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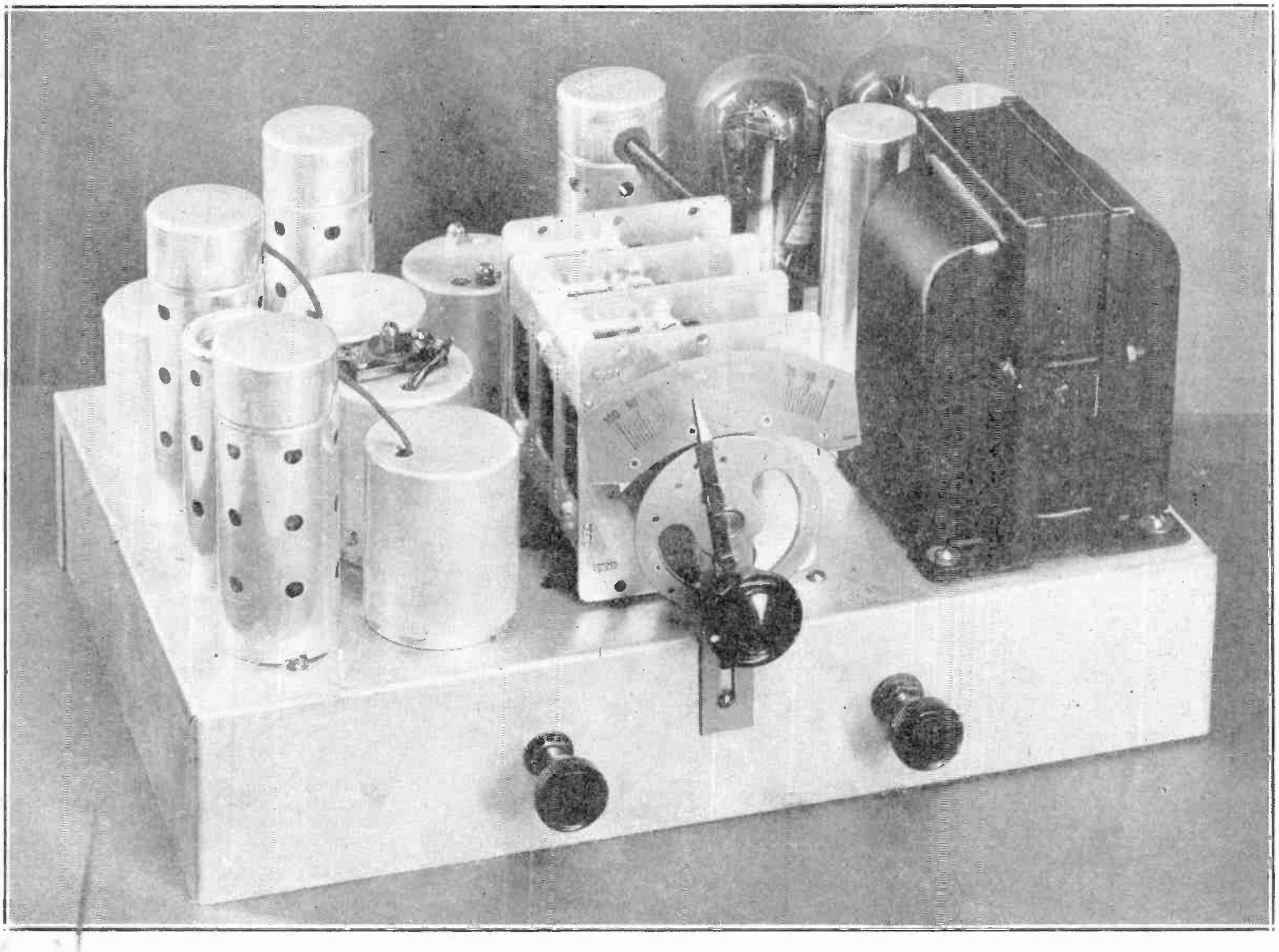

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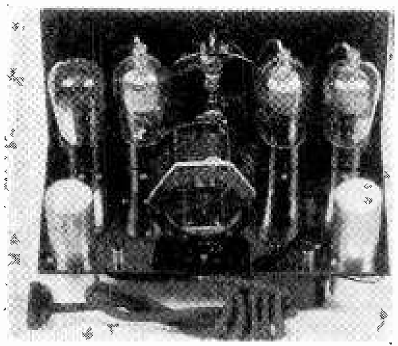

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ELEVENTH YEAR

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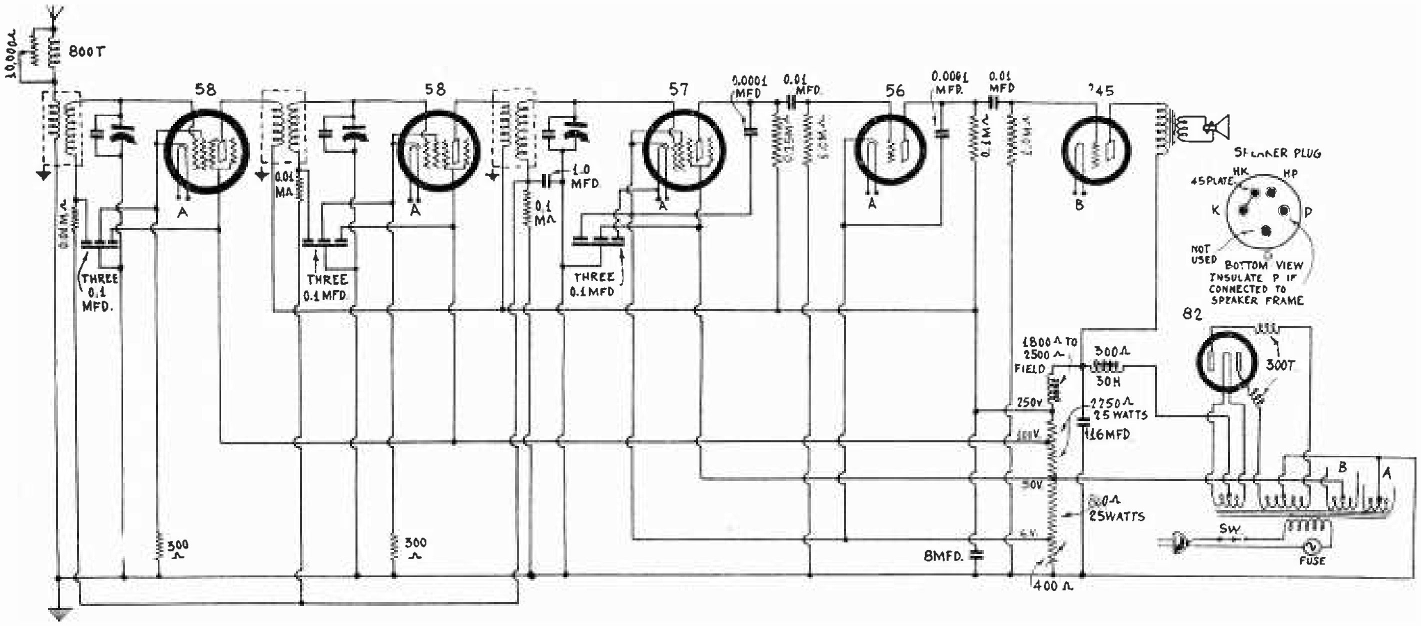
A. V. C. In a T-R-F Set

Latest Developments Improve Results

By Heinrich von Prittwitz



STANDARD COLOR CODE

Resistance		Color		
Megohms	Ohms	Body	Dot	End
....	300	.....	......	.....
0.01	10,000	Brown	Orange	Black
0.1	100,000	Brown	Yelow	Black
0.25	250,000	Red	Yelow	Green
1.0	1,000,000	Brown	Green	Black

THERE are two new features in the 6-tube tuned radio frequency circuit herewith. They are the volume controls, both manual and automatic. It is well known that a radio frequency choke coil, if large enough, placed in series with the aerial, will reduce volume greatly. The choke is simply performing its usual function of choking out the very radio frequencies desired to be received. If a rheostat of sufficiently large ohmic value is placed across this choke, then the amount of choking will be regulated from zero (coil shorted out) to maximum (full resistance of rheostat having little effect on the choke) and provide satisfactory manual control. This method is suggested in lieu of a variable pickup coil for the antenna coupler, as such coils are not obtainable in shields.

The automatic volume control is not new, but its application to the 57 tube is.

(Continued on next page)

LIST OF PARTS

Coils

Three shielded r-f transformers as described.
One 800-turn honeycomb coil.
Two 300-turn honeycomb coils.
One 30-henry B supply choke coil, d-c resistance 300 ohms.
One power transformer (three 2.5-volt windings, one high-voltage winding, one primary). (Note: Speaker specified later.)

Condensers

One three-gang 0.00035 mfd. condenser with trimmers.
Three shielded condenser blocks, three 0.1 mfd. in each block.
Two 0.0001 mfd. condensers (equalizers of that value at maximum are satisfactory).
Three 8 mfd. electrolytic condensers (two in parallel for 16 mfd.).
Two 0.01 mfd. mica condensers.

Resistors

Two 300-ohm pigtail resistors.
Two 0.01 meg. pigtail resistors.
Three 0.1 meg. pigtail resistors.
Two 1.0 meg. pigtail resistors.
One multi-tap voltage divider, or voltage divider with sliders, total from about 10,000 to about 20,000 ohms, or individual resistors of values specified on diagram (two 2,250 ohms, 25 watts; one 800 ohms, 25 watts).
One 400-ohm potentiometer.
One 10,000-ohm potentiometer with a-c switch attached.

Other Requirements

One dynamic speaker with 1,800 to 2,500 ohm field coil, and '45 output transformer built in; speaker cord and plug attached.
One chassis 18x9x2⅝ inches over all.
One drum dial with pilot light and bracket.
Three six-spring sockets, two UY sockets and two UX sockets (one of the UY sockets intended for speaker plug).
One a-c cable and plug.

(*Continued from preceding page*)

Usually the 57 detector is to serve sets where the signal level input to the detector is low. If the input amplitude at the detector is too high, of course the tube will overload.

Grid Current Utilized

Grid current will flow. By using the voltage drop in a resistor of 0.1 meg. for bias control of the two r-f tubes, the bias on the 58 tubes will increase as the signal amplitude increases, and thus a levelling effect is produced. Of course, the a-v-c is not effective as such unless there is some grid current in the detector, but it is permissible to have some. Low values of such current do not produce any distortion the ear notices, and the practicality of permitting some grid current has been pointed out by the noted tube authority, Prof. Frederick Emmons Terman, of Leland Stanford, Jr., University.

Since the action of all automatic volume controls is to reduce the sensitivity below what it would be on strong signals without such control, and since the more modest designs of t-r-f receivers haven't any great degree of sensitivity to spare, the circuit should include a driver stage of audio for the output tube. This is the resistance-coupled 56, first a-f amplifier.

How the automatic volume control works may be gleaned from the following: The controlled stages, first and second r-f, have their grids returned not directly to ground, but each through a separate bypassed resistor to a resistor in the detector circuit that goes to grounded B minus. This resistor is thus common to three circuits. Because it is common the resistor-capacity filters ahead are advisable. Returns are grounded to radio frequencies by the bypass condensers, however they are not at a d-c ground potential unless there is no grid current.

A fact not to be overlooked is that if there is any grid current in the radio frequency amplifiers — a most unlikely situation—the negative bias is increased thereby. The tendency exists to eliminate such current in this manner, for the grid becomes more negative, and there is grid current only when the signal input voltage swings the grid positive. The same direction of polarity obtains in the detector, hence the bias on the detector also will change, but the change will be also in the direction of levelling.

A Sensitive Detector

Tube data specifically point out that the 57 should not have its bias obtained exclusively from a cathode resistor to B minus, but that there should be some bleeder current. The reason is obvious from the first tests one makes of the tube, with signal impressed and meter across the cathode resistor. Bias that is 3.5 volts at no signal input may be swung to 21 volts negative by the signal in a set like this. This is a state of unbalance quite unwholesome and is due to the great changes in output current or voltage, due to small changes of grid voltage. While the signal changes the current in the voltage divider, too, this change is relatively much smaller, and nothing like an equivalent condition of instability obtains.

Since the detector is an audio frequency tube one must safeguard against the automatic volume control being based on audio frequencies, and the condenser used for bypassing should be large enough to cut out the modulation from the feed line to the controlled grids. So 1.0 mfd. was selected. Having picked the capacity, one must select a resistor of such value that the time constant will not be too small. There is a time delay in the automatic volume control of the controlled tubes, expressed by the time constant, which is equal to the resistance in megohms multiplied by the capacity in microfarads (or the product of ohms and farads).

The time constant effect is a complicated phenomenon. If the resistor used in conjunction with 1.0 mfd. is 0.1 mfd., then the time constant will be 0.1, which means that it will take 0.1 second for the voltage to build up to the maximum voltage divided by 2.72. During the short period involved the control is gradually effective, but at the condition of approximately one-third the total voltage the effect is appreciable, and so it is said roughly that if the time constant is 0.1 the control will be effective in one-tenth of a second. This is a short enough time delay.

Bypass Condensers

The detector has a condenser from one side of its heater to ground, as this will eliminate undesirable feedback effects in some instances, especially if the tube has a cathode leakage to heater, so that both sides of the heater are at a slightly raised r-f potential. The r-f current will be grounded through the condenser as the shortest path. A condenser at each side is unnecessary. Of course, the condenser is effective on all tubes on the same secondary winding, as four tubes are connected to secondary A. This is 2.5 volts, center-tapped, or, if not center-tapped, has a small center-tapped resistor (not more than 30 ohms).

There is a bypass condenser from detector plate to cathode. This is 0.0001 mfd. It is not material whether the connection is made to cathode or to ground. But it is material that the condenser be not much larger than specified, otherwise the high audio frequencies will be attenuated. It has been customary to use altogether too high a capacity in this position.

The same capacity condenser is used again in the first audio circuit, plate to cathode, because in some instances there has not been sufficient removal of radio frequencies by the previous condenser, and r-f is subjected to amplification in five tubes. It can even get to the speaker, and one can determine the fact by noting the detuning and general damping effect, or squelching of oscillation, resulting from one grasping the speaker cord.

Speaker Plug

It is usual to connect the speaker to the set by means of a plug that fits into a tube socket. For this circuit only three socket connections are necessary, but there are no three-spring sockets, so a UX socket may be used, or a UY, with only three springs in service. As so many speakers have UY plugs the diagram shows that use. Connect the primary of the output transformer to the heater terminals of the speaker socket. That makes one of the heater points B plus 250 volts. This point also goes to the choke field coil, so connect either side of field coil to K and interconnect K and HK at socket. Then there is only one remaining connection, the other side of the field coil. You may use P of socket for this, and it goes also to highest voltage on the pure resistance part of the voltage divider.

These connections are virtually standard. They apply certainly to the Rola and Magnavox speakers. In some instances the P terminal lead to speaker is conected to the speaker frame. If you desire to ground the frame, or at least not to have it at 250 volts above ground, be sure to unsolder or unscrew the connection between frame and the lead that goes to P of speaker socket.

Precaution When Turning Set On

The actual resistance of the field coil is not very important, if it is anywhere between 1500 and 2,500 ohms. It may be of the tapped type, say, 300 ohms and 1,500 ohms, total 1,800 ohms, but it is not practical to use the 300-ohm section for choke input, because then the field coil would be in series with the rectifier, and it should be in parallel.

The series resistance, looking into the rectifier, should be small, so that the voltage changes due to current differences developed by signal effects will be small. This is called good regulation. The high voltage secondary is a series reactor and its d-c resistance should be as small as practical, if you have any choice. But you may not have any choice, and therefore the bleeder current of the voltage divider comes in handy, for it is of a steady value and this makes for voltage stability. The instability is the proportion of the steady value to the changed value, and if the steady value is large then the effect of the change is relatively smaller.

