias does not allow much to a sensitive receiver, even if only of the two-stage t-r-f and detector type, for less than 4.5 volts of a-c (signal) may be put in safely.

Causes of Overload

Overload is caused by two things: (1), plate current retarded to or near cutoff, resulting in a choking or blasting sound; and (2), a-c input exceeding that permitted by the bias, the plate current well supported meanwhile.

The smaller change in bias with larger input to detector, resulting when the bias is 6 volts negative, therefore is advantageous in safeguarding against overload in respect to the signal amplitude only, while the other, with larger steady plate current, better safeguards against overloading due to proximity to or actual condition of plate current cutoff.

Across the biasing resistor a large condenser should be placed, 4 mfd. or more, and this applies also to the screen resistor, otherwise detecting efficiency suffers, and hum may run high because of the ripple voltage drop in an inadequately bypassed resistor.

It is by no means the preferable method to put a resistor in series with the cathode return to produce the bias, as the current is so small that the resistor has to be of high value. Take the case of the recommended 0.1 ma plate current, sum of plate and screen currents then 1.3 ma. The biasing resistor would have to be, for 6 volts bias, a trifle more than 46,000 ohms.

Screen Voltage

If 58 tubes are used elsewhere in the set, as in the radio frequency amplifier, it is possible to keep the resistance low by tying the amplifier cathodes and detector cathode together and returning to ground through a much smaller resistor. Thus for each r-f tube, with total of 10 ma drain, for 3.5 volts negative bias, which is fine for the 58 amplifiers, the resistance would be 350 ohms, for two tubes 175 ohms, for three 117 ohms (125 ohms commercially). The detector current may be neglected as too small to affect the resultant bias more than trivially. Now with such low values of resistance, and r-f and detector tubes biased by a single resistor, the bypass condenser need be only of radio frequency proportions.

The question arising regarding the 57 is what about the screen voltage? The characteristics chart contains the recommendation of 100 volts, as stated. But for the '24 the screen voltage recommended is from 20 to 45 volts. The necessity of this is apparent from the limitation on plate current swing, but the 57 has not that limitation, because the suppressor grid removes it. The screen voltage has to be high on the 57, as low values tend to remove the effect of the screen and turn it into a grid, whereupon the hum across the series resistor that dropped a high voltage to the screen voltage was much more pronounced.

Screen Resistor

In regard to the voltage supply to the screen, just as it was preferable to use a low value of resistor in the cathode circuit, so it is advisable to use a low value in the screen circuit, as by a high bleeder voltage divider, approximately midtapped, from 250 volts to ground. The drop in the part between B plus and joint will be a little more than that between joint and ground, so the resultant voltage on the screen will be around 100 volts, and due to the high current this voltage can be measured by ordinary meters.

Radio University

Ultra Frequency Set

I WOULD LIKE to try my hand at some real high frequencies but before doing so would like a little advice. I have some intermediate transformers suitable for around 400 kc. Would this be a good intermediate frequency for tuning in around 5 meters or even 3 meters? What type oscillator shall I use?—K. M., Springfield, Mass.

For tuning in ultra frequencies it would be better to use a higher intermediate frequency, say, 1550 kc. This you can do by using regular broadcast radio frequency transformers, with a small trimming condenser across secondaries, or, if you want broader tuning and greater gain, use the commercial 1600 kc. transformers, both primary and secondary tuned. These afford a band-pass effect, and that means in reality less selectivity. However, you will have plenty, because the intermediate channel, if too selective, will make it too difficult to find the desired stations, and even to hold them, as many transmissions are subject to frequency drift in this region. The oscillator may be a Hartley, with leak and condenser, with or without negative bias. Shiepe's oscillator, a modification of this, and first presented in these columns, is excellent, because of its nonreactive plate circuit and its frequency-stabilized grid circuit. See page 8 for a diagram that reveals again Shiepe's oscillator.

Old Set Too Weak

SOME YEARS AGO I bought a Federal t-r-f set in a small table cabinet and an extra speaker. While I lived in Detroit the reception was satisfactory. I have moved to Pennsylvania and I can not get the New York stations loud enough. Will you please advise me what changes will be necessary to improve the sensitivity and the selectivity?—S. A. E., Ardmore, Pa.

There isn't much that can be done about a set like that. It is about five years old and while it was a satisfactory receiver in its day it will not do at present, and the best advice no doubt is that you build yourself or buy a truly modern receiver, as the results are far better, and your requirements will be amply fulfilled. It would cost you almost as much to get the set fixed up as to buy a new one, and the repair job would be doubtful. The new set would not be.

STATION SPARKS

By Alice Remsen

Songs of Childhood

FOR "THE SINGING LADY"

WJZ. Every week-day except Saturday, 5:30 p.m.

Through the years that come and go,
When our hair is touched with snow,
Blessed memory often strays
To the songs of childhood days.
Nursery jingles, childish rhymes,
Take us back to other times
When our hearts were free from care,
And life was just a playground fair
Centered round the latest toy.
Little things gave untold joy,
Little heartaches soon passed by,
Fed with doughnuts, cake or pie.

When a long-forgotten strain,
Touches memory's strings again,
Tears will moisten hardened eyes,
Narrow lips will stifle sighs;
And we wonder how and why
We have passed our childhood by.
Still we should be thankful for
Memory and its treasured lore,
Thankful for the things we know,
Thankful that the tears can flow
When our blessed memory strays
Back to songs of childhood days.

—A. R.

* * *

AND THE SINGING LADY will take you back to your childhood days, if you tune in and listen to her pleasant voice recounting stories and singing songs for the children of today. A very entertaining program for children of all ages. Sponsored by the Kellogg Company and emanating from the Chicago NBC studios.