Care must be taken not to turn on the set unless and until the speaker plug is inserted; otherwise there will be no load on the rectifier except the power tube, the voltage will be abnormally high, and irreparable damage may result to the condensers and rectifier tube. This is true though the condensers be electrolytic of the so-called self-healing type, for the voltage may rise to a peak value of around 1,000 volts, and the rectifier tube envelope will be filled with a strong blue spray, because of abnormal leakage through the damaged condenser. Normally only the top and bottom of the plates of the mercury vapor rectifier (82 or 83) will glow with a concentrated bluish-green, and this is true even when the set is originally turned on, for which thank the choke input. Otherwise at starting the whole tube will show blue-green and a few seconds after normal condition will obtain. Choke input prevents this surge in the rectifier tube. The tube life is extended. Normal use for 1,200 hours may be expected. Say, 8 mfd. next to the rectifier will reduce this to 900 hours.

Quiet Set

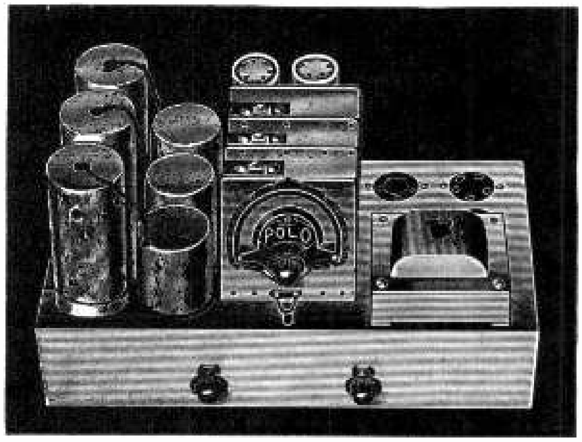
The set has attractions not present in earlier models. The new tubes are not as noisy as their predecessors. This is due to the suppressor grids. They limit, almost exinguish, the secondary emission that was the source of hissing modulation in the '35 and '24 as r-f amplifiers and detector. The audio frequency amplifier tubes do not need suppressor grids for this purpose, so long as they are not of extremely high mu, and the 56 and '45 are not, their mus being respectively 13.8 and 3.5.

The circuit is somewhat along the lines of the popular five-tube midget, except that the extra audio stage is included, so that even with a-v-c the sensitivity is greater than that of the five-tube design. Another point, however, is that to attain real elimination of hum, a reduction to 2 per cent. ripple in the output, the field coil of a dynamic speaker has not been relied on solely, but a low resistance 30-henry choke has been used for additional filter coil, used as choke input, while the voltage divider in parallel with the rectifier output consists of the dynamic field coil in series with resistors.

The result is that it is impossible to tell, simply by listening to the speaker, with ear at grille, whether the set is on or off Moreover, there is not starting hum such as characterizes the filter that uses field coil only. At any time the set is on you will have to consult other media than ears to determine the fact, unless a station is tuned in. By the hum you can't tell the difference because there is no hum audible. This is the only set I have ever listened to concerning which I could make that statement.

Bias for the '45

The bias for the output tube is taken off the voltage divider, so there is no inclusion of the grid circuit of that tube in the B filter choke, as where the tapped choke method is used to provide bias through the potential difference in the negative leg of the rectifier. The methods over which the present circuit is an improvement are ones necessitated by price



The layout used in the receiver is illustrated herewith. The sixth tube position is hidden by the tuning condenser. The speaker socket is at rear. The chassis size is 14x3x8¾ inches.

considerations, but at little extra expense —around two dollars—the filtration is made so much better that any one hearing the two different results would choose the better even if he had to borrow the money.

The capacity next to the rectifier is omitted in choke input methods, but there is a 16 mfd. condenser at the output of the 30-henry separate choke, while at the other end, at the joint with the field coil, appears an 8 mfd. condenser. The considerable improvement is due in no small part to the extra 8 mfd. condenser, to constitute 16 mfd., and as such a unit is purchasable for around 65 cents I doubt whether any one would want to omit it and be denied this considerable improvement.

Low Impedance Audio Bias

The bias for the r-f tubes is obtained from separate resistors, each bypassed. That reduces the length of leads and permits of more amplification without oscillation. In some instances it may be found that a little oscillation will develop around 1,400 to 1,500 kc, and if so the simple remedy is to increase the resistance of the unit biasing the first 58 tube until such oscillation is obliterated.

But the detector bias is taken off the voltage divider. The reason is that the detector handles audio frequencies, and any biasing resistor in the cathode circuit alone wolud have a negative feedback current through it. Moreover, the resistance would have to be fairly large, because the tube current is small, and a greater capacity than one dares to mention would be necessary to remove sufficient of the negative feedback to put the audio sensitivity on a satisfactory level, particularly as to low notes. So if the bias is obtained from the voltage divider, through the section of which flow the power tube and bleeder currents, which are appreciable, then a 400-ohm rheostat can be adjusted until the bias for the tube is just right.

Detector Bias

The tube charts recommend "approximately 6 volts" negative bias for detection, under stated conditions, duplicated here, but it may be found that considerably greater sensitivity will result at a somewhat reduced bias, hence the rheostat may be adjusted accordingly. Once it is set it is left thus, therefore it is not a front panel device. The first a-f tube may take the same bias as the detector, as the bias here is not critical.

The screen voltage for the detector may be lower than that usually recommended. The normal voltage for the 58 and 57 screens is 100 volts, but when the '24 came out the screen voltage recommended was twice as great for detection and audio amplification as was shown by the tube manufacturers' charts later, and it is believed a similar process will be gone through regarding the 57. At least in the present circuit we find better low-note response when the screen voltage is 45 volts, as compared to 100 volts, and some audio regeneration must be present to account for this.

Indeed, audio regeneration helps get rid of the otherwise imperative requirement of extra large bypass capacities across the biasing section of the voltage divider serving the power tube. Bias and screen voltage supplies seem to be deucedly poorly bypassed, but it's not required that the bypassing be any greater, for audio regeneration steps in to do more with its automatic contribution than hundreds of microfarads would do without such regeneration.

Power Circuit

It will be found that around 300 volts will prevail from rectifier filament to B minus, but if greater voltage is desired a condenser may be put next to the rectifier (filament to minus). This is not recommended, merely being mentioned. Thus 8 mfd. would boost the voltage to 400 volts, smaller capacities less. The B voltages for the set tubes are purposely kept a little low in this set.

Remember that the 82 requires 2.5 volts a-c on the filament, but if you have a transformer that has a 5-volt filament as intended for the 280, no circuit change need be made, but the rectifier should be an 83 tube.

Harsh interference may result if the plate leads of the rectifier have no chokes, so, although this is not a set of the high degree of sensitivity supposed exclusively to require those chokes, the parts cost only 30c each and it is well to include them. Values from 1 millihenry up may be used. Commercial coils are 300-turn honeycombs (1.3 mlh) and 800-turn honeycombs (10 mlh) these being of the 1-inch diameter type.

The primary of the power transformer should be fused, and the fuse holder be out of the way so as not to offer short-circuiting danger. A fuse of 2 ampere rating is sufficient. The large line fuses (30 amps, etc.) should not be used, as they do not protect the receiver.

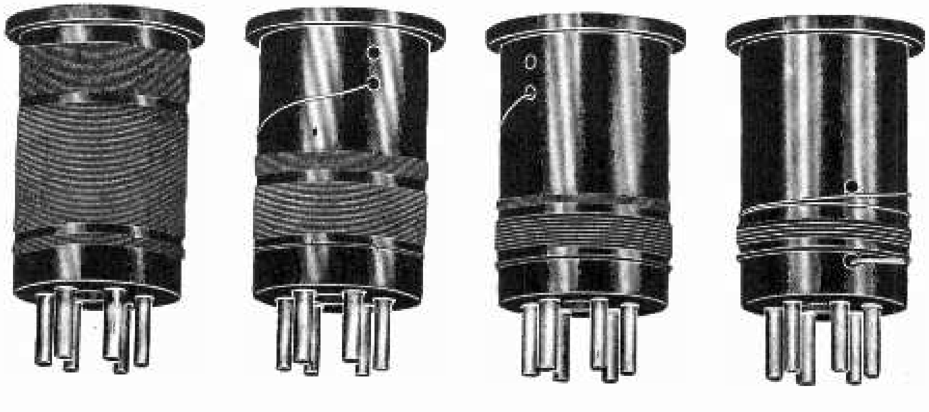
Coil Information

The coil data for 0.00035 mfd. tuning condensers are: secondaries on 1 inch diameter, 127 turns of No. 32 enamel wire. Primaries wound over secondaries, near the bottom, insulating fabric between, consist of 30 turns of any fine wire, No. 40 being commonly used. The antenna coil then is the same as the others, and its primary need not have larger wire than the other primaries, for the circuit is stabilized almost at the verge of oscillation, and thicker wire on primaries would cause renewal of trouble otherwise avoided.

A word should be written about the tone. It is exceptionally fine. The r-f bypassing in the audio line has not been overdone so as to cut the higher audio frequencies seriously, nor have the low notes been sacrificed. These are the two extremes usually to suffer. The leak values in the two audio stages are given as 1.0 meg., as there was complete absence of motorboating, but it is well indeed to try just as high values here as are consistent with absence of motorboating. Some may even tolerate incipient motorboating when the set is turned on, which disappears in about three or four seconds. Such incipient condition does not exist in the circuit as diagrammed, but to those who won't mind the drumming start, the increase of the leak values permits adio channel operation on the verge of oscillation.

If there is any motorboating the leak values may be reduced. It makes little if any difference to which circuit, first or second audio, the treatment is applied, either to build up the low notes to the verge of motorboating, or to reduce them, with smaller leak values, to the point where stability is completely present.

The circuit is at present giving abundant satisfaction, and is competing with honors against a very fine and expensive set owned by a neighbor. The neighbor's set is played so loud that our family hears it often and distinctly, and the tone surely is excellent. But it is not quite as excellent as the tone of the present set, the cost of building which was less than one-fourth of what our neighbor paid for his set. In fact, a wife's goading that we ought to have a set as good as the Jones's led to the construction of the present receiver, and as for keeping up with the Joneses, I'll say we're keeping ahead of them, on the radio score at least. On fancy clothes for the good woman the situation may be different.

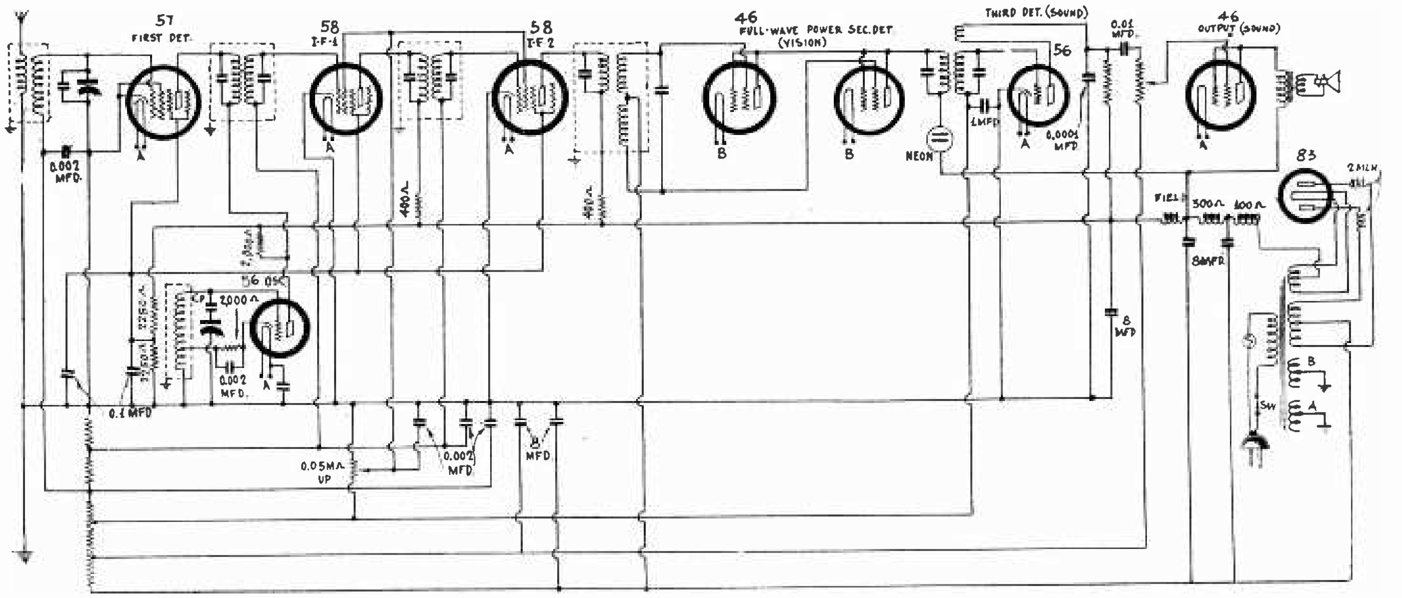


Four coils with 0.00014 mfd., cover 200 to below 15 meters. Illustration shows how windings are placed, to keep leads short.

Sight-Sound Receiver

Both Components Picked up by the Same Set

By Hardin Edgeworth



SIGHT and sound on one wave certainly present a fascinating possibility. Only one receiver, instead of two, and tuned to only one carrier frequency, yet sight and sound are receivable. How shall reception be accomplished?

The answer depends on the method used at the transmitter. The receiver may be regarded as a reversed transmitter.

Recently W2XAB, of the Columbia Broadcasting System, started transmitting on 2,800 kc, modulating the carrier with both vision and sound, as follows:

The principal or fundamental transmission was on the carrier frequency of 2,800 kc. The vision took up 86 kc, or 43 kc either side of the fundamental. Then a local oscillator at 45 kc was sound-modulated, and this sub-carrier was impressed on the fundamental. Hence we have a fundamental carrier of 2,800 kc, affected by vision frequencies so as to cause frequency changes between 0 and 2,843 kc on one side and 0 and 2,757 on the other side. There remain 14 kc, or 7 kc on either side. If some allowance is made for lack of perfection in frequency cutoff by tuned circuits, the 45 kc well may be used as the local oscillator for sound modulation, leaving 2 kc for separation of the two, and the audio band is limited to 5 kc.

Receives Entire 100 kc Band

When the fundamental carrier is tuned in the entire 100 kc band width is received, assuming that the receiver is sufficiently broad to permit this, and once the full band is brought in the two components, sight and sound, may be picked off.

There does not seem to be any practical method of doing this except by having a superheterodyne with a third detector. The reason for the superheterodyne circuit is the sensitivity obtainable, and that for the third detector the seeming necessity of separately demodulating the sound from the 45 kc transmission.

Thus, to express the receiver requirements in units, we must have:

(1) A mixer circuit, consisting of first detector and oscillator, to cause a beat equal to the intermediate frequency. This may be accomplished with tube circuits and suitable coils, to be discussed later;

(2) an intermediate frequency amplifier, which may be 1,600 kc, as commercial coils are made for this frequency that have sufficient broadness, or greater broadness can be provided by unbypassed plate series resistors;

(3) a second detector, to remove the carrier and leave only the modulation—that is, all the modulation, both sight and sound;

(4) a division of the output of the second detector, so that the vision frequencies (0-43 kc) are fed to the neon lamp, and the 45 kc is fed to the third detector, for conversion to sound.

Output Is Novel

The requirements of the first three subdivisions just mentioned are generally familiar, as they do not differ in principle from the requirements of any other superheterodyne. A division of the output of the second detector, however, is as new as the sound-sight single carrier method.

In the diagram herewith the first detector is the left-hand upper tube, below it, just to the right, is the oscillator, the combination of the frequencies generated in both is the useful output of the first detector, i.e., the intermediate frequency carrier, fed to two stages of i-f amplification.

When we come to the second detector we find something that has never before been printed—a full-wave detector for television, though useful also in any other superheterodyne, but especially so here.

It can be seen that the transformer coupling the plate of the second intermediate amplifier tube to this special power tube full-wave second detector has a center-tapped secondary. One extreme goes to the grid of one second detector power tube, the other extreme to the grid of the other second detector power tube. These tubes are 46's, used as triodes, with socket K tied to socket P, but with the negative bias very much higher than recommended for Class A amplifiers. In fact, the bias is of the Class B type as found in battery-operated receivers, i.e., high enough just about to cut off the plate current. This bias may be obtained from a voltage divider, providing the bleeder current through the biasing section is heavy enough to make the regulation pretty good, despite the great changes in current that will be produced in the full-wave detector tubes.