* * *

News of the Studios

WABC

Barbara Gould, internationally known beauty specialist, who has recently returned from a ten-weeks' tour of the middle west, has inaugurated a new series of summer broadcasts over WABC and the Columbia network, Thursdays at 10:45 a.m., E.D.S.T. Throughout her western tour, Miss Gould continued her regular weekly beauty talks over Columbia, speaking from various stations on the network. The new series is devoted to summer beauty suggestions and advice on care of the complexion. Miss Gould has discovered four ages of beauty, each presenting an individual skin problem. The ages of beauty are divided into decades: the 'teens, twenties, thirties and forties, with each demanding a particular treatment. Miss Gould's broadcasts will cover all four periods. What a comfort, girls, to know that, in this day and age, even the forties may be beautiful!

* * *

Kathryn Parsons, known over WABC airwaves as "The Girl O' Yesterday," but who, in private life, is the wife of George Clark, city editor of the New York "Daily Mirror," was honored with a party at the Village Grove Nut Club recently. A big crowd turned out to fete the popular singer.

* * *

Ralph Wonders, head of the Columbia Broadcasting System's Artists' Bureau, will supply the talent for the Ambassador. This means plenty of Columbia artists will earn a few extra pennies this summer.

* * *

NBC

Lanny Ross and the Maxwell House Tune Blenders slip from NBC to Columbia and back again periodically. After a winter on WABC, Lanny and Don Voorhees' orchestra may now be heard three times weekly over an NBC-WEAF network. Mondays, Wednesdays and Fridays at 7:30 p.m., E.D.S.T., and again at 11:15 p.m. E.D.S.T., over an NBC-middle and far-western network.

* * *

Listened to Mae Singhi Breen's attempt to glorify the lowly ukulele, during a recent Paul Whiteman concert. Must give Mae credit for making her uke sound okay against a background of symphony-size orchestral accompaniment. She played a symphonic tone-poem, "Inspiration," written specially for the occasion by her husband, Peter de Rose, and by Charles Harold. It was the first time a ukulele had ever been utilized in a serious musical manner, and was done as part of the fight put up by Miss Breen to have the "uke" recognized as a full-fledged member of the musical instrument fraternity.

* * *

Sorry that the Sherlock Holmes broadcasts are ended, but hope they will return in the Fall. These dramatic mystery playlets, presented by the George Washington Coffee concern, have been very popular with both young and old listeners. The voices of Richard Gordon and Leigh Lovel, playing Sherlock Holmes and Doctor Watson, were two of the most delightful in radio, particularly the half-humorous, nonchalant drawl of Leigh Lovel.

* * *

WOR

And now it appears that WOR is utilizing the Moonbeam girls for other things than soothing listeners to sleep. The girls will be known as "Sweet and Low," and may be heard every evening, except Saturday and Sunday, at 8:30 p.m., E.D.S.T. They will also double on Footlight Echoes, the Sunday night musical comedy sustaining feature, at 10:30 p.m. Maria Cardinale has been let out, after over two years of building-up a following; so also, has Charlie Harrison, tenor, whose place will be taken by Jack Arthur, staff baritone. A successor for the soubrette has not yet been discovered. The Moonbeam girls will replace the male octette, besides doing solo work. Station economy is the motive for the drastic changes, as both the girls and Mr. Arthur are engaged on a weekly salary basis.

* * *

John Garrick, young English star of the stage and screen, currently appearing in "Face the Music," may be heard in his own program of songs and chatter, over WOR three times weekly: Sundays at 9:45 p.m., Wednesdays at 7:15 p.m., and Saturdays at 6:45 p.m., E.D.S.T. Mr. Garrick does his own announcing and is assisted on the series by an orchestra.

* * *

Sidelights

G. C. CAMPBELL, of the engineering staff of WOR, and MISS BETTY JOHNSON were married recently. Campbell is from East Orange and his bride from Bloomfield, so they compromised and started housekeeping in Roseville, N. J. . . . HUGO MARIANI, NBC musical director, is married to NELLA BARBU, Rumanian painter. . . . MAJOR EDWARD BOWES of the Capitol "family," is the husband of MARGARET ILLINGTON, former Frohman star . . . MRS. GERTRUDE BERG, creator of "The Goldbergs," who plays Mollie in the skits, is married to a New York City sugar broker . . . LEE SIMS and ILO MAY BAILEY, heard in "Piano Moods" from the NBC Chicago studios, are Mr. and Mrs. Sims to their friends . . . GRACE MOORE, NBC songbird, is the wife of VALENTIN PARERA, Spanish movie star . . . FRANK LUTHER, NBC tenor, is married to ZORA LAYMAN, his childhood sweetheart . . . SAM HERMAN, NBC xylophonist, quit taking piano lessons when a boy to practice on a drum. He liked it better because it made more noise than a piano . . . TED JEWETT, NBC announcer, was born in Yokohama, Japan, the son of an American silk merchant . . . ARTHUR ALLEN, NBC actor, was born in Gowanda, N. Y. . . . PHILLIPS H. LORD, of Seth Parker fame, was born in Vermont but reared in Maine . . . PARKER FENNELY, of the Stebbins Boys, was born on Mount Desert Island, off the coast of Maine . . . JACK SHILKRET was born in New York City, of a musical family . . . MORTON DOWNEY will make his first vacation stop in Ireland, the birthplace of his parents . . . SINGIN' SAM likes home cooking but can't stand carrots or turnips. . . . EDWARD REESE, of the Eno Crime Club, was born in Baltimore of English parents . . . JAMES MELTON, tenor of the Revelers quartet, was born in Ocala, Fla. He once handled a saw in a Southern saw mill for seventy-five cents a day . . . FRANK PARKER, A. & P. Gypsies tenor, learned to sing when he was fifteen months old; his 28th uncle, who was a hand-organ impresario, tossed his tambourine to Frank in his crib and he learned his true tones from the jingles—I think that one's good enough for the "Tall Story Club" . . . JANE PICKENS and RAY GOLD wrote the theme song, "Just You and I," used by the Pickens Sisters on all their NBC programs.