Is It Push-Pull Detection?

Thus we have push-pull input, which we may have in any circuit whatever. But do we have push-pull output? Can we? That is not possible in detection. The requirement for push-pull detection would be that the output be symmetrical, the voltages equal and opposite, so both sides of the wave would be required. Push-pull detection can not be, because to have detection there must be a suppression, giving the familiar pulsing curve of a rectified a-c voltage where the pattern is exclusively on one side of the zero axis. Where it is on both sides of the zero axis there is not detection but perhaps amplification.

So we may put a neon lamp directly in the parallel plate circuits, in which circuits, or really circuit, there will be the one-sided pulses that constitute detection.

It has been said that the negative bias on these tubes is such as to produce virtual plate current cutoff. Suppose there is complete cutoff. Then there will be no current through the lamp and it will not light. However, we will use the scheme for a practical purpose—the reception of television—and that means there will be a carrier. This carrier will cause the grid voltage on the full-wave second detector to increase, and thus plate current will flow, as the bias will be thrown in a positive direction by the signal amplitude. There will be no effect due to the negative cycle of the signal, as the steady bias value itself cuts off the plate current, and you can't have less than zero current.

The Restoration

Note that there will be no distortion. The present popular Class B amplifier is worked with grids that swing positive, so grid current flows, and there is some distortion, noticeable at low signal levels, although at the highest levels the distortion is no greater, which is the advantage of Class B amplification of that type. But no grid current will flow until and unless grids are positive, and here we have grids biased negatively some 100 volts or so, and the danger of positive grids does not exist. Hence no distortion from this source.

When the Lamp Glows

The carrier of the television transmitter will light the lamp, as many lamps of this type will glow when there is as much voltage across the lamp as would be caused by any carrier that would render reception possible. That is, the only time the lamp will not glow is when nothing that can be turned into a picture is being received.

However, instead of the full-wave second detector common plate circuit being fed directly to the lamp it is interrupted by a circuit tuned to 45 kc, the frequency of the sound-track sub-carrier. We have found that there has been demodulation. We have even asserted that demodulation is necessary. so that the 45 kc can be picked off, giving as the reason that the receiver must reverse the process of the transmitter. If the transmitter intermodulated sound-modulated 45 kc with a carrier of 2,800 kc, we must restore the 45 kc, which the full-wave detector does, because it removes the 2,800 kc carrier and restores the modulation frequencies.

Separation of Two

These frequencies are in two groups, one television. the other sound. It is true that up to this point the sound appears as a modulation on a radio frequency—45 kc—but we can remove the modulation and reduce the frequencies to those of the sound alone, by the familiar detecting process. This is the third detector.

There is considerable selectivity required to pick off the 45 kc, principally because there are television frequencies close by, and both would be mixed, or buzz-saw vision noises heard as interference with the desired sound. By tuning both the primary and the secondary of a three-circuit coil, and using regeneration we can obtain sufficient selectivity. The idea of a more elaborate band pass filter was considered, but as a single tuned circuit, if critically regenerative, may be made sharp enough to give severe attenuation above 5 kc, the regenerative hookup was favored.

The rectified output of this third detector, which consists of sound frequencies, is amplified in the usual way and fed to the second output tube through a resistance coupler. This sound output tube is a 46 used as Class A amplifier.

Two Volume Controls

There is a volume control in the grid circuit so that any tendency to overload the sound output tube may be corrected, and also, of course, sound volume held to any desired level. There is an overall manual control of sensitivity for the television signal in addition, the sound volume control being included so that if desired the sound may be reduced to low values even when the rest of the receiver is worked at maximum sensitivity as perhaps required for best picture reception. The r-f volume control is of the selectivity-control type, and varies the voltage on the suppressors of two tubes from zero to about 33 volts negative. The greater sensitivity, the less the selectivity. Thus the band width is adjustable.

Such a receiver should have excellent regulation of the B voltage. This will result if the rectifier tube is an 83, the choke input method is used, the d-c resistance of the filter choke total is low, and the bleeder current is high. As the tube rectifier will stand 200 ma easily, this bleeder well may be high without danger. However, the voltage should be high, as there is quite a span to take care of, the extremes represented by, say, 100 volts negative and 400 volts positive, a total of 500 volts from B plus output to power tubes and B minus. Note that B minus is not grounded, but all cathodes are.

Coil Construction

For use with a two-gang 0.00014 mfd. condenser, the coils may be wound as follows, for 80-200 meters: antenna coupler, primary 6 turns, 1-8 inch separation, secondary 53 turns, No. 24 enamel wire for both, diameter 1.25 inch. For oscillator coil, 40 turns of No. 24 enamel on 1.25 inch diameter, tapped 15 turns from ground end. Padding condenser, 100 mmfd. equalizer.

The sound detector consists of two tuned windings separated by 1 3-4 inches, 20 turns No. 24 enamel each; feedback coil 14 turns No. 40 silk covered, 1-8 inch separation, diameter 1.25 inch, condensers, 0.0001 mfd. equalizers.

How W2XAB Sends Sight-Sound

By E. K. Cohan

Technical Director, Columbia Broadcasting System

The frequency band, or ether channel. occupied by W2XAB extends from 2750 kilocycles to 2850 kilocycles. Thus we have a channel 100 kilocycles or 100,000 cycles wide. (The regular broadcasting facilities are 10 kilocycles or 10,000 cycles wide.)

We transmit a picture composed of 4320 picture elements and we transmit twenty complete pictures per second in order to obtain a satisfactory illusion of motion. This requires approximately 86% of the 100,000 cycle channel just mentioned, leaving 14%, or about 14,000 cycles, unused.

Since the next progressive step in picture detail and definition under present methods would require a channel wider than 100,000 cycles, 86% occupancy of the band has been the highest efficiency thus far.

Instead of wasting the remainnig 14%, as has been the practice heretofore, the system uses nearly all of this "waste space" for the accompanying voice or music.

Basic Idea For Future

Looking to the future, perhaps one of the greatest values possessed by this contribution will be not so much the more efficient use of the channel, but rather the identical transmission characteristics of picture and voice, thereby automatically assuring satisfactory reception of both, if one can be received.

This, coupled to the greater economy effected through the elimination of a large amount of equipment duplication, both at the transmitter and the receiver, practically assures the future universal adoption of this basic idea,—regardless of specific methods or channels used.

Experiments conducted by the Columbia Broadcasting System have led to the use of the system by which a television picture, and the voice and music originating on the scanned scene, are simultaneously broadcast by the same transmitter. To use one wavelength for both signals has long been the field of study for research engineers. Several experimenters have successfully accomplished this in the laboratory, but it is believed that the Columbia Broadcasting System is the first to make such a system generally available to the public. At the present, a rudimentary description of this development will be given.

Uses Double Modulation

"Double modulation" is the term which best describes the principle upon which the new system depends. The average user of a radio set is familiar with the fact that when he tunes his receiver to a certain broadcasting station, he is tuning to the particular carrier frequency of that station. The signal which reaches the set from the antenna consists of this carrier frequency combined with the frequencies of the speech or music. The receiver has the ability to separate the speech or music from this complex wave, and to reproduce them in the loud speaker. The carrier frequency is said to be modulated by the audio signal.

The first step in the new system is to modulate a carrier of 45 kc. with the signal picked up by a microphone in the television studio. This produces a complex wave, impressed on the fundamental carrier, which also carries the television modulation.

Transmission Lines Gain Favor

Transmission lines are now receiving considerable attention in radio. The theory of these lines has been known a long time but it has not been applied to radio transmission and reception until recently. Now lines are used for conducting the power of radio stations from the transmitter tubes to the antenna, for conducting received power from the antenna to receivers, and for generating ultra-short waves.

With proper lines power may be sent over some distance with negligible loss whereas without lines of proper design scarcely any power could be sent over the same distance.

One of the notable applications of transmission lines was the system described recently by the Bell Laboratories which enabled many receivers to be connected to a single antenna. Lines were used to conduct the received power from the roof of the building, where the antenna was placed, to receivers everywhere in the building.

The theory of the transmission line is now also applied to the generation of extremely short waves. New tubes are being made and so constructed that the internal leads become part of the line. The Lecher wire system used in high frequency measurements is also an application of the transmission line theory.

Measuring Electrolytics

Two Methods of Determining Capacity

By Brunsten Brunn

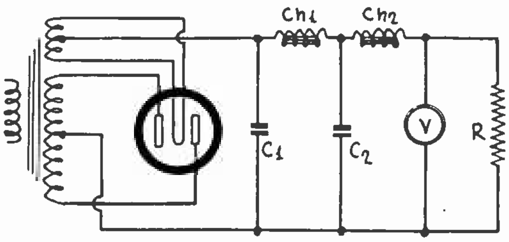


FIG. 1

Circuit for measuring the capacity of an electrolytic condenser by its effect on the output voltage of the rectifier. C1 is the condenser under measurement.

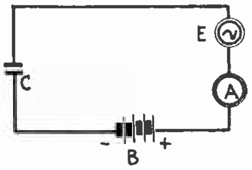


FIG. 2

Another circuit for measuring the capacity of an electrolytic condenser with a known a-c voltage and an a-c ammeter. B is a polarizing battery.

THE MEASUREMENT of the capacity of electrolytic condensers offers a problem that is often avoided because the usual methods of measuring do not apply. But the capacity can be obtained by relatively simple arrangements provided we do not require high accuracy.

One method makes use of the fact that the capacity of a condenser controls the output voltage of a rectifier circuit to some extent. Consider Fig. 1, for example. Here we have a regular B supply circuit containing two chokes and two condensers, with a voltmeter connected across the load. For a given voltage applied to the primary of the power transformer there will be a certain reading on the voltmeter. The magnitude of this reading will depend on the capacity of condenser C1. Hence the voltage can be used as a measure of that capacity, provided that the circuit has first been calibrated against known capacities.

When no condenser is used in the C1 position the voltage indicated will be low, for the choke Ch1 will prevent current from flowing when the rectifier tries to send pulses through, and there is no tank condenser to take the pulses and to send them through the chokes and the voltmeter slowly.

Voltage Increases

When a small condenser is used in the C1 position the voltage is considerably higher, for there is some tank capacity to accept the current pulses and to send them on through the chokes and the meter slowly. As we increase the capacity of C1 the voltage rises. It makes no difference whether the condenser is a dry one or an electrolytic. We may define the capacity of the electrolytic as that which has the same effect on the output voltage as a given paper dielectric condenser, for that will be the effective capacity as far as the filtering action is concerned.

In order to calibrate the circuit we must have a group of fixed condensers of known capacity and we must also be sure that the voltage of the line will remain constant, for if the voltage varies the calibration will be in error in direct proportion to the voltage change.

Not for Large Capacities

This method of measuring capacity has one disadvantage, aside from the relative complexity of the circuit, and that is when the capacity is large there is a relatively small change in the voltage. Hence large values of capacity cannot be measured accurately. This is offset by the fact that the capacity is measured under actual operating conditions of the condenser and not under fictitious conditions.

The voltage indicated will be higher the higher the value of the load resistance R and it will be lower the higher the inductance of the choke Ch1. The value of R might be from 10,000 to 50,000 ohms and the choke may have an inductance of 100 henries. It is not the actual voltage indicated by the voltmeter that is of importance but the change in the voltage with a given change in capacity. This change in voltage should be large if accurate values of capacity are to be obtained.

The second choke Ch2 and the second condenser C2 do not enter into the functioning of the circuit essentially and may be left out if the circuit is to be used exclusively for measuring the value of C1. However, if the circuit is already built there is no reason for removing Ch2 and C2. Any B battery eliminator can be converted to this purpose by removing the condenser next to the rectifier, if any, and then putting in the particular condenser to be measured.

Use of A-C Meter

Another method of measuring the capacity of an electrolytic condenser depends on the application of Ohm's law as modified for alternating current. The circuit of this is shown in Fig. 2. C is the condenser to be measured, A is a milliammeter of suitable range, B is a polarizing battery, and E is a source of known alternating voltage.

The object of the polarizing voltage is to insure that the condenser is operating under actual conditions, that is, with a d-c voltage across it in addition to the alternating voltage. The polarizing voltage should be greater than the peaks of the alternating voltage applied and it must be poled so that no d-c flows in the circuit. The positive terminal of the condenser is usually marked with red paint. The polarizing battery should be so connected that the positive terminal points in the direction of the marked condenser terminal.

A-C Will Flow

When an a-c voltage is applied in series with the polarizing voltage an alternating current will flow through the circuit, and this will depend on the a-c voltage applied, on the capacity of the condenser, and on the frequency of the a-c voltage. The current will be the product of the applied a-c voltage and the reciprocal of the impedance. This reciprocal is Cw, in which C is the capacity in farads and w is 2π times the frequency in cycles per second. Hence the current I in the circuit will be given by $I=ECw$, E being a-c voltage applied and I being measured in amperes. From this we get $C=I/Ew$.

If the voltage applied is 100 volts and the frequency is 60 cycles per second, the capacity is given by $C=24.1xI$, in which C is measured in microfarads and I in amperes.

Meter Requirements

Let us see about how much current to expect so that we may choose the milliammeter properly. Let the largest condenser to be measured be 16 mfd. Then the current will be $I=16/24.1$, or 0.664 amperes. Hence we need a 0-1 ammeter if we use 110 volts.

There will be a d-c component in the current and this will be included in the reading of the ammeter. It will introduce an error, but this error will be small if the applied a-c voltage is high. The d-c can be measured before the a-c is applied and if it is found appreciable it can be deducted from the reading obtained with the a-c. While this is not absolutely correct it will be accurate enough, especially in view of the fact that the d-c current is small. If it is very large it does not matter, for the best thing to do with the condenser then is to throw it away.

Second Method

The second method of measuring the capacity of a condenser has the advantage that no calibration is needed since it depends on the measurement of alternating current and voltage, for which standard meters may be used. An a-c voltmeter and an a-c ammeter are needed. These two are often combined in one instrument.

In case an ammeter is not available a milliammeter can also be used provided that the a-c voltage used is decreased. This reduction can be effected with a step-down transformer. When this is used the voltage across the secondary, which is the voltage in series with the condenser to be measured, should be measured while the condenser is drawing a-c current because the voltage across the winding many be considerably higher on

(Continued on next page)

Testing Condenser Leakage

Principle of Vacuum Tube Voltmeter Used

By J. Howard Sandidge

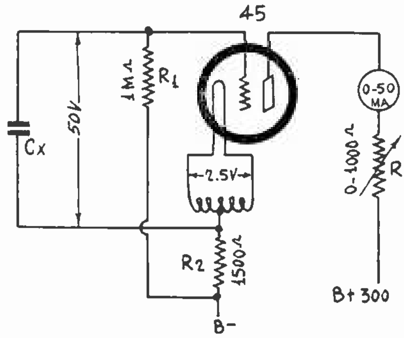
HERE is a simple method for testing the relative leakage of condensers which should be of great interest to every experimenter and technician. Most of us have had to content ourselves with the usual devices for condenser tests, at best a thousand ohm per volt meter and battery, satisfying ourselves at most that the condenser under test accepted a charge and was not open or shorted. This commonly accepted method is not satisfying or capable of ready standardization, and leaves us with no real idea as to the probable performance of the unit in service. The plan outlined in the following is capable of exact duplication and yields visible results which we may reduce to absolute values.

The layout is simplicity itself and necessitates a meter of only moderate sensitivity. As shown in Fig. 1, a '45 (or '71) power tube is connected up, using customary values of voltage. A 0-50 MA current meter is wired in the plate circuit. The tube is self-biased by a 1,500 ohm resistor from filament to B—, and this bias, about 50 volts, is supplied to the grid by a grid leak, shown as 1 megohm. Test leads are connected to the grid itself and to the filament. Across these leads there will be the 50 volt C bias, which is used for testing. Variable resistance is put in the plate circuit. The size of this resistor is not critical and 1,000 ohms is shown.