* * *

Biographical Brevities

ABOUT CESARE SODERO

Cesare Sodero was born in Naples, Italy, on August 2, 1886. His mother was a concert pianist, his father a harpist, widely acclaimed in Italy. Sodero conducted his first orchestra when only fourteen, upon his graduation from the Naples Conservatory of Music. He then went to England to become conductor of the Aborn English Opera Company. Then America called, and Sodero, cello under his arm, found himself, a young man of 21, in New York. That was in 1907. Two days after his arrival he joined a musical organization at Pittsburgh.

When phonographs became as ordinary in the average home as the radio is today, Sodero became conductor of a symphony orchestra for the Edison Phonograph Company. Through these recordings his work became known all over the world.

With the popularity of radio Sodero entered the new field of entertainment, joining the artists staff of the National Broadcasting Company in New York.

He was asked to make two guest appearances as conductor of the Philadelphia Opera Company during the 1931-32 season, and then was invited to become staff director for the 1932-33 season.

Sodero's popularity so increased with the radio audience that the NBC arranged for a series of concerts during the summer season of 1932.

He makes it his business to love everything he conducts, be it Bach, Beethoven or jazz; for he says that much jazz is good music, portraying the present age, and believes that there is room for good popular music, properly arranged, on a program of heavy classical music.

Sodero is also a composer of note, writing his first compositions as a youth in Naples, although the better part of his work has been done in his new home—America.

* * *

If you would care to know something of your favorite radio artists, drop a line to the conductor of this page. Address: Miss Alice Remsen, care* Radio World, *145 W. 45th St., New York City.

A THOUGHT FOR THE WEEK

THE public would never know what poor specimens of orators many of our politicians are if it were not for the microphone. Dear old Mike certainly has a way about it that defeats the best-laid plans of man.

RADIO WORLD

The First and Only National Radio Weekly

Eleventh Year

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

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

Radio and Conventions

TWO outstanding radio facts of the Democratic National Convention were that the nation listened to the proceedings, as broadcast, and that two of the listeners thus became first apprised of their actual choice.

Some of the suspicion the average man attaches to politics may be allayed by the broadcasting of such proceedings, as he becomes almost a personal participant in the difficulties that arise. Certainly the proceedings are important to him, for though he may be of another political faith he can not fail to recognize that the same party does not always elect its Presidential and Vice-Presidential candidates every four years. To that extent Democrats as citizens are interested in the Republican conventions and Republicans as citizens interested in the Democratic conventions, although as voters their fervor attaches perhaps to one or the other, or to the convention of some smaller party.

Interest did not run quite so high in the Republican convention because there never was any doubt as to who would head the ticket, and the momentary dilemma regarding the nomination for second position was quickly allayed. But the Democratic convention was a real treat to the ear and the brain, for it was alive with all the uncertainty that makes for listener interest in such events, until the final avowal of California and Texas for Roosevelt, that ended the suspense.

Then Roosevelt flew from Albany, N. Y., to Chicago, and on the plane wrote part of his acceptance speech. Arriving at the Stadium in Chicago, he was notified officially of his nomination, and delivered the acceptance speech, the radio listeners being able to hear him even better than some of the delegates at the convention, and not because of any ear trouble suffered by delegates, either.

More so than ever before this will be a radio campaign, with speeches by the candidates on both sides. Roosevelt has announced that he will use coast-to-coast chains for eight speeches, making each speech on a given subject, or including two or more closely correlated subjects in each speech, so as not to ask his listeners to weigh too much at one time. President Hoover likewise will face the microphone repeatedly, and the nation has before it an interesting and important series of political campaign broadcasts, with two leaders of thought constituting the biggest attraction that will rule the air until the end of October.

As radio's importance grows, campaigns come into the home more and more, and there is no reason at all why the radio business should not therefore increase.

Nervous Hearing in

THE radio industry has its money invested considerably in the nervous systems of its customers. The occasional listener, who awaits some big event or at least some feature that is particularly to his liking, is not of much help as a consumer. But the person who listens habitually, who is well-informed about radio artists and programs, knows just when they are on the air, and tunes them in faithfully, is the one who wins the admiration of the industry.

When one listens chronically, the radio is going nearly all the time, and that has an attraction to the trade. The listener becomes more exacting. He buys tubes more frequently, replaces his set more frequently, talks radio more frequently, and thus also is an emissary. What it degenerates into finally is that the so-called chronic listener really becomes to a large extent a radio hearer. The strict term listener may not apply. The male addict will have the set going while he's reading, shaving or, indeed, by accident, even sleeping, while the woman deems it not inconsistent to bring in a favorite team of comedians at the dinner hour, when she's occupied with the table and later really couldn't tell what had been said or sung.

The nervous habit of hearing the radio has its trade advantages, and also perhaps it unconsciously trains our minds to be able to do several things at once, with comprehension as to each. Some day the growing youth of the world may develop the faculty of being able to listen to a 10-minute speech while reading a book and writing a letter at the same time, evidencing the letter for its own sake, and giving verbatim the extract from the book as well as the entire speech heard over the air.

Just now radio dealers and manufacturers are wishing there'd be some more nervousness, or anything else, that would increase sales and profits.

Chicago Amateurs Form "Playing" Golf Club

Chicago radio amateurs, led by Mrs. Lee W. Mida, Butterfield golfer, have taken steps to organize a playing golf club.

Holding their first meeting as guests of Mr. and Mrs. Mida at Cherry Hill, the owners and operators of several Chicago amateur stations induced the woman champion to accept the chairmanship of the organization committee. She explained some of the fundamentals of the game to them.

Charter member of the club, all active amateurs and members of the American Radio Relay League, include Mrs. Mida, who operates her own station W9LW; Mark Hanna, W9LL; Ed. Reid, W9SJ; Harlan Oehler, W9GAI; Paul Lovegren, W9AFN, and Francis Welcher. W9FT.

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.*

Wm. A. Morton, 310 N. 14th St., Allentown, Penna.
Charles Seufer, R.F.D. No. 1, Burton, Ohio.
Theodore Harhat, 1313 W. Chicago Ave., Chicago, Ill.
Merrill H. Tilghman, 3rd, 406 Audubon Ave., Wayne, Penna.
Albert G. DeWitt, 727 So. 24th St., Louisville, Ky.
Darrell W. Miller, R. No. 3, Gaston, Ind.
Geo. M. Biel, P. O. Box 38, Mesilla, New Mex.
Elbert Lucky, 1325 N. 31st St., Birmingham, Ala.
H. K. Miller, 51-24—58th Place, Woodside, L. I.
M. G. Humphrey, 2420 S. 4th St., Springfield, Ill.
The Martin Machine Co., C. R. Martin, Mgr., Second St., Henry, Ill.
Joe Zetko, Croweburg, Kans.
Benj. L. Thomas, General Delivery, Shamokin, Penna.

Million Well Spent On Convention

Listeners to the Democratic National Convention heard favorite son after favorite son placed in nomination. The New York delegation was split between Roosevelt and Smith. It seems that the unfavorite sons get the nominations these days.

* * *

Rule, rote and formula mark convention speeches, and every listener now must know just what to say. The stock phrases are as handy to the Democrats as to the Republicans, although all they're after are a couple of names.

* * *

The difference between being a delegate and being a radio listener is that a listener can go to bed during a night session of the convention.

* * *

Nobody begrudges the delegates the small handouts they get in the way of nominations for local office and appointments to places, after all they have to suffer aurally from the hands of the political leaders at the conventions.

* * *

Conventions are places where men and women say nice things about other men and women, and so are fully justified.

* * *

Remember that the two big chains, in depleting the air of sponsors, and in actual expenditure of money out of hand, defrayed some million dollars of expense in connection with the Democratic convention alone. To us, the privilege of hearing it all was well worth a million—of their money.

* * *

Anybody who's microphone-shy had better give up hopes of ever being President and try to be a King somewhere.

NEW INCORPORATIONS

Teco Manufacturing Corp., New York City, electrical appliances—Attys., Teleradio Engineering Corp., 484 Broome St., New York City.

City Service Light and Fixture Co., New York City, electrical appliances—Atty., M. Kaplan, 32 Court St., Brooklyn, N. Y.

Somerset Appliance Co., Somerville, N. J., electrical supplies, oil burners—Atty., George W. Allgair, Somerville, N. J.

Keystone Electrical Corp., New York City—Attys., Exco Lawyers Albany Service, 116 Nassau St., New York City.

Leo Neiman, New York City, electrical business—Attys., Karelsen & Karelsen, 230 Park Ave., New York City.

Freeman Electric and Hardware Co., Buffalo, N. Y.—Atty., M. Weinstein, Buffalo, N. Y.

Grossman-Keeley Electric, Inc., Wilmington, Del.—Filed by the company.

CAPITAL INCREASES

Marquette Radio, New York City, 150 to 200 shares, of which 100 are preferred, $100 each; 100 common, no par.

ASSIGNMENTS

Benlew Electric Co., Inc., electrical appliances, 1,284 - 6th Ave., New York City, to Fannie Kolker, 3,235 Grand Concourse, Bronx, New York City.

Samuel Chertoss, trading as Pioneer Radio and Supply Co., radio sets and supplies, 394 Stone Ave., Brooklyn, N. Y., to Abraham Memberg, 110 W. 40th St., New York City.

BANKRUPTCY PROCEEDINGS

Petition Filed—Against

General Television Mfg. Corp., 57 Van Dam St., New York City, by Hyman Gaslow on a claim for $500.

SCHEDULE FILES

Apco Electric Corp., 1,164-6th Ave., New York,—Liabilities $12,634, assets $8,470, main item being accounts, $6,948.

Redifone Corp. of America, radios, 72 Cortlandt St., New York City; liabilities, $34,871; assets, $4,228.

NEW TUBE, 89, FOR AUTO SETS, IS ON THE WAY

While five new tubes have been announced and two more have definitely been put in line for early announcement (the 55 duplex-diode triode and the 83 constant-voltage-drop mercury vapor rectifier), there is still another tube on which the finishing touches are being put, and that is a tri-purpose power tube of the automotive series, the 89.

While nothing official is being stated regarding the 89, and the estimates now available are in general subject to change, it has been decided at least that the tube will be of the 6.3-volt heater type. It is expected to have six prongs and a grid cap and to be housed in an envelope like the 57 and 58, that is, dome-shaped.

Tri-Purpose Tube

The three purposes to which the tube may be put are expected to be:

(1)—Class A power amplifier triode. moderate plate voltage (180 or less), 20 volts negative bias, mu 4.7 and power output of 0.3 watt.

(2)—Class A power amplifier pentode, moderate plate voltage, 18 volts negative bias, mu 135, power output 1.5 watts.

(3)—Class B power amplifier triode, moderate plate voltage, power output (two tubes) 3.5 watts.

Highest Mu Factor

The amplification factor or mu of the pentode thus will be the highest, as the '38 has a mu of 100, the present leader. The three different results are obtained depending on how the elements are connected, a situation that became familiar when the 46 tube was announced, with its extra grid that was to be tied to plate for Class A amplification or to control grid for Class B amplification.

There had been some preliminary hints that such a tube as the 89 was in the making, based on the fact that some smaller tube manufacturers had special output tubes for automobile sets that were gaining favor with set manufacturers. However, the new tube is expected to be superior to the special ones now used, just as it is quite different in the almost universality of its application.