Method To Pursue

The method of testing is as follows: With the tube operating, R-3 is varied until the plate current meter needle comes to rest on any meter division, for easy reading. The test leads are then clipped to the terminals of the condenser to be tested. A sudden rise in plate current will ensue. This rise indicates that the condenser is not open, and that it IS a condenser and will accept a charge.

If the plate current rises to a very high value, and stays there, the condenser is shorted. If the condenser is not open and not shorted the plate current will subside slowly, approaching the point of previous setting. If it returns exactly to the setting point the condenser has no leakage current, a condition theoretically impossible of attainment. The increase in plate current, above the setting point, after stability has been attained is a direct index of the leakage current through the condenser.



As set forth above, the test is a relative one only, but the results are easily reduced to absolute values. Since the leakage current must flow through R-1, it follows that each volt of grid change indicates a leakage current of 1 microampere, using 1 megohm for R-1. Reference to the plate current-grid voltage curve of the tube yields the grid voltage change from the plate current change, and thus the leakage current in microamperes. If we wish to carry the results still further, a simple calculation will give us the leakage current per applied volt and per unit of capacity. For all practical purposes we will not be concerned with these.

Polarity of Electrolytics

This test is capable of many refinements and of almost unlimited sensitivity. The higher R-1 is made the greater the plate current change will be, a fact to be used when testing small condensers. A very material increase in ease of reading and sensitivity may be made by setting up a local battery circuit around the plate current meter and cancelling out the normal plate current, so that the meter will read zero when no condenser is under test with a multi-scale meter, say 0-5 and 0-50 ma, in the plate lead. We can use the low scale for testing and the high scale for preliminary setting.

Electrolytic condensers may be tested for uniformity and leakage just as outlined above for paper and mica dielectric condensers. Proper polarity connection must be made and recognition taken of the fact that electrolytics have a definite, and rather large, leakage. Electrolytics must be tested with much smaller values of R-1.

Benefits Experimenters

It is almost impossible to over-emphasize the value and practicability of this condenser test, and every experimenter will benefit by making the set-up and trying it out on a series of condensers. It will yield surprising and illuminating results. In trouble shooting it is invaluable for when used with intelligence it will prophesy the ultimate failure of a weak condenser, and will point out the "weak" ones. It will successfully diagnose many cases of fading and instability of volume as, very often, these troubles have a fixed condenser which varies in value as their ultimate cause.

WBT South's First Super-Power Station

A 41-hour broadcast, dedicatory exercises by state and municipal officials, and a civic holiday marked the premiere of super-power broadcasting by WBT, Charlotte, N. C., recently. The opening half hour was carried over Columbia's Dixie Network.

The WBT transmitter, key station of the Dixie Network, increased its power from 5,000 watts to 25,000 watts and is the South's first super-power station to broadcast entertainment.

Barbara Maurel, Columbia concert contralto, flew from New York to appear as guest star of the program. Officials of the two Carolinas and of Charlotte spoke from the new transmitter, located eight miles out of Charlotte.

Tube List Prices

Type	*List Price*	*Type*	*List Price*	*Type*	*List Price*	*Type*	*List Price*
11	$3.00	'38	2.80	'24-A	1.65	'80	1.05
12	3.00	'39	2.80	'26	.85	'81	5.20
112-A	1.55	'40	3.00	'27	1.05	82	1.30
'20	3.00	'45	1.15	'30	1.65	'74	4.90
'71-A	.95	46	1.55	'31	1.65	'76	6.70
UV-'99	2.75	47	1.60	'32	2.35	'41	10.40
UX-'99	2.55	'50	6.20	'33	2.80	'68	7.50
'100-A	4.00	55	1.60	'34	2.80	'64	2.10
'01-A	.80	56	1.30	'35	1.65	'52	28.00
'10	7.25	57	1.65	'36	2.80	'65	15.00
'22	3.15	58	1.65	'37	1.80	'66	10.50

Allowance for Capacity Variation

(Continued from preceding page)

open circuit than when it is delivering current. If the same instrument is used for measuring both voltage and current, it is not necessary to leave the ammeter in the circuit while the voltage is being measured. Of course, it cannot be if there is only one meter.

The polarizing voltage should preferably be supplied by a battery but if only a rectifier type supply is at hand that too may be used. Whatever source is used, its voltage should be higher than the a-c voltage that is applied in series with it.

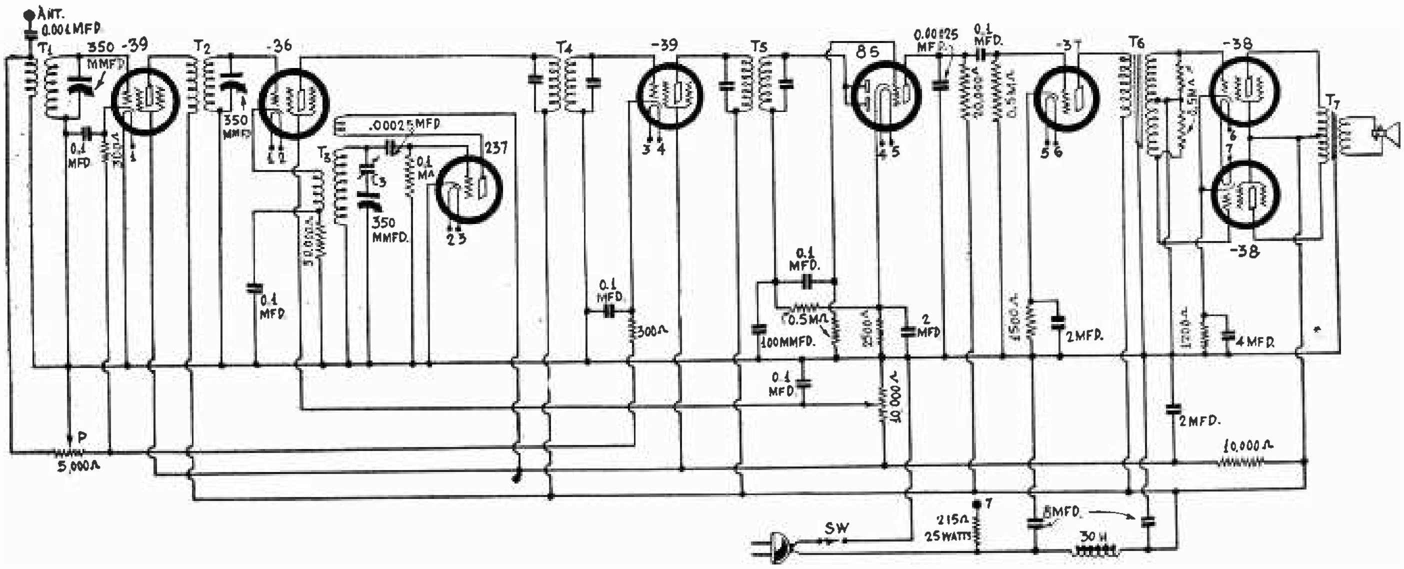
The capacity of an electrolytic condenser is not a constant value but depends on the temperature and on the frequency. Thus an 8 mfd. condenser may have a capacity of 8 mfd. at 20 degrees Centigrade, 7.5 mfd. at zero Centigrade, and 8.5 mfd. at 80 degrees. The actual temperature of a condenser depends on where it is in the circuit and what it is doing. Twenty degrees Centigrade is approximately room temperature, or 68 degrees Fahrenheit. The operating temperature is considerably higher than this in nearly all cases because of the heating effect of tubes and transformers near it and also because current is flowing through it.

The capacity of an electrolytic condenser decreases slightly with increasing frequency. Thus at 60 cycles per second the capacity may be 8 mfd. and only 7.5 mfd. at 7,000 cycles per second. This variation is entirely negligible in the audio range.

The 85 in a D-C Set

8-Tube Super Accomodated to 89

By J. E. Anderson



STANDARD COLOR CODE

Resistance		Color		
Megohms	Ohms	Body	Dot	End
0.5	500,000	Green	Yellow	Black
0.1	100,000	Brown	Yellow	Black
0.03	30,000	Orange	Orange	Black
0.02	20,000	Red	Orange	Black
0.01	10,000	Brown	Orange	Black

SINCE the advent of the automobile tubes we have had splendid tubes for use in d-c operated receivers. From every viewpoint, with the exception of output power, they are the most suitable for the purpose. They take a comparatively low filament current and a high filament voltage. Hence they are economical in that it is not necessary to waste a lot of power in a heavy-duty ballast resistor. The filaments can be connected in series and this can be done without subtracting from the available plate voltage because all these tubes in this series are of the heater type. This is one point in which these tubes are vastly superior to any of the low-current filament tubes which were used in such circuits before the automobile tubes came out.

The filament current required by the automobile tubes is 0.3 ampere, with the exception of the latest, the 89, which requires 0.4 ampere. If this tube is not used all that need be taken from the line, outside of the plate current, are the 0.3 milliamperes, which include the speaker because the field current can be the same as the filament current, and when we connect the field in the series we need an even lower ballast resistor and less power will be wasted.

An Eight-Tube Super

In Fig. 1 is the circuit diagram of an eight-tube superheterodyne making use of the automobile tubes in a d-c circuit. All the filaments are connected in series. One side of the first filament is connected to the chassis and the negative side of the line is also connected to the chassis. The other end of the filament of the first tube is connected to one side of the second tube's filament. The two points to be connected together are marked (1). Thereafter the filament terminals to be connected together are marked (2), (3), and so on. Finally we come to (7) on one of the output tubes. This point is to be connected to (7) on the ballast resistor, which is connected to the positive side of the line.

Now if there is no loudspeaker field to be connected in the series, the value of the ballast resistor should be 215 ohms and it should have a rating of 25 watts. This resistance is based on the assumption that the line voltage is 115 volts and that each tube takes a voltage of 6.3 volts.

LIST OF PARTS

Coils

T1, T2—Two shielded r-f transformers for 350 mmfd. condensers.
T3—One shielded oscillator coil for 350 mmfd. condenser and desired i-f.
T4, T5—Two shielded doubly tuned i-f transformers, 175 kc or 400 kc.
T6—One push-pull input transformer.
T7—One push-pull output transformer.
One 30 henry choke coil.

Condensers

One gang of three 350 mmfd. tuning condensers.
Six 0.1 mfd. fixed condensers.
One 0.001 mfd. fixed condenser.
One 100 mmfd. condenser.
Two 0.00025 mfd. condensers.
Three 2 mfd. condensers.
One 4 mfd. condenser.
Two 8 mfd. electrolytic condensers.
One 350-450 mmfd. adjustable condenser, or one 700-1,000 mfd..

Resistors

P—One 5,000 ohm potentiometer, with line switch.
One 10,000 ohm potentiometer.
Two 300 ohm bias resistors.
One 30,000 ohm bias resistor.
One 100,000 ohm resistor.
Five 0.5 megohm grid leaks.
One 2,500 ohm bias resistor.
One 1,500 ohm bias resistor.
One 1,200 ohm bias resistor.
One 20,000 ohm resistor.
One 10,000 ohm resistor.
One 215 ohm ballast resistor.

Other Requirements

Seven UY sockets (5-prong).
One six-prong socket.
Six grid clips.
One binding post.
One slow motion dial with pilot light.

If the field coil of the speaker is to be connected in series with filaments, which is the most economical way, it should be put between the two points marked (7) and the ballast resistor should be reduced by the number of ohms in the speaker field. For example, if the ohmage of the speaker field is 125 ohms the ballast resistor should be made 90 ohms. The speaker field winding should be designed for 0.3 ampere for this is the current that will flow in it. Such a speaker is available. In this case it is not necessary to make the 90-ohm ballast one of 25 watt rating, for the power expended in it will only be 8.1 watts. The rating should be higher than 8.1, of course, or the resistor will run too hot.

In case a pilot light is to be used, this should be connected in series with the heater circuit, and it should be placed between the chassis and the negative end of the filament of the first tube. That is, the lead now connected to the chassis should be cut and the pilot light inserted. This pilot light should be designed for 2.5 volt operation and not 6 volts. The 6-volt light will burn out.

The Intermediate Frequency

The intermediate frequency may be any desired value, such as 175 or 400 kc. But whatever frequency is chosen the oscillator coil, marked T3 in the drawing, should be designed for that frequency. Intermediate transformers are available both for 175 and 400 kc and sets of r-f coils, including oscillator, are also available for either intermediate.

The first two r-f coils, of course, do not depend on the intermediate frequency but the oscillator does. The r-f coils should be wound to match the capacity of the tuning condensers. If the standard 350 mmfd. condensers are used, sets of r-f and oscillator coils are available. The tuning condenser should be a three-gang assembly, each section having 350 mmfd. Of course, each section should be provided with a trimmer.

In addition to the trimmer across the

oscillator section there is a series condenser marked C3. For an intermediate frequency of 400 kc this should have a range of 350 to 450 mmfd. and for an intermediate of 175 kc it should have a range from 700 to 1,000 mmfd.

Oscillator Trouble

Very often trouble arises in the oscillator. For example, the oscillator may not work. This may be due to incorrect connection of the tickler. In case of failure, the tickler leads should be reversed to see if that will cause oscillation. If neither connection of the oscillator will work, the trouble may be due to insufficient voltage on the plate. It should be increased. If the oscillator coil is homemade it may be that the tickler does not have enough turns. It may also be that the tube used for oscillator is subnormal.

Another trouble is blocking, and this is the most common. This is directly due to excessive oscillation. The quickest remedy for that is to decrease the grid leak resistance from 100,000 ohms to 50,000 ohms, or even less. Another way of stopping the blocking is to put a resistance of from 2,000 to 10,000 ohms in series with the 0.00025 mfd. stopping condenser.

Padding Adjustment

Trouble also arises in the adjustment of the padding of the oscillator. If a standard coil is used, this trouble is easily overcome, for all serious troubles have been removed already. The adjustment of the trimmer condenser should be made at 1,450 kc and the adjustment of the series condenser at 600 kc, or at frequencies not far removed from these if other frequencies are more convenient.

Since the order of making these adjustments is important we shall go through the procedure.

First set the gang condenser with the dial at about 6. With the trimmer condensers alone tune in the station, or the frequency, selected for the adjustment. Tune with all the trimmers. Now check the tuning at 1,500 kc to see that this comes in above zero, that is, make sure that the upper limit of the broadcast band will be within range of the tuner. If it will not, retrim at the selected frequency with the gang condenser set a little higher, say between 6 and 10 on the dial.

When the adjustment has been made at the high frequency end, preferably at 1,450 kc, convert the set to a t-r-f receiver by moving the grid clip that normally goes on the first detector to the cap of the second detector tube. In this particular circuit this change will make the set rather insensitive due to the fact that the second detector is eliminated. Hence the signal used should be strong.

Adjusting at 600 kc

After this change has been made provide a 600 kc signal and tune the circuit to it. Do not touch any of the trimmers but turn only the main condenser gang. When the signal has been tuned in as loud as possible return the circuit to a superheterodyne by switching the grid clips to where they normally belong. Make certain in doing that that the condenser setting is not disturbed. Now tune in the 600 kc signal with the series condenser, C3, and with nothing else. This completes the adjustment. However, it may be desirable to return the dial to the setting where it was at the 1,450 kc adjustment, accurately, and then retrim at this frequency, touching nothing but the trimmer on the oscillator.

Avoid Slip-up

If there is any slip-up during the process, such as touching the trimmer condensers when they should be left alone, or fooling with the series condenser when that should be left alone, or touching the main tuning condenser during the process of switching from a t-r-f set to a superheterodyne, start at the beginning and go through the correct process again.

If the padding adjustment should lead to insensitivity and squealing in the middle of the band, the trouble may be due to "crossing of the carrier." For an explanation of this trouble and for a remedy, see an article on the subject in the Aug. 13th, 1932, issue of RADIO WORLD (last week).

The tuning of the intermediate, of course, must be done before any of the padding adjustments are made. This part of the adjustment of the receiver offers a greater difficulty than the padding, unless an i-f oscillator is available. If it is, the tuning of the intermediate can be done in about five minutes.