55 To Be in Dome Bulb

The 89 will draw around 20 milliamperes, it is expected, and this is not very serious for a power tube even for automobile use. The tube is not likely to be recommended for a-c use, as heater type output tubes in this class do not exist as standards, and manufacturers discourage the use of the automotive tubes in a-c sets because there are a-c tubes better adapted to such needs.

In its dome-shaped envelope the 89 will share appearance with the 57, 58 and even the 55, which is expected to be made universally in the dome-type glass container.

SOLAR APPOINTS AGENTS

Solar Manufacturing Corp., 599-601 Broadway, N. Y. City, announces the following new appointments to handle their line of electrolytic and mica condensers: W. F. Seaman, 763 Tacoma Ave., Buffalo, N. Y.; Leslie M. DeVoe, 2121 N. Alabama St., Indianapolis, Ind.; F. C. Somers, 2004 Grand Ave., Kansas City, Mo.; Hill-Hedquist Co., Commercial Bldg., Minneapolis, Minn. Henry C. Lieberman, formerly with Aerovox, is selling Solar products in the New York metropolitan district and is doing well.

Tradiograms

By J. Murray Barron

Installing High-Grade Replacement Parts

Servicemen installing replacement parts owe it to themselves, if only as a business proposition, to be most careful in sticking to specifications and in every case using only manufacturers' parts as designed for the particular receiver. Simply to use any make and get away with it, so to speak, is not in reality getting away with it, for a practice of this kind will only lead to the same tactics in other respects and the final result will be a poor job, dissatisfied customers and eventually loss of business.

In the smaller communities even greater care is necessary, if only for one's own protection, for here the customers are limited and good-will is an even greater asset. There is very little economy in substitution, for the name itself implies inferiority and that necessarily condemns the practice.

Of course when the replacement part is no longer to be had in the market, and some other high-grade part really will do as well the exception is all right, but be sure of your ground. Servicemen who are employees very often overlook the fact that though they are working for another, the work and job is in their hands and to do a poor job is not only a blow to the employe but to the employer who has confidence in him. Many of the most successful servicemen who have started out as employees and have eventually gone into business for themselves owe the greater part of their success to the very beginning, almost the first job.

At times some of them say it was a fight to get the boss to use specified parts and those that fought for a principle in many cases are today in business for themselves. This came about by building up good-will as they went along and that's something very difficult for any competitor to break down.

Nataurally jobs will come along where a receiver has to be rewired and practically reconstructed, and new type tubes installed which will require various parts. In this case there is no option but to use any good make high grade part. Here is a case where one must be careful, for in rebuilding a receiver added performance will quite naturally be expected and to get quality, one must use quality.

A good point to remember is that folk do not mind paying a fair price for a good job, but nobody enjoys paying even little money for a poor one.

* * *

The Federal Telegraph Company has received from the Department of Commerce, Airways Division, an order for thirty wavemeters.

* * *

Leon L. Adelman, sales manager, has resigned from A. M. Flechtheim & Co., condenser manufacturers of 136 Liberty Street, New York City.

* * *

Treasury Department regulations, Official 46, relating to the new five per cent. federal excise tax on radio products, are obtainable at Washington and at the offices of local Internal Revenue Collectors.

* * *

A. M. Flechtheim & Co., 136 Liberty Street, has a new listing of bypass and filter condensers, Pamphlet 25, including a new tubular condenser rated at 1,000 volts d-c.

MUSIC CONSULTANTS NAMED

Leopold Stokowski, Dr. Walter Damrosch, S. L. "Roxy" Rothafel and Erno Rapee form a committee of prominent musicians and showmen assembled by the National Broadcasting Company to serve in an advisory capacity in the construction of the new NBC studios in the Radio City unit of Rockefeller Center, New York City.

158 STATIONS IN BROADCAST OF CONVENTION

The Democratic National Convention was given about 50 hours on the air by the National Broadcasting Company, with the Columbia Broadcasting System devoting almost as much time.

For NBC 86 stations carried the event, and for CBS 72, these 158 stations having been on the air without cessation for 11 hours, 50 minutes, including the all-night session. Countries in various parts of the world also heard the event, due to short-wave relay.

For the first time in history great parabolic microphones or "electric ears" measuring between five and six feet in diameter were used by the NBC to pick up the sounds of speeches and demonstrations in all parts of the hall. People seated before radio sets in their homes heard the proceedings more clearly than the delegates in the hall, due to the fact that the engineers were able to filter out extraneous noise.

Heard in Various Places

Throughout the long session of Thursday night and Friday morning the NBC stations were on the air for the long stretch. The calling of the roll for the first three ballots sounded during the quiet early morning hours in crowded cities, on lonely western prairies and in the most inaccessible mountain hamlets.

In isolated homes far from railroads and unequipped with telephones, men and women followed the voting as readily and as rapidly as did the delegates in the hall. It was truly a national convention.

Political broadcasting, of which the Democratic Convention is the outstanding achievement, was born in November 1920, when KDKA in Pittsburgh sent out the returns of the Harding-Cox election, which were picked up through the earphones of excited amateurs all over the country.

The development from that time was rapid. In 1924 stations WEAF and WJZ, although not then regularly associated, as the NBC had not been formed, combined their respective networks for the first time to broadcast the conventions. Eighteen stations were joined for the Republican meeting in Cleveland, and seventeen for the famous Democratic Convention in New York, when the network was on the air for 110 hours.

Puts Campaign in Home

By the next election year, 1928, the NBC had been organized, and its 41 stations carried the Republican Convention in Kansas City and the blistering Democratic meeting in Houston which nominated Al Smith.

Since that time the NBC networks have more than doubled, and facilities such as the parabolic microphones have been developed so that listeners may hear for themselves just what is occurring, instead of being forced to depend entirely upon announcers and commentators.