The question often arises as to whether the intermediate coils are tuned accurately so that it is not necessary to tune them in the circuit. They are not. A 175 kc intermediate, for example, is only tunable to 175 kc. But it is also tunable to 180 or 170 kc, or even to frequencies more remote from the 175 kc. The same holds true of all other intermediate transformers. They must be tuned, and tuned accurately, in the receiver.

Tuning By Guess

The tuning may be done by guess in the absence of a calibrated i-f oscillator. If the frequency obtained by guessing is close to the frequency intended, or the frequency for which the oscillator coil has been designed, a good adjustment will result. But if the frequency guessed at is far removed only fair results can be obtained. It pays to build an i-f oscillator for making the adjustment, or to have someone do the work who has an oscillator. But if the circuit must be adjusted without the aid of an i-f oscillator it can be done by the trial and error method. This amounts to guessing at the intermediate frequency several times, adjusting the padding each time, and retaining the adjustment that gives the best results. But it is difficult to know which guess is the best, or to return to the best adjustment even if it is recognized. With a calibrated i-f oscillator all this guessing is avoided.

The choice of 600 and 1,450 kc as the two adjustment frequencies is based on computations on the padding problem which show that these yield the best results. However, they do so only if the inductance of the oscillator coil has been designed for this adjustment. But there is very little difference in the results obtained at these frequencies and at 1,500 and 550 kc from the practical point of view. For this reason the adjustments may be made at any frequencies close to those which give the optimum adjustment.

The Detector

The detector in the circuit is the 85 duplex diode triode, the two diode plates being tied together. The load resistance on the diode is half megohm and it is shunted with a 100 mmfd. condenser. This capacity is high enough for 400 kc but it might be increased to 150 mmfd. if the intermediate frequency is 175 kc. The determination of this capacity depends on the quality desired. If the high audio frequencies are not desired, make the capacity larger. By making this condenser variable it provides a good tone control.

The stopping condenser is 0.1 mfd. and the grid leak half megohm. The high values of these are intended to bring out the low mu audio tones strongly.

A bias resistor of 2,500 ohms is used on the triode part of the tube, and this is shunted with a condenser of 2 mfd. This value of bias resistance is based on a normal tube and on a load resistance of 20,000 ohms. If the load resistance is increased, which it may be, a higher value of grid bias resistor must be used or the tube will be underbiased. However, there is much amplification after the tube so it is not necessary to give the tube the full recommended bias of 20 volts. A greater sensitivity will be obtained with less bias.

Noise Elimination

It is well known that receivers operating on d-c lines are very noisy. There is a strong hiss present all the time. It has been found that if a resistance is connected across the secondary of the input transformer, or one across each half of the transformer in case of push-pull, this noise will be eliminated. For this reason there are two half megohm resistors across the secondary of the push-pull input transformer. These resistors will cut down the output a little bit but at the same time they will improve the quality. The removal of hiss alone makes their use well worth while.

Little Filtering Needed

As a rule, very little filtering is needed in a d-c operated receiver because the voltage is already partly filtered. This is due to the fact that the machines used for generating the power contain many poles so the fundamental hum frequency is much higher than 120 cycles. Receivers have been operated without any filtering without much objectional noise. However, there is usually a rhythmic noise from the commutators, apparently occurring once every time the generator turns around. This noise may be due to a pitted commutator or possibly to some load on the circuit near the receiver. The filtering will remove this noise. Hence we have a 30 henry choke in series with the plate voltage supply and we have two 8 mfd. condensers across the line.

Inexpensive Condensers

These condensers are suggested because they are inexpensive and easily obtainable. They have one disadvantage, however, and that is that they require a particular polarity. If the line plug should be inserted in the socket in the wrong way the condensers will draw a heavy current and if this is allowed to continue long they will be ruined.

The set will not work with the plug in the wrong way, but before this is discovered the damage may have been done. Hence the plug should be marked, as well as the socket, so that the mistake need not be made if a little care is exercised. To prevent this difficulty entirely 4 mfd. paper dielectric condensers could be used instead of the electrolytics, and they would be ample.

Full Voltage on Plates

The full voltage available is applied to the plates of all the tubes with the exception of oscillator. The voltage on this tube and that on all the screens, with exception, is about one-half the total voltage. The division is obtained by using two 10,000 ohm resistors across the supply and tapping the junction for the screens. The lower of these 10,000 ohm units is in form of a potentiometer, and the slider of this is connected to the screen of the first detector. Any voltage between about 55 and zero can therefore be applied to the detector. The most sensitive setting should be found, and then the slider may be left alone.

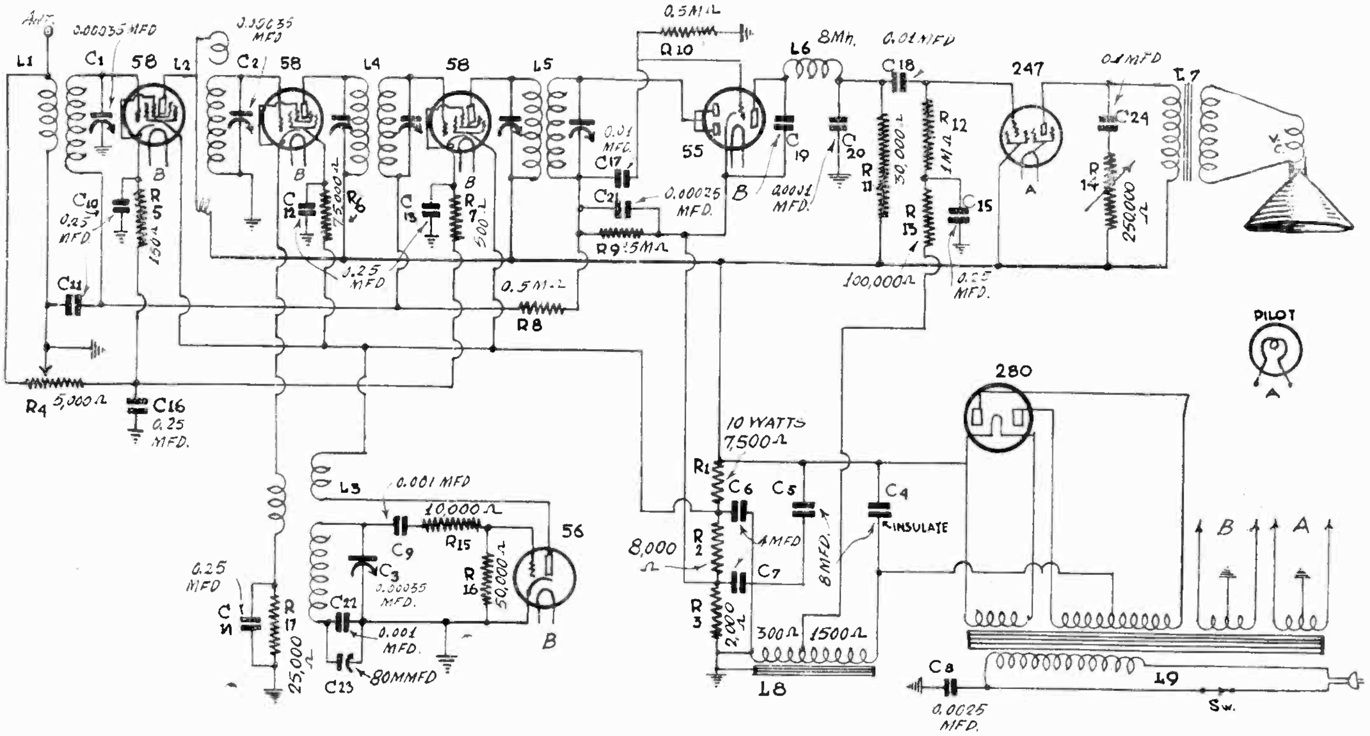
The volume is controlled with a 5,000 ohm potentiometer connected between the antenna and the cathode returns of the r-f and i-f amplifiers.

The condenser in the antenna lead is used to prevent a possible short circuit of the line. No ground is needed on the set for the circuit is effectively grounded through the line. And it is safer not to use a ground.

GOOD DESIGN, GOOD PARTS,
AND SU

By Alan

Thor



STANDARD COLOR CODE

Megohms —Resistance—	Ohms	Body —Color—	Dot	End
......	150	......	......	......
0.0005	500	Green	Brown	Black
0.002	2,000	Red	Red	Black
0.0075	7,500	......	......	......
0.008	8,000	Gray	Red	Black
0.01	10,000	Brown	Orange	Black
0.025	25,000	Red	Orange	Green
0.03	30,000	Orange	Orange	Black
0.05	50,000	Green	Orange	Black
0.1	100,000	Brown	Yellow	Black
0.25	250,000	Red	Yellow	Green
0.5	500 000	Green	Yellow	Black
1.0	1,000,000	Brown	Green	Black

THE NEW PATHFINDER a-c seven-tube super contains seven tubes only in appearance. In performance it contains eight tubes, or even more, for one of the tubes in the circuit is the 55 duplex diode triode which serves three distinct purposes, namely, diode detector, voltage amplifier, and automatic volume control. No particular novelty is claimed for the circuit, because from the antenna binding post to the loudspeaker terminals it is based on well-tried principles. Yet there are several features worthy of special **notice.**

Oscillator Design

Consider the oscillator, for example. It employs a 56 tube, which is a very good amplifier. And because it is a good amplifier it is also an excellent oscillator. It is a too vigorous oscillator, in fact, and something has to be done to keep down the intensity of oscillation. In the grid lead is a 10,000-ohm resistor which does its share in keeping the oscillation within bounds. Then there is a 50,000-ohm grid leak instead of the usual 100,000 ohms. This prevents blocking due to excessive oscillation and to insufficient leakage. The voltage in the secondary is also divided so that only a part is impressed on the grid, which is done by grounding the junction of the tuning condenser and the series padding condenser. This arrangement also has the advantage that both the tuning and the series condensers can be grounded, making adjustment of the series condenser much easier.

The Modulator

The modulator is a 58 type tube, which is usually recommended for this function. It is operated with a grid bias resistor of 25,000 ohms, shunted with a condenser of 0.25 mfd. The pick-up coil, which is coupled to the oscillator coil, is connected in the cathode lead. This has been found to be an excellent way of coupling the two circuits.

When the 58 is used as a detector better results are obtained when the screen voltage is somewhat less than when the same tube is used for amplification. Hence a 75,000-ohm resistor is connected in the screen lead. This increases the detection efficiency.

For second detector the 55 is used in half-wave connection. That is, the two diode plates are connected together and the entire voltage developed across the secondary of the second intermediate transformer is impressed on the rectifier. The load resistance is the usual 0.5 meg-ohm and it is shunted with a condenser of 0.00025 mfd. The audio voltage developed across the combination is impressed on the grid of the 55 through a 0.01 mfd. mica dielectric condenser and a 0.5 meg. grid leak.

The amplifier grid is biased to the extent of 20 volts through a 2,000 ohm resistor in the voltage divider by connecting the cathode of the tube to a point 20 volts above ground potential. A condenser of 4 mfd. is connected across this resistor to make certain that there will be no audio feedback. The output of the 55 amplifier is filtered for radio frequencies by two 100 mmfd. condensers and a small radio frequency choke. The first of these condensers is connected between the plate and the cathode and the second to ground.

Automatic Volume Control

The automatic volume control voltage is derived from the d-c component in the load resistance on the diode and it is measured from the cathode of the 55. It will be noticed that this point is 20 volts above ground. The minimum bias on the controlled tubes is about 3 volts. This would make the actual grid voltage 17 volts positive when no signal is coming in. However, there is some grid current flowing in the controlled tubes, and this current must flow through 1.0 meg. resistance before it comes to the point from which the automatic voltage is measured. This current will cause a d-c drop, which is added to the fixed bias. It only requires a grid current of 17 microamperes to offset the positive bias, and this current can easily flow, especially when the automatic voltage is not effective. Therefore the tubes actually operate at the proper minimum grid bias.

As the signal comes in, the drop in the load resistance increases rapidly and therefore the bias on the controlled tubes increases. This in turn decreases the am-

VEW TUBES, PER SURE DOES STEP OUT!

Mannion
dio Co.

LIST OF PARTS

Coils

- L1—One antenna coil, shielded, for 350 mmfd. condenser.
- L2—One capacity coupled r-f coil, shielded, for 350 mmfd. condenser.
- L3—One shielded oscillator coil for 350 mmfd. condenser and 175 kc i-f.
- L4, L5—Two shielded doubly tuned 175 kc intermediate transformers.
- L6—One 80 millihenry r-f choke coil.

Condensers

- C1, C2, C3—One 3-gang, 350 mmfd. tuning condenser assembly.
- C4, C5—Two 8 mfd. electrolytic condensers.
- C6, C7—Two 4 mfd. by-pass condensers.
- C8—One 0.0025 mfd. condenser.
- C9, C22—Two 0.001 mfd. condensers.
- C10 to C16, inclusive, seven 0.25 mfd. by-pass condensers.
- C17, C18—Two 0.01 mfd. mica condensers.
- C19, C20—Two 0.0001 mfd. condensers.
- C21—One 0.00025 mfd. condenser.
- C23—One 80 mmfd. equalizer condenser.
- C24—One 0.1 mfd., 400 volts, condenser.

Resistors

- R1—One 7,500 ohm, 10 watt resistor.
- R2—One 8,000 ohm, 2 watt resistor.
- R—One 2,000 ohm, 2 watt resistor.
- R4—One 5,000 ohm potentiometer, with line switch.
- R5—One 150 ohm resistor, one watt.
- R6—One 7,500 ohm, one watt resistor.
- R7—One 500 ohm bias resistor, one watt.
- R8, R9, R10—Three 0.5 megohm resistors, one watt.
- R11—One 30,000 ohm, one watt resistor.
- R12—One one megohm, one watt resistor.
- R13—One 100,000 ohm, one watt resistor.
- R14—One 250,000 ohm variable resistor.
- R15—One 10,000 ohm, one watt resistor.
- R16—One 50,000 ohm, one watt resistor.
- R17—One 25,000 ohm, one watt resistor.

Other Requirements

- One drilled chassis.
- Eight wafer type sockets (Four 6-pin, two 5-pin, and one 4-pin)
- Insulating washer for C4.
- Antenna and ground binding posts.
- One roll of hook-up wire.
- One package of hardware.
- One line cord and plug.

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plification and the increase in the output is checked.

Designed for Performance

It will be observed that throughout the set has been designed for good performance. This is particularly noticeable in the choice of by-pass condensers and resistors. Large condensers and resistors of high wattage are used. In the voltage divider, for example, there are two two-watt resistors and one ten-watt resistor and the two condensers from the taps to ground are 4 mfd. units. The resistors are also low so that the regulation of the voltage will be good. Good regulation always yields better performance.

Besides the distributed filtering throughout the circuit there is the usual B supply filter consisting of two 8 mfd. electrolytic condensers and the speaker field choke. The resulting hum is negligible but it is still further reduced by a 100,000 ohm resistor and a 0.5 mfd. condenser in the grid circuit of the power tube.

A tone control is another feature that adds to the value of the circuit. It consists of a 0.1 mfd. condenser and a 250,000 ohm variable resistor, connected in series across the output of the power tube.

The Power Supply

There are two 2.5 volt windings on the power transformer, both centertapped. One of these is used only for the power tube and the pilot light, and the other winding is used for all the other tubes. Of course, there is also the 5-volt winding required by the 280 rectifier, but this is not centertapped. The high-voltage winding maintains a voltage of 350 volts each side of the center, or a total of 700 volts. The rectified output voltage with the tubes all functioning is 235 volts.

The speaker field winding is put on the negative side of the voltage supply in order to provide a bias for the power tube from the drop in a portion of the coil. The coil has a total resistance of 1,800 ohms and a tap is put at three hundred ohms. This smaller section is put between ground and the grid return of the power tube. A bias of a little more than 16.5 volts is thus obtained.

The intermediate frequency is 175 kc and there are two doubly tuned transformers adjusted at this frequency. As customary, there is only one stage of intermediate amplification and the tube used is a 58. It is biased with a fixed resistor of 500 ohms in addition to the manually controlled bias and the automatic bias. The high limiting resistance is used as a preventive of oscillation when the circuit is in its most sensitive adjustment.