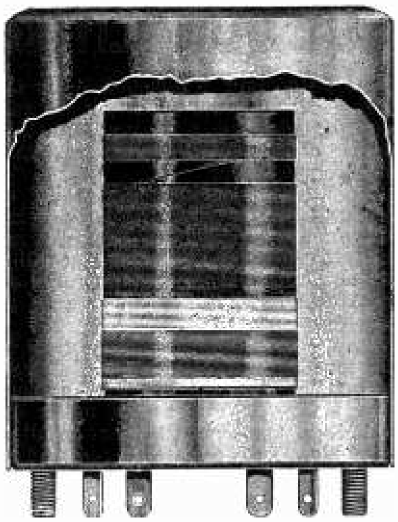
Through radio, the voters have an opportunity to become acquainted, through the medium of voice, with the personalities of the candidates. Broadcasting has put the campaign into the home.

SHORT WAVE CLUB

Charles Brand, 1063 Lafayette Ave., Brooklyn, N. Y.
Ace Case, 1181 4th Ave., New Kensington, Penna.
Harry Doyle, 39083, Box 47, Jefferson City, Mo.
Vernon Pickett, Pineville, Louisiana.
Harry G. Wood, 116 Grota Street, Houston, Texas
Frank F. Stroud, 317-6th Street, San Francisco, Calif.
Wm. E. McMahon (218Foi), 52 Bristol St., Canandaigua, N. Y.
George A. Riggs, 511 Iowa St., Burlington, Iowa.
Frank Cooper, 1733 K Ave., N.E., Cedar Rapids, Iowa.

Secondary Inductances Accurate to plus or minus 0.6 microhenry

Coils That Exceed Your Requirements for Precision



CAT. NO. 1—Three matched shielded t-r-f transformers, for 0.00035 mfd., with 80-meter tap. $1.35

CAT. NO. 2—Three matched shielded t-r-f transformers, for 0.00046 mfd. (Scovill condenser), with 80-meter tap......................$1.35

CAT. NO. 3—Three matched shielded t-r-f transformers, for 0.0005 mfd., with 80-meter tap. $1.35

Three-deck long switch for above coils, $2.50

Tuned Radio Frequency Coils

THESE coils are for two stages of screen grid radio frequency amplification, using any type screen grid tubes, including the newest ones, and any type of detector tube. There are three coils to a set. Each coil is wound on a 1-inch diameter tubing and anchored to an aluminum shield base, to which base the shield proper makes a tight fit.

The bases have punched openings through which four lugs protrude, and also are provided with rigid 6/32 machine screws for mounting. These screws protrude downward and are 1 11/16 inches apart. The coils may be mounted on chassis cut for the wafer type tube socket, or may be mounted by means of threaded bushings, elevated half an inch from a chassis top, requiring no cutout chassis.

The shield has a small protected opening at top so the lead for the grid cap may be brought through. The opening is bevelled. This constitutes the protection against fraying the insulation of leadout wire to grid cap. The shield cover is 2⅛ inches outside diameter and 2½ inches high.

Inside the shield base are stamped designations as follows: P, B, G and ground symbol. These stampings are near openings through which the corresponding lugs protrude downward. Besides, there is a side lug, protruding outward near the bottom of the form. P and B are always the primary connections, P going to plate an B to B plus, except in the case of the coil used for antenna coupler, when P goes to aerial and B to ground. G is always the connection for grid cap of the r-f tubes, also grid cap of the detector if it is a screen grid tube, otherwise to G post of socket of the detector tube.

The side lug is the grid return connection, usually grounded in circuits. The stamped ground symbol is not the ground connection but represents a tap on the secondary for tuning to 80 meters. The broadcast band is covered in full with the entire secondary—G and side lug—while from 200 to 80 meters are covered when the ground symbol tap is picked up by condenser stator.

To accomplish 80-550 meter coverage, therefore, a three-deck switch, two positions for each deck, is required, and must be of the insulated type. The moving arms connect to condenser stators. and pick up either the full secondary or the tap, which is about one-quarter of the secondary, in number of turns. The full secondary is always in the grid circuit, wired as previously stated, but the tuned circuit is made to consist either of the full secondary of one-quarter of the secondary, by switching the condenser stator to either point.

The 80-meter tap does not have to be used, but is advantageous to those desiring to tune in television, amateurs, police calls, some relay broadcasting and other interesting transmissions in a band of frequencies replete with novelties for the usual broadcast listener.

High impedance primaries are used, the number of turns chosen so that the same coils may be used for antenna coupler and interstage couplers.

All coils are guaranteed to cover the wave band when condensers of the specified capacity are used.

All coils are sold on a 5-day money-back guarantee. We pay the postage on all coil orders, on basis of remittance with order.

Precision Coils for Double Detection Circuits

Tuner-Mixer Coils

THE tuning coils for superheterodyne construction are for a stage of t-r-f, modulator and oscillator, with oscillator secondary inductance accurately chosen on the basis of specified capacity of padding condenser. These coils are for broadcast band coverage only.

The coils are of the same type of mechanical construction as the t-r-f coils. Since there is no secondary tap, the code for connecting the t-r-f coils of the superheterodyne combination is different: P and B, primary; G and ground symbol, secondary. P would go to plate or antenna, G to grid cap, while B and ground symbol are the returns.

The oscillator has a smaller inductance secondary, for padding, and moreover is a three-winding coil. The three windings are: pickup, secondary and tickler. Th. pickup winding consists of 10 turns, and is brought out to two side lugs. The polarity of its connections unusually is of no importance. The secondary is represented by G and ground symbol, G going to grid and ground symbol to grid return, usually ground. The tickler connections for oscillation require that the lug at B be connected *not to B plus but to plate*, hence the P lug goes to B plus. In any case. if no oscillation results, reverse the tickler connections.

Tuning Coils for 175 kc Receivers

CAT. NO. 4—Three shielded coils, two for modulator and r-f and one for oscillator, for 0.00035 mfd. three-gang condenser. Oscillator coil has pickup winding. Intermediate frequency intended, 175 kc. Price includes padding condenser, 700-1000 mfd. $1.80

CAT. NO. 5—Same as Cat. No. 4, except that this set is for 0.0005 mfd.........$1.80

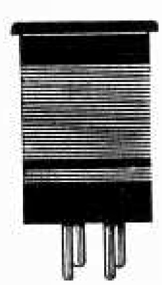
CAT. NO. 6—Same as Cat. No. 4, except that this set is for the 0.00046 mfd. Scovill condenser $1.80

Tuning Coils for 365-465 kc Receivers

CAT. NO. 7—Same as Cat. No. 4, except padding is for 365-465 kc and padding condenser is 350-450 mmfd...$1.80

CAT. NO. 8—Same as Cat. No. 6, except padding is for 365-465 kc and padding condenser included is 350-450 mmfd..................................$1.80

Short-Wave Plug-in Coils

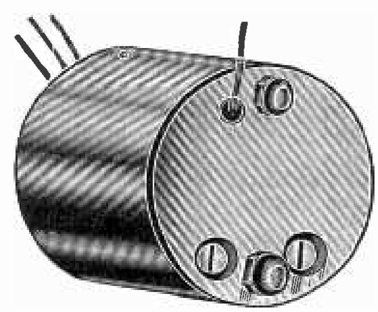


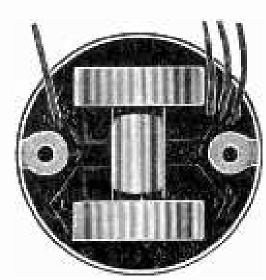
WOUND on 1.25 inch diameter finest bakelite forms, with flange for gripping, these short-wave plug-in coils afford high efficiency. Tube sockets serve as receptacles for these coils. The coverage with four coils is 13 to 200 meters with 0.00014 mfd. capacity. Also 0.00015 mfd. may be used without change. The coils may be used for any of the popular short-wave circuits.

CAT. SWA—Four plug-in coils, UX base, primary and secondary; primary may be used for feedback if condenser connects aerial to grid.........$1.35

CAT. SWB—Four plug-in coils, 6-pin base; primary, secondary, fixed tickler............$1.70

UX wafer sockets or 6-pin wafer sockets, 11c. *each*





The intermediate frequency transformers are in an aluminum shield and consist of two loosely-coupled low r-f resistance honeycomb coils, with compression type Hammarlund condensers that hold their setting.

Intermediate Transformers

THE intermediate transformers consist of two honeycomb coils, wound with low resistance wire, coils spaced 1 inch apart, and thus affording loose coupling, stability and high selectivity. The coil assembly is enclosed in an aluminum shield, with open bottom. The shields are 2⅛ inches diameter, 2 inches high. At bottom are two small rigid brackets, tapped for 6/32 machine screws. The taps are 1 11/16 inches apart. Four outleads, 6 inches long, are wired to the coils. Their colors are green, black, yellow and red.

The primary consists of the yellow and red leads, yellow to plate, red to B plus. The secondary consists of the green and black leads. Green emerges through a protected small opening in the top of the shield and goes to grid cap of a screen grid tube. Black is the return for the secondary, usually to ground. Both primary and secondary are tuned, and thus the coils are for screen grid tubes exclusively, except the second detector may be any type tube. The condensers for tuning the coils are Hammarlund's compression type, on an Isolantite base. The set-screws for adjusting these condensers with a screwdriver are accessible from the top of the shield.

CAT. FF-175—Shielded intermediate frequency transformer, 175 kc........$1.10

CAT. FF-450—Shielded intermediate frequency transformer, affording choice by condenser adjustment of frequencies from 365 to 450 kc....................$1.30

Padding Condensers @ 45c Each

CAT. PC-710—For 175 kc intermediate. Put in series with oscillator tuning condenser. Capacity 700-1000 mmfd. Hammarlund, Isolantite base.

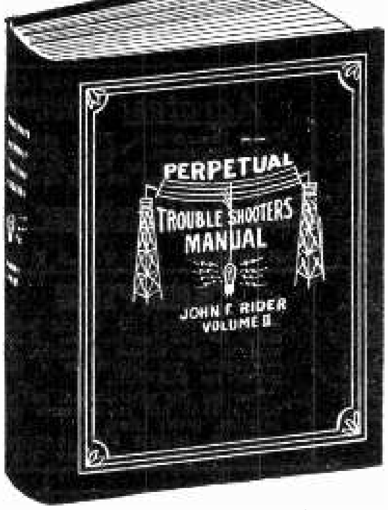
CAT. PC-3545—Same as above, except 350-450 mmfd. for 365-400 kc intermediate.

Prompt Service

SCREEN GRID COIL CO.
145 West 45th Street, N. Y. City

We Pay Postage

Volume No. 2 of Perpetual Trouble Shooter's Manual



Having assembled 2,000 diagrams of commercial receivers, power amplifiers, converters, etc., in 1,200 pages of Volume No. 1 of his Perpetual Trouble Shooter's Manual, John F. Rider, noted radio engineer, has prepared Volume No. 2 on an even more detailed scale, covering all the latest receivers. Volume No. 2 does not duplicate diagrams in Volume No. 1 but contains only new, additional diagrams, and a new all-inclusive information on the circuits covered.

All Electrical Values Given for First Time

This new detailed, comprehensive information gives the resistance values from point to point in all circuits in Volume No. 2—such complete information as is unobtainable elsewhere. All condenser values are given. Chassis diagrams (pictorial), schematic diagrams and photographic views of receiver "insides" are included. Parts are identified on photographs. Intermediate frequencies are stated. Socket and tube identities are revealed, color codes given, continuities of sealed units disclosed. The information is painstakingly complete. Rider made personal trips virtually all over the country to obtain the information, and it's now yours.