The R-F Tuner

The r-f tuner consists of one antenna coupler, one interstage coupler and one oscillator coil. The antenna coil contains two windings and is a typical transformer. The interstage coil contains three windings, one acting as a coupling choke, another as a coupling condenser, and the third as tuned winding. The choke winding is not inductively coupled to the tuned winding but is mounted so that its axis is a right angles with that of the tuned winding. This type of coil has been found to be particularly advantageous.

The oscillator coil also contains three windings, a tickler and pick-up in addition to the tuned winding. The three tuned windings are for the usual 350 mmfd. tuning condensers. Of course, the tuning condensers are ganged and padding is depended on for tracking of the oscillator with the r-f circuits.

Manual Volume Control

The manual volume control is a 5,000-ohm potentiometer connected between the antenna and the cathode returns of the r-f and i-f amplifier tubes. The slider is connected to ground. When a potentiometer with a tapered resistance is used the slow taper end should be connected to the antenna, as this gives a better control of the volume on strong signals. The reason for this is that it permits very nearly short-circuiting the input, whereas with a resistance that is not tapered slow graduations are not possible. The input is either completely shorted or there is a considerable input. The same difficulty arises with a tapered resistance if the taper is connected in the wrong direction.

The amplification in the r-f and i-f amplifiers is high and for that reason it is important that all the coils and the radio and intermediate frequency tubes be shielded. It is not necessary to shield the power tube and the rectifier.

High Sensitivity

Care in the design, use of excellent parts, and care in construction and lining up will result in this circuit providing sensitivity of better than 10 microvolts per meter, and selectivity that meets all requirements.

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What Screen Voltage?

Question Arises About New Tubes

By Conrad Halleck

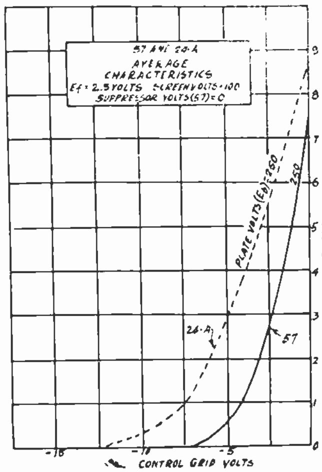

FIG. 1

IT IS now well known that when screen grid tubes are used in resistance coupled audio circuits the screen voltage should be low for best results because the screen voltage must always be less than the effective voltage on the plate. Now we have a new set of screen grid tubes. These tubes differ from the old in that they have a suppressor grid between the plate and the screen grid, the extra grid, ordinarily, being connected to the cathode. The question about these tubes at once arises as to the necessity of using a low screen voltage for r-f and a-f when the tubes are used in resistance coupled circuits. The recommended screen voltage on these tubes is much higher than that for the older tubes without the suppressor grid. This recommendation is based on the fact that the screen voltage no longer must remain lower than the effective plate voltage, for the plate current is virtually independent of the screen voltage.

If we glance at a set of plate voltage plate current curves for different grid bias values taken on the new tubes we arrive at the conclusion that it should not be necessary to use a low screen voltage because the irregularities in the curves in the region where the screen voltage is higher than the plate voltage no longer exist. However, preliminary tests have shown that in these particular audio circuits, both in amplifiers and detectors, it is better to use somewhat lower screen voltages than those recommended when the tubes are to be used in circuits having a low d-c load resistance, but not nearly as low as the value necessary with the older tubes.

Plate Characteristics

In Fig. 2 are two families of plate current, plate voltage curves, one for the 24-A and the other for the 57. A striking difference is noted in the region zero and 150 volts on the plates. The curves for the 24-A tube begin to drop rapidly at 150 volts on the plate, 50 volts higher than the screen voltage, but the curves for the 57 do not begin to drop rapidly until the plate voltage is less than 50 volts, which is about 50 volts less than the screen voltage. Thus the usefulness of the 57 tube extends to a plate voltage less than half the screen voltage. Thus the reason is clear why it is not necessary to use so low screen voltages on the 57.

It is equally clear from the curves that if the load resistance is 250,000 ohms we cannot use the full screen voltage recommended. If the applied voltage is 250 volts the resistance in the load is 250,000 ohms, the load line will pass through 250 volts on the voltage axis and 1 milliampere on the current axis. This line will cross the curve for zero bias well beyond the point where it begins to drop rapidly. In fact, the load lines will cut all the curves well beyond the bend and we can expect a great deal of distortion, and very little else. If the load resistance is limited to 50,000 ohms we stay well within the regular region of the curves and there will be little distortion. It appears that if we bias the grid 5 volts for detection we shall have a good detecting efficiency with the recommended plate load resistance, that is, 250,000 ohms and the recommended screen voltage. But this will be investigated specifically by taking curves of the tube under detecting conditions.

Grid Voltage Curves

Fig. 1 shows grid voltage plate current curves for the two tubes for 100 volts on the screen, 250 volts in the plate circuit and zero suppressor voltage. While the curve for the 24-A is higher this does not mean that the tube is superior to the 57. The slope of the 57 curve is steeper and the cut-off sharper. Thus the 57 is the better amplifier as well as the better detector. The fact that the curve is lower shows only that the 57 is more economical in plate current.

Unfortunately, these curves have been taken with no load resistance and therefore they do not show the effect of the screen voltage. About all they do show is what the grid bias should be for best detection, which is about 5 volts for the 57 and 8 volts for the 24-A. Here again it is necessary to take additional curves to show the performance of the 57, and these curves show the voltage across the load resistance for various grid voltages. These curves will show more definitely what can be expected from the tube, both as voltage amplifier and as detector. They will be published as soon as they can be obtained.

Performance of 58

The performance curves of the 58, shown in Fig. 3, show clearly that this tube is superior to the 35. But if we are to use the tube in a resistance coupled circuit with 100 volts on the screen and 250 volts in the plate circuit, we should limit the plate load resistance to about 17,000 ohms. The amplification under these conditions will only be about 20 times. If we want to use the 250,000 ohm resistance we must limit the screen

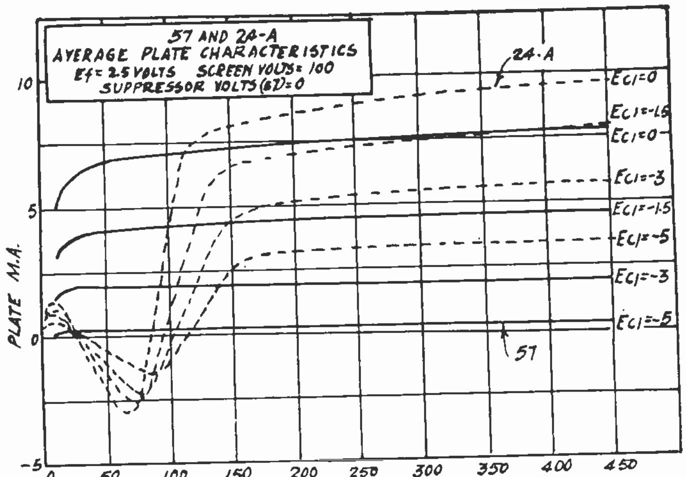

FIG. 2

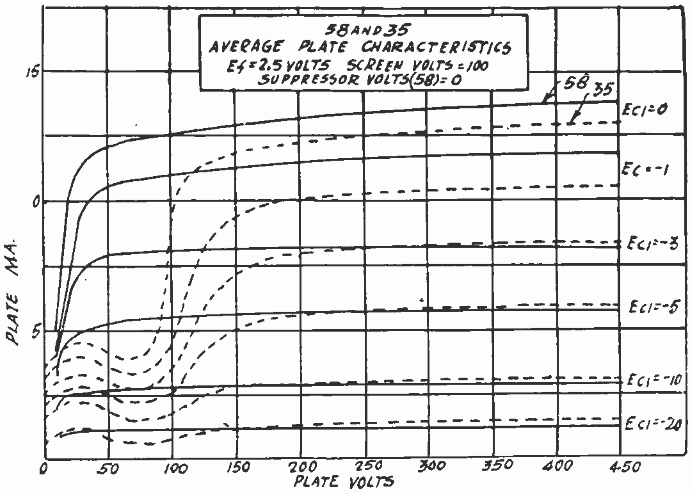

FIG. 3

voltage to a comparatively low value, although not as low as we would have to use with a 35. Just what voltage should be used on the screen the curves do not show and other curves will have to be obtained. These curves will show the voltage across the load resistance against the grid voltage for various screen voltages.

With the higher load resistance a higher gain is possible, but this gain is reduced by lowering the screen voltage. Hence it is necessary to find the highest screen voltage that can be used with a given load resistance. Just what the limiting value is depends on the extent of the regularity of the curve, as well as on the amplitude of the signal on the grid.

Using Suppressor Grid

One of the advantages of a tube having an accessible suppressor grid is that various voltages may be applied to that grid to obtain certain desired effects. For example, the extra grid can be used for controlling the amplification in the r-f amplifier for the amplification is less the higher the negative voltage on the suppressor. The 58 can be operated with negative voltages up to about 45 volts on the suppressor. At this voltage there is a complete cut-off in the mutual conductance, and therefore of the amplification. At the same time that it is used as a volume control it can also be used as a control of the selectivity, which means a control of the tone. The functions of selectivity and volume control, however, are not independent.

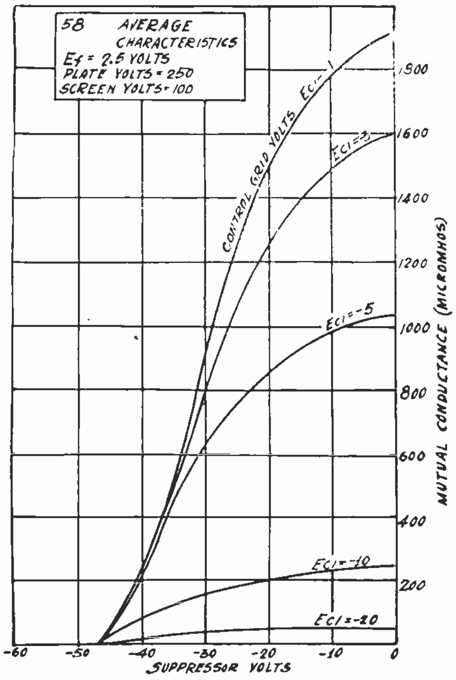

FIG. 4

Another use of the suppressor is for modulation in the first detector of a superheterodyne. The oscillator voltage may be applied to the suppressor grid and the carrier voltage on the regular control grid, or vice versa. For this application the suppressor grid should be biased negatively by an amount somewhat exceeding the amplitude of the oscillator voltage applied, or preferably by an amount somewhat greater than the sum of the peaks of the oscillator and signal voltages. This is to insure that at no time will the suppressor voltage be positive.

The effect of varying the suppressor grid voltage is shown in Fig. 4, which gives the relation between the mutual conductance and the suppressor volts for the case of 250 volts on the plate, 100 volts on the screen, and various grid voltages and no load in the plate circuit.

If the tube is to be used as a modulator in a superheterodyne the control grid might be given a bias of 5 volts negative and the suppressor grid a negative voltage of 20 volts. While the 58 has been recommended for modulator the 57 is preferable for this purpose. However, curves of the mutual conductance are not available for this tube and the best operating conditions will have to be found experimentally until the curves have been obtained.

THE MIXING PROCESS

When two different frequencies are combined there are resultant frequencies equal to the sum of and also the difference between the two. For instance, if an audio frequency of 500 cycles were mixed with an audio frequency of 200 cycles the result would be two frequencies, 700 cycles and 300 cycles. If the frequencies were multiples the result would be higher. If 500,000 cycles (50 kc or 600 meters) were mixed with 200,000 cycles (150 meters) the resultant frequencies would be 700,000 cycles (700 kc) and 300,000 cycles (300 kc). What the frequencies are does not make any difference so far as the process of the mixing is concerned.

Besides these two—the sum and the difference—there are other frequencies, due to harmonics mixing with fundamentals and harmonics mixing with harmonics, but with these we need not concern ourselves, as they are not generally used in superheterodyne receivers.

In a tuned radio frequency set it is quite simple to understand that all the tuned circuits are resonant, that is, tuned to the same frequency at the same time, and thus the signal is selected better and better in progressive stages.

Tuned to Two Frequencies

In a superheterodyne we always have the tuned radio frequency feature also, even if the only tuning to the signal carrier frequency is that of the modulator, and even if the modulator is also the oscillator tube, as in the autodyne, for then the same tube is tuned to two different frequencies. Most often there is a stage of t-r-f ahead of the modulator. Another name for the modulator is the first detector.

So we tune part of the receiver, the first part, to the frequency of the station desired to be received. We have an intermediate amplifier at a fixed frequency, be it 175 kc, 400 kc or whatever else, and it is therefore necessary to do something to lower the frequency of the original station carrier to the very frequency of the intermediate amplifier. This we do by the beat system.

So we set up an oscillator. When this is going, and coupled to the modulator, the oscillator frequency is mixed in the modulator with the station's carrier frequency. The modulator is that, or first detector, because frequency changing takes place in that tube. Frequency changing defines detection as well as does anything else.

Tuning in the Band

Now we know two things: first, the frequency of the station carrier and, second, the intermediate frequency. Therefore we need only add the two to determine the oscillator frequency. It may be greater than the signal carrier frequency, or less than the signal carrier frequency, but we shall follow the practice of using the higher alternate frequency for the oscillator. Therefore to tune in a station at 1,000 kc the r-f part of the circuit is tuned to that, the oscillator to 1,000 plus the intermediate frequency, say, 175 kc, hence an oscillator frequency of 1175 kc is necessary.

As there are some ninety-six channels, for which the r-f tuning is very simple, we must have an oscillator that tunes to a frequency 175 kc higher than that of any one channel to create the intermediate frequency to receive that channel. So if the span of the r-f tuner is 1500 to 500 kc, that of the oscillator for 175 kc intermediate should be 1675 to 675 kc. If we desire to use gang tuning—single control—we must pad the oscillator condenser, to cut down its capacity ratio, and also reduce inductance, so as not only not to tune in too wide a frequency span, but also so that for every dial position representing one channel there will be the same dial position for the osscillator representing a frequency 175 kc higher. Then when mixing takes place, the intermediate frequency will be the modulator's output, because the signal frequency has been subtracted from an oscillator frequency 175 kc higher, and the difference is the intermediate frequency.

DC POSSIBILITIES — — 82 "HASH"

Sets for D-C Lines

WHY HAS so little attention been paid to sets for use in places where there is only direct current line? We realize that a-c is used mostly, but how about us d-c fellows?—G. S. A., Buffalo, N. Y.

The reason why not so much attention has been given to sets for operation on d-c electric lines is that until the heater type tubes of relatively low power consumption were brought out it was not practical to devise a d-c set of any consequence. The wasted power due to voltage drop for filaments of filament type tubes, or indeed only for the power tube, was a serious item of upkeep expense, so serious that the power consumption was seldom mentioned. Now with a complete line of automotive tubes, including power tube, all heater type, the way is open to building efficient d-c sets, and the diagram of one of them is published elsewhere in this issue.

* * *

"Hash" from the 82

HAVING tried the mercury vapor rectifier, type 82, in my sensitive receiver, I am disappointed, because there is a constant interference that resembles "hash" static, and I can not eliminate it.—F. R. E., Beloit, Wisc.

Yes you can. Put a radio frequency choke in series with each plate lead of rectifier. The inductance may be from 1 mlh up, and as much as 10 mlh. commercial type 800-turn coils, have been used with satisfaction, the receiver drawing 80 ma. Just as soon as the chokes were put in the interference stopped, and you will undergo the same pleasant experience.

Detectors to the Fore!

55 and 85 for Quality, 57 for Sensitivity

By Capt. Peter V. O'Rourke

THERE has been wide discussion of the amplifiers among the new tubes, but the subject of detection is certainly no less interesting, and if anything is more important. The two opportunities offered are high-class quality detection, with the duplex diode triodes, and highest sensitivity, with the same general order of quality as heretofore, with the 57.

Taking first the subject of quality, it is practical to obtain linear detection with the 55 and 85, these two being the 2.5 volt a-c model and the 6.3 volt automotive model, respectively. The requirement is that the resistor from cathode to the return of the anode be sufficiently high, and a value of 0.5 meg. is generally recommended. This should be bypassed, but the capacity should not exceed 0.00015 mfd.

Low Sensitivity

Since quality is the main consideration with the 55 and the 85, naturally sensitivity is second. On this score we can not give the tube much credit, because, as with all diodes, there is no amplification, so a high signal level must be fed to the tube if the final output of the receiver is to have a large sound volume. To offset this low sensitivity, at least to a substantial degree, the triode unit has been included in the same envelope. Thus we have a tube with a six-pin base and a metal (triode) grid cap at top. The heater connections are the larger pins side by side, the two plates of the diodes are in line with the heaters, while between one plate and the nearer heater is the cathode in familiar position and between the other plate and the nearer heater is the plate of the triode. Perhaps to avoid confusion the diode plates should be called anodes. Then "the plate" should have its common meaning, the plate of a tube with three or more elements.

The pictorial representation of the socket connections for all the new tubes, with drawn-in details of tying the various grids to different places for different purposes, was published last week, in the August 13th issue, together with a tube chart, two full pages, giving the characteristics of all detector and amplifier tubes, including power amplifiers.

Full-Wave Detection

Now, with the 55 and 85 we may use the two separate diode units as we see fit. For instance, one unit may be used for half-wave detection, the other for automatic volume control. Or we may use both diodes units for full-wave detection and a. v. c. There we again strike the sensitivity consideration, for with full-wave detection we put in normally half the voltage that we do when we use half-wave detection. This assumes the same ratio of transformation, but with a center tap. Since the voltage put in is between center and each side, naturally if the center is just that, the voltage input is halved.

Commercial coils are now obtainable for intermediate frequencies of 450 kc* and 175 kc, with center-tapped secondaries, as well as t-r-f coils for 0.00035 mfd. tuning, so that full-wave detection may be tried out. The t-r-f coils do not have the tuned windings center-tapped, since the common rotor of the tuning condenser is connected to one side of the tuned winding and is grounded, whereas the diode input can not have the r-f coil grounded except in the special case of a diode-biased triode, to be discussed presently. So, to avoid grounding as a necessity, an r-f choke coil of 200 turns, inductance about 1.3 millihenries, is wound on a piece of insulation material that just fits into the inside of any ordinary standard coil of 1 inch outside diameter. The two extremes of this choke are connected to the respective anodes of the diode, while the center tap goes to one side of the 0.5 meg. load resistor, the other side of which resistor goes to cathode. Due to its high inductance this choke builds up the amplification on the lower radio frequencies, and thus the r-f response is made more nearly level, whereas otherwise the characteristic is one of sharp increase in amplification with frequency.

Application

The diode has been tried out very thoroughly, and it can be rated as the best quality detector so far, with the triode section introducing a stage of resistance-coupled audio with 0.1 meg. plate resistor, and 20 volts negative bias on the triode, not quite making up for the sensitivity lost by replacing a '24 with a 55, although coming close to it. The voltage is about 25 per cent. off, which is not serious, especially as it scarcely notices differences in volume of sound unless they exceed 25 per cent.

The resistance coupling may be direct, by connecting return of the anode winding also to grid cap, resulting in self-bias, permitting cathode grounded.

If one takes the familiar five-tube a-c t-r-f set, and puts in a diode, to replace the '24 detector, using the extra audio stage, the volume will therefore be less, but the quality will be improved. It is advantageous to capitalize this quality by using a high-quality output tube, and while this should be done by those desiring the finest tone, it requires three changes: replacement of the '47 with a '45 or 46 Class A, alteration of the bias and use of a matched output transformer. The pentode takes 16.5 volts bias. Speakers with tapped field coils in the negative leg permit a bias of a little more through the 300-ohm biasing section, due to 60 ma B current being drawn by the set. To get the right bias, therefore, all one need do is to ignore the tap, and connect the grid return to the joint of two resistors connected between B minus and ground. What the proportion of resistance values should be will depend on the tube. For the '45 the easiest way, since the drop is about 100 volts across the dynamic field, would be to use two equal resistors of at least 50,000 ohms each, in series, and connect grid return to the joint of the two resistors.

Bias for the 46

For the 46, at 33 volts, the proportion is 1 to 3, with the resistor one-third the total placed between ground and joint and the resistor of two-thirds the total resistance between B minus and joint, grid return to joint. The output transformer will not be right for either of these tubes, as the '47 output impedance is about twice that of the others, and this extra change may be made by the fastidious.

The diode therefore is most suitable for superheterodynes, and if the sensitivity is not quite so great it does not matter. There is plenty to spare if the set is pretty good. Besides, by carefully aligning the intermediate coils, setting the condensers with insulated screw drivers, greatest possible accuracy of setting being watched preferably with the aid of an output meter, no doubt the drop in the sensitivity in the detector can be made up by the intermediate alignment. With even '35 tubes in the intermediate it is no trick at all to get a gain of 300 per stage, compared to 100 per stage when there is even slight misalignment.

The diodes are high signal level detectors, but it is not true that virtually anything you can put into it will be safely handled. An emission test is recommended, whereby with 10 volts of d-c input, between anode and cathode, the current should not be less than 0.5 ma, with no other load. This 10-volt figure may be significant. Not very much more may be put into the tube without causing trouble, for this diode can not "stand anything and everything."

The 56 as a Diode

If one wants a diode that will stand up to 40 volts input then he should use the 56 as a diode, by connecting plates and cathode, and using the joined elements as cathode, and the erstwhile grid as anode. The amplifier tube, if any, would be additional. Moreover, this method lends itself to push-pull resistance coupling, concerning which there was an article in last week's issue (August 13th).

The 57 as a detector is unique for its sensitivity. It is far more sensitive than the '24. But it is recommended for operation at 6 volts negative bias, and that discloses at once that it is a low-signal-level detector. The reason is that high signal levels will overload it. Taking the d-c bias voltage as 6 volts, then the peak value of the signal must not exceed 6 volts, unless the tube is self-biased, when the signal may be somewhat higher, because the self-bias will increase.

But if self-bias alone were used on the 57 we would have a resistor from cathode to B minus to furnish the bias due to resultant voltage drop across the resistor, and with a sensitive detector tube the plate current will change greatly with small changes in signal amplitude. So we find with a voltmeter that if the drop is 6 volts with no signal input, it may rise to 20-odd volts with the signal input of the strongest local. While it is true the bias has gone up, the detecting efficiency has gone down, and indeed half the time there may be no plate current flowing.

Bias from Total Current

Therefore the tube is recommended to be biased at least in part from bleeder current, as this is only slightly affected by signal amplitudes, compared to the 57 alone.

To put the same situation differently, when the tube is self-biased the actual bias changes so much that from station to station the bias keeps changing consider-

(Continued on next page)

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*Tunable 380 to 40 kc.

The Crystal Receiver

Why It May Get Some Distance Occasionally

By Paul Erwin

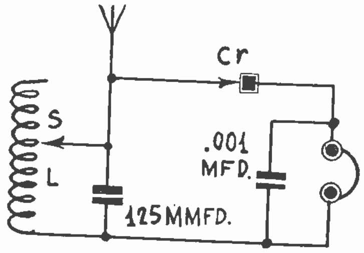

FIG. 1
The circuit of a simple crystal set of the type that was popular many years ago.

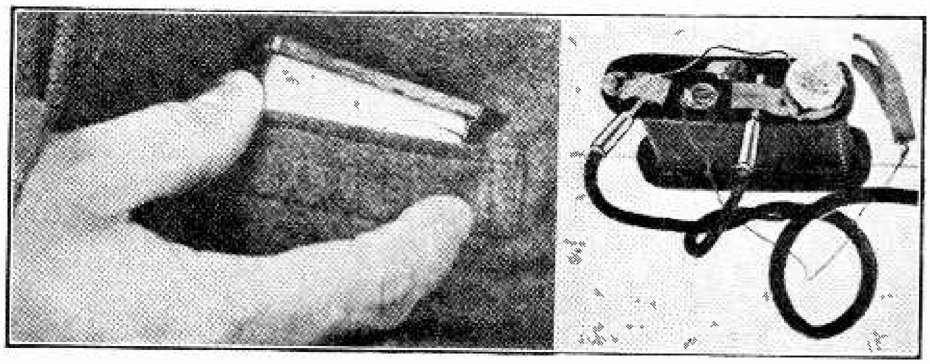

FIG. 2
At right is shown the construction of the vest pocket crystal receiver, with the crystal and the terminals on top. At left is shown the receiver inserted in the vest pocket.

WE described a crystal set last week, the type of set that was very popular years ago, and which now is once more receiving some attention. The crystal set is the simplest possible receiver and the least expensive to build. Because of its low cost, it is still used extensively in many European countries, especially where the tax on receivers is in proportion to the number of tubes used. A crystal set, of course, cannot be used with a loudspeaker, but with a headset very satisfactory results can be obtained. That was true in the days when the power output of the greatest stations was 500 watts. Now the power has been increased a hundred-fold, and even a thousand-fold.

What Crystal Set Can Get

There are now stations in this country operating on an experimental basis with 200,000 watts and it will not be long before the power will be up to 1,000,000 watts. Most of the large stations on cleared channels use regularly 50,000 watts. All this power means that with a good antenna and ground even some distant stations can be received with a crystal set. Surely in every principal locality several stations could be received regularly with a crystal set. Thus in the vicinity of New York stations such as WEAF, WJZ, WOR, WABC, WMCA, and a few others can be received. Occasionally even KDKA and WGY would be receivable in view of the high power used by these stations.

Problem of Good Antenna

The better the coil in a crystal receiver the more stations will be picked up, but this point is not nearly so important now as it was when the higher power of a station was 500 watts. It is of greater importance to provide a good ground and a good antenna.

In crowded sections it may be that a good antenna cannot be erected, but this is partly compensated for by the fact that a first class ground is always possible. There is no better ground than a cold water pipe. In the suburbs both a good ground and a good antenna can be provided without much trouble.

But signals can be received even without a first class antenna. The crystal set diagrammed in Fig. 1 and pictured in Fig. 2 picked up signals from local stations with a portable antenna and ground. This is notwithstanding the fact that the entire set is about the size of a cigar lighter and fits into a vest pocket. For details of winding the coil those interested may look in the preceding issue.

The frame of the coil and set is made of wood and the crystal and terminals are mounted at one end of the wooden piece.

Effect of Self-Bias of the 57

(Continued from preceding page)

ably. With strong stations one may be far from the most desirable detecting point. But if the bias is obtained from a voltage divider through which considerable current flows—particularly all the B current of the set—then a state of steadiness obtains. But it is a little difficult to get the bias just right that way, because at 100 ma 60 ohms would give just 6 volts, and an adjustable instrument, like a 75-ohm rheostat, would have to be used. Once set, it need not be changed.

From experimental findings it is possible now to state that if self-bias alone is to be tried (although not recommended) the biasing resistor may be 40,000 ohms, if the plate resistor is 0.25 meg., the screen plate voltage 250 volts, and the screen voltage 100 volts. The warning must be given that the current through the tube is extremely small (in this case it was 0.15 ma). and the ordinary voltmeters will not accurately read the voltage drop across the self-bias resistor, not even 1,000-ohms-per-volt voltmeters. The way to measure the voltage is with an electrostatic voltmeter, or a vacuum tube voltmeter, or compute it, after measuring the value of the biasing resistance and the current through the circuit when the resistor is in circuit.

In short-wave set, or simple t-r-f receivers, therefore, the 57 serves an excellent purpose, providing the sensitivity where it is needed most. But one precaution should be taken for capitalizing the sensitivity and also for providing good response on low notes. The resistor used for dropping the higher B voltage to the 100 volts used on screen should be 8 mfd. or higher capacity, especially if the resistor is of the usual 1-watt pigtail type, as the resistance will be pretty high, in the tens of thousands of ohms.

Radio University

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RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

Second I-F Stage Troublesome

IN THE SUPERHETERODYNE I built I tried two stages of intermediate frequency amplification at 400 kc and have had quite a job trying to stop it from oscillating at the intermediate level. I have about come to the conclusion that one stage is about as far as can be accommodated, using the new tube (58). I can stop oscillation only at a sacrifice of sensitivity that brings me back to the level where I was with one stage.—T. H., Springfield, Ill.

Unless special precautions are taken as to filtration and shielding it is virtually impractical to use two stages, whether the intermediate frequency is 400 kc or as low as 175 kc. The filtration should be as follows to support two stages: Each plate, cathode and screen lead choked and bypassed by a condenser of 0.1 mfd. or higher capacity, common B lead to plates and common B to screens each bypassed by 1 mfd. or higher capacity, stage shielding in a separate box shield that encloses tube, coil, chokes and bypass condensers, and the tube should have a separate special shield of the type made just for the 57 and 58. The coil centers, despite shielding, should be not less than 6 inches apart, shields should be grounded and a metal chassis used, with a metal cover for the bottom. Unless these precautions are taken it is, as you say, impractical to get any more out of two stages than out of one. Besides, please note that one-stage intermediate amplifiers are in sets that have sensitivity of better than 10 microvolts per meter.

* * *

PLEASE SHOW connections for plug-in coils to provide regeneration. I have several different types of coils, including UX, UY and six-pin bases.—O. W., Los Angeles, Calif.

It is assumed you are building a short-wave t-r-f receiver, and that you have a suitable coil system for the antenna stage. For the regenerative detector any of the arrangements illustrated in Fig. 1025 may be used. At upper left a UX base coil is used, the tuned winding is in the plate circuit, and the series condenser C1 prevents shorting the B supply if condenser plates touch. It may be 0.006 mfd. or higher for tuning capacities around 0.00014 mfd. The grid leak may be 2 meg., or higher, if regeneration is not satisfactorily strong. Control is by capacity feedback, and C2 is a protective series condenser again. At lower left a UY base coil is ill used. The secondary is tuned. The primary and the feedback winding are a single tapped coil, used for two electrically different purposes, but having their returns to a common voltage source. This is a makeshift use, and so is that of upper right, with a UY type again. The better methods are upper left and lower right. The lower right uses the new six-pin base coils, with three separate windings for plate of r-f, detector grid and detector plate. Capacity control is feedback as shown.

* * *

Spasmodic Set

FOR SOME TIME I have enjoyed reception on my set, but recently performance has become decidedly erratic. I notice that for long periods there is no reception and I can not restore it by any means. Other times there is no trouble at all. I have tested the set itself and it is O.K. I have tested the tubes and they're fine, too. I notice that sometimes when we are dancing to radio music the set stops. I have examined the aerial but it is all right. So is the ground. Is there anything left that can be wrong, and if so please let me know in a hurry, as I am in a quandary? I have connected my neighbor's aerial to the flexible leadout wire for aerial at the set and that doesn't make any difference—behaves badly on my set, though serves perfectly on his. Hurry your reply.—K. H., Carson City, Nev.

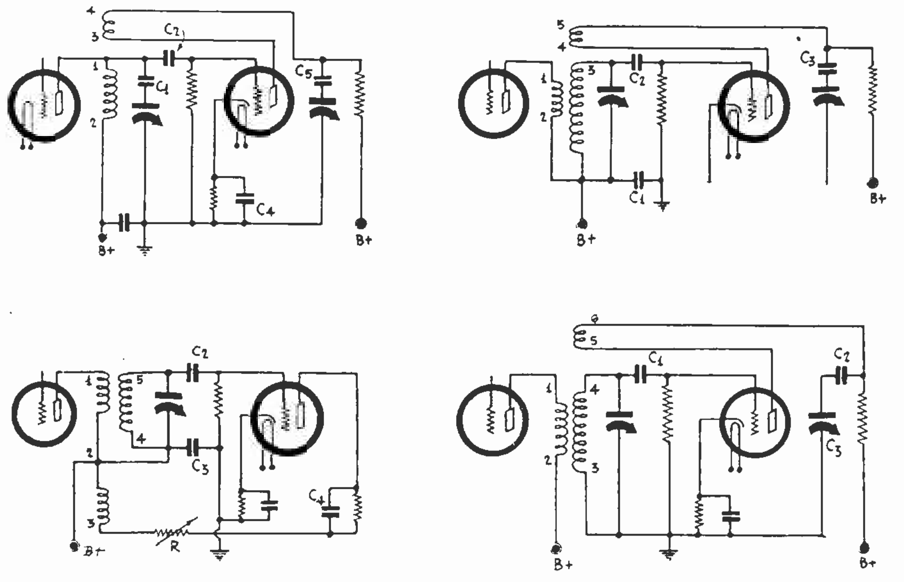

FIG. 1025

Use of plug-in coils in a regenerative detector for short-wave purposes particularly, although of course practical on the broadcast band as well. UX type coil upper left, UY type coils lower left and upper right, six-pin base type coil, three separate windings, lower right.