Everyone who makes his living as a radio service man, salesman, laboratory man or in any other technical capacity, as well as all students and teachers of radio, should possess Volume No. 2.

Volume II and Volume I are loose-leaf editions of 8½ x 11" page size, flexible fabrikoid binding.

Volume No. 2—Perpetual Trouble Shooter's Manual, by John F. Rider. Shipping weight 6 lbs. Order Cat. RM-VT @ $5.00
Volume No. 1 (8 lbs.). Order Cat. RM-VO @ $4.50

We pay postage in United States on receipt of purchase price with order. Canadian remittances must be in funds payable in New York.

We will send a copy of Volume No. 2 as it has just recently come off the press —on a 10-day money-back guarantee, on receipt of remittance. Volume No. 1 can be shipped at once. Same guarantee, same postage defrayal.

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145 WEST 45th ST., NEW YORK, N. Y.

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THE FIVE NEW TUBES, 46, 56, 57, 58 and 82, characteristics, installation data, uses, fully described and illustrated in the April 30th issue (7 pages) and in the May 7th issue. Send 30c for these two copies. Radio World 145 West 45th Street, New York, N. Y.

THE FORD MODEL—"A" Car and Model "AA" Truck—Construction, Operation and Repair—Revised New Edition. Ford Car authority. Victor W. Page. 708 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

"MATHEMATICS FOR SELF STUDY," by J. E. Thompson, B.S. in E.E., A.M. A complete course in four inexpensive books: Arithmetic, Algebra, Trigonometry, Calculus, for the Practical Man. 1240 pages, cloth, illustrated, $7.65. Radio World, 145 W. 45th St., New York City.

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

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Your Choice of NINE Meters!

To do your radio work properly you need meters. Here is your opportunity to get them at no extra cost. See the list of nine meters below. Heretofore we have offered the choice of any one of these meters free with an 8-weeks' subscription for RADIO WORLD, at $1, the regular price for such subscription. Now we extend this offer. For the first time you are permitted to obtain any one or more or all of these meters free, by sending in $1 for 8-weeks' subscription, entitling you to one meter; $2 for 16 weeks, entitling you to two meters; $3 for 26 weeks, entitling you to 3 meters; $6 for 52 weeks, entitling you to six meters. Return coupon with remittance, and check off desired meters in squares below.

RADIO WORLD, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)

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☐ 0-25 Milliamperes D.C. ....No. 325
☐ 0-50 Milliamperes D.C. ....No. 350
☐ 0-100 Milliamperes D.C. ....No. 390
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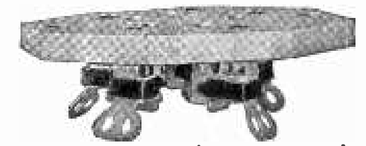
SUPERIORITY ON SHORT WAVES

ISOLANTITE COIL FORMS

The watchword of short waves is "Results." The best results are obtained with plug-in coils. The best plug-in coil results are obtained with non-hygroscopic, low-loss coil forms. Hammarlund's Isolantite coil forms, 1½" diameter, permit of an excellent "shape factor"—a better coil than with smaller diameters. These coil forms are obtainable with UX, UY or 6-pin bases. Removable knob included.

Cat. HCF-4—(UX, four-pin base). Net price......59c
Cat. HCF-5—(UY, five-pin base). Net price......59c
Cat. HCF-6—(six-pin base). Net price...59c

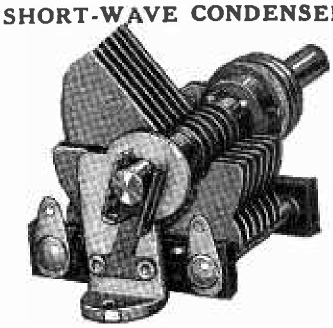
ISOLANTITE SOCKETS



Having a superb coil form, one must have an equally efficient socket for coil form receptacle to produce uniformly superior results. Hammarlund's Isolantite socket may be mounted below or above chassis. Elevating bushings are provided.

Cat. HS-4—(UX, four-prong socket. Net price......44c
Cat. HS-5—(UY, five-prong socket). Net price......44c
Cat. HS-6—(six-prong socket). Net price.44c

SHORT-WAVE CONDENSERS



Junior midline condensers, single panel hole mount, with Isolantite insulation. Entire condenser encompassed by 2-inch diameter. Front and rear brackets threaded for 6/32 machine screws for optional mounting to chassis. Shaft ¼ inch.

Cat. H-14, capacity 0.00014 mfd., single, net price $1.20
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Cat. H-14D, two gang, 0.00014 mfd. each section $2.40

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Cat. HPRO, wired model receiver, net price $90.00
Cat. HCBT, (cabinet for receiver), net price ....$ 8.82
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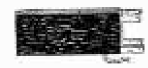

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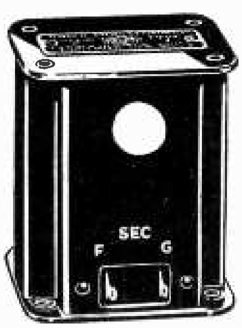

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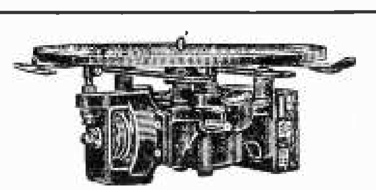

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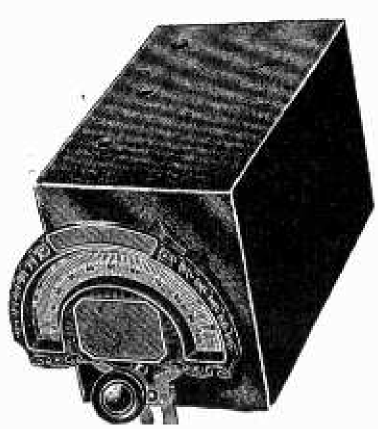

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