Tension on the flexible leadout wire from your set used for aerial connection has abrased the insulation, so that on certain occasions a short of the aerial input occurs, when the conductor strikes the metal chassis. This is likely to occur when there is vibration, as when you are holding a dance. Also vibration may dislodge the short for a while. Hence you have spasmodic results. Put bicycle tape around the leadout wire for several inches either side of the hole through which the wire emerges from the chassis.

* * *

A Dead Stage

ONE OF THE STAGES of a set I recently built prevents the signal from coming through. I have tested the stages ahead and those afterward and they are all right. The coil in the dead stage is O.K., so is the tube when tested outside, though when in that socket it gets very hot in a short while. In fact, the tube emission is lower and lower the more I try doing something with the tube in that socket. Please advise what remedy to apply.—K.U.L., Cheyenne, Wyoming.

Remove the flattened drop of solder that accidentally becomes wedged between two springs of the socket in the dead stage. Solder drips produce exactly the situation you complain of, and cause considerable mischief. The tube is probably not worth using now, as it has been worked with two shorted elements for too long a time. Always check carefully the presence of stray or extraneous solder after you have wired a set.

* * *

Peck's Scanner

IN THE PECK SYSTEM of scanning concerning which you have printed several articles, am I right in supposing that there is parallel light, and that no focussing is necessary to change the size of the television image on the screen, simply moving the screen forward or backward producing the desired result?—J. R. Z., Amityville, N. Y.

No, a system of parallel light is not used but the situation you describe is what obtains. The Peck system of scanning (at the receiving end) consists of a small disc around the periphery of which are disposed sixty lenses for 60-line scanning. The arrangement is strictly circular, not spiral. The lenses are tilted to produce the scanning, and have mirrored backs for reflection. So the output of a neon lamp, into which lamp the television pulses are fed from a receiver, is concentrated through a condensing lens on approximately a spot on the disc, at optic center of the lenses. As the disc is rotated by a synchronous motor the scanning of the spot of light takes place. The lenses reflect the light to the screen. Thus the light does not have to pass through a pinhole, and the severe attenuation of any such passage is avoided. The light efficiency is very high. The system is one of the best devised. It is ahead of both the receiver, the neon lamp and the transmitter. Application of the system to a transmitter was discussed in last week's issue (August 13th).

* * *

Push-Pull Detection?

FREQUENTLY I HAVE SEEN diagrams elsewhere of push-pull detectors and yet you have consistently maintained

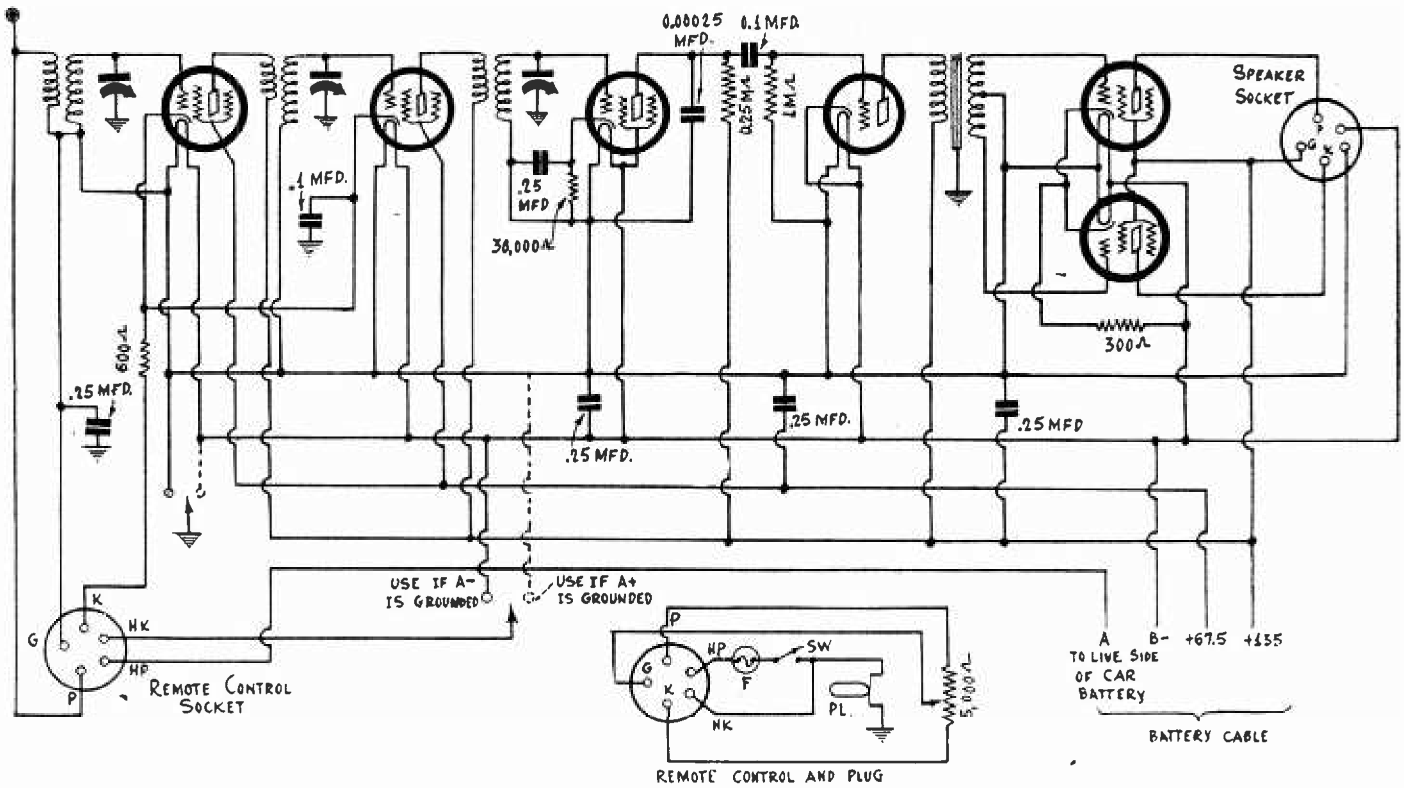

FIG. 1026

This is the circuit of six-tube automobile receiver of the t-r-f type. It uses two 238 tubes in push-pull in the output stage. It can be used on cars with positive or negative grounding of the battery with a slight change in wiring.

that there is no such thing as a push-pull detector. What is the answer?—P. O., Monmouth, N. J.

The answer is that there is no such thing as a push-pull detector. The input may be so-called push-pull, but is better described as what it is, full-wave. There is no way of obtaining a push-pull output where the output is rectified.

It is practical to use the diode-biased triode. That requires that the grid (cap) of the 55 be connected to the return of the anode input winding, the resistor from this return to the cathode providing not only the rectified output voltage drop but also the same voltage drop constitutes bias on and input to the triode. It is nothing but direct coupling. Its use is not recommended by us, because at no signal there would be zero bias, and too much plate current in the triode, while at any and all signal inputs the bias would change with the signal amplitude. Fortunately the bias change is in the right direction—higher signal input, higher bias—but too often, at lower signal levels, there is not enough bias, and the triode chokes up. One way out would be to reduce the plate voltage. But that is strictly a compromise, and we believe it is a poor one. We prefer to use the separate bias method, as you outline, unless something is fed to the diode when there is no carrier input, and thus a limiting and stabilizing agency is introduced.

* * *

Super He Wants

WILL YOU PLEASE give me the diagram of a seven-tube super, a-c operation, using the diode detector, half-wave detection and a.v.c., diode plates tied together, and tell something of its performance? The output should be a '47 tube.—U. S. T., Annapolis, Md.

Just the circuit you inquire about is described this week on pages 12 and 13 and is illustrated on the front cover. This circuit has all the selectivity you will require, as it can separate local stations from distant ones 10 kc apart, and has a sensitivity of better than 10 microvolts per meter all through the broadcast band, being somewhat more sensitive from 1,500 to 1,000 kc. It works well in New York City with aerial consisting of six feet of wire, partly under the carpet, and ground a cold water pipe connection. Persons living in outlying sections, or at least not close to broadcasting stations, may improve the practical sensitivity simply by using a longer aerial. In all cases an indoor aerial suffices, but in rural districts an outdoor aerial may be used.

* * *

58 As A-F Detector

CAN THE 58 TUBE be used as an audio frequency detector? I notice that it is never so recommended, but it is recommended for use as a first detector in superheterodynes. Since detection is detection, how come?—T. R. W., Rye, N. Y.

The 58 does not work well as an a-f detector, even with a resistive plate load. If you put a 58 into a socket intended for the 57 you will find this out. The volume drop is nearly 90 per cent. However, the showing is improved considerably as the screen voltage is lowered. For instance, 10 volts on the screen for detection afford about twice as much sensitivity as 100 volts. This does not, however, apply to the 57. Since the lower screen voltage for the 58 does so much more for detection, it is suggested that any who are using the 58 as first detector in supers try a much lower screen voltage than the one recommended (100 volts). Try 10, 20, 40 volts. While detection is detection, the first detector changes one radio frequency to another, while the second detector, or any t-r-f set detector, changes radio frequencies to audio frequencies, or rather, eliminates the carrier to leave only the r-f. There is some difference in the tube exactions under these two somewhat dissimilar circumstances.

An Automobile Receiver

WILL YOU KINDLY PUBLISH a diagram of a six tube, t-r-f automobile receiver utilizing two 238 tubes in push-pull in the output stage? Please show in detail how the volume control and the pilot light should be connected. I desire to try the receiver on different cars so the circuit should be arranged so that it can be used on cars with either positive or negative grounding of the storage battery. I have heard that if the tubes are biased with the storage battery voltage as far as possible that better tone will result. If this is the case I should like to have a circuit of this kind. Please suggest the type of coils and condensers to use in the tuning system.—W. A. Jones, St. Joseph, Mo.

In Fig. 1026 is a receiver of just the kind you want. It is arranged so that it can be used for either type of grounding of the storage battery provided that you make the proper connection of a couple of leads. The dotted lines are to be followed in wiring for cars with the positive of the storage battery grounded and the full lines for cases where the negative is grounded. In case your battery cable contains only three leads, B minus should be connected to A plus on the car battery with an external lead. For tuning use a gang of three 350 mmfd. condensers and midget coils to match. It is customary in automobile sets to use coils with large primaries in order to get a high sensitivity. High selectivity is not of first importance in a receiver like this, but a high sensitivity is. In many auto sets of this type as many as 90 turns are used on the primaries, where the secondaries have about 127 turns. The two power tubes require a higher bias than the 6 volts of the storage battery and for that reason a 300 ohm resistor is connected between the cathodes of these tubes and the positive side of the filaments. This resistor practically doubles the bias, which makes the bias high enough.

A THOUGHT FOR THE WEEK

RUMORS STILL PERSIST to the effect that the National Broadcasting Company and the Columbia Broadcasting System are to merge. No confirmation of this is to be had from either the N. B. C. or the C. B. S.,—but Rumors still persist!

RADIO WORLD

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Eleventh Year

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

Standard RMA Color Code for Fixed Resistors

Body color indicates first significant figure.
End color indicates the second significant figure.
Dot or ring color indicates the number of ciphers after the second significant figure.

0	**Black**	**.0**
1	**Brown**	**0**
2	**Red**	**00**
3	**Orange**	**000**
4	**Yellow**	**0,000**
5	**Green**	**00,000**
6	**Blue**	**000,000**
7	**Violet**	
8	**Gray**	
9	**White**	

The first column gives the numerals and the second column the color corresponding. The third column gives the ciphers if ring or dot has color opposite.

HOOVER NAMES DELEGATES TO MADRID PARLEY

Washington

American delegates to the fourth International Radio Telegraph Conference at Madrid, Spain, opening September 4th, have been appointed by President Hoover at the invitation of the Spanish Government. Eugene O. Sykes, acting chairman of the Federal Radio Commission, will head the delegation. Other delegates are Dr. Charles B. Jolliffe, chief engineer of the commission, and Walter Lichtenstein, of the Frst National Bank of Chicago. The following technical advisers to the delegates will accompany the delegation: Dr. Irvin Stewart of the State Department, Lieut. Commander dward M. Stewart of the Coast Guard, Major William F. Friedman and Lieutenant Wesley T. Guest of the army, Lieut. Commander Joseph R. Redman of the Navy, Dr. John H. Dellinger and H. J. Wells of the Department of Commerce, and Gerald C. Cross of the Radio Commission.

Richard Southgate of the State Department will be secretary-general, Hugh Millard, second secretary of the American Embassy at Madrid, will be secretary, and R. Allen Haden, foreign service officer of the State Department, assistant secretary.

Private companies and organizations will be represented as follows:

Paul oldsborough, Aeronautical Radio, Inc.

W. G. H. Finch, American Radio News Corporation.

Kenneth B. Warner, Paul M. Segal and Clair Foster, American Radio Relay League.

Robert F. Hand and Harold L. Cornell, American Steamship Owners Association.

Eugene S. Wilson, Herbert E. Shreeve, Lloyd Espenschied and Laurens E. Whittemore, American Telephone and Telegraph Company.

Milton M. Price and Michael Schwartz, Associated Telephone and Telegraph Company.

Lawrence W. Lowman, Columbia Broadcasting System.

Ralph M. Heintz, Globe Wireless, Ltd.

Logan Rock and H. H. Buttner, International Telephone and Telegraph Company.

John Goldhamer and Morgan Heiskell, All America Cables and Commercial Cables.

A. Y. Tuel and Haraden Pratt, Mackay Radio and Telegraph Company.

F. G. Hummel, Mutual Telephone Company.

Louis G. Caldwell, National Association of Broadcasters.

Armstrong Perry, National Committee on Education by Radio.

Joseph B. Pierson, Press Wireless, Inc.

Colonel Samuel Reber, Radio Corporation of America.

Lloyd A. Briggs and W. A. Winterbottom, R. C. A. Communications, Inc.

Charles J. Panneill, Radiomarine Corporation of America.

William E. Beakes, Tropical Radio Telegraph Company.

Stanley J. Goddard, C. P. R. Goode, A. J. Deldime and L. C. Smyth, Western Union Telegraph Company.

WSM's Tallest Aerial to Be Ready in Fall

Nashville, Tenn.

Construction work on the vertical radiator antenna of WSM has started and is expected to be completed in the Fall, Harry L. Stone, associate director, declared. The mast, rising 878 feet into the air from the Brentwood site of the new 50,000-watt transmitter, will be the tallest antenna on the North American continent.

Vacuum Tube Characteristics

The charts of detector, amplifier and power amplifier tubes were published last week, issue of August 13th. The following completes the tube charts

REGULATORS IN NUMERICAL ORDER

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

TYPES FOR AMATEUR AND EXPERIMENTAL RADIO USES, IN NUMERICAL ORDER

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

STATION SPARKS

By Alice Remsen

An Envious Plaint

FOR "SKIPPY"

WABC, 5:30 P. M. Every Day Except Sunday

Just a barefooted boy wand'ring lone on the track,
With ragged blue jeans hanging limp on his back;
A fishing rod carelessly flung o'er his shoulder;
A king on his throne could ne'er have been bolder.

He strutted along with his head in the air,
A laugh on his lips, and a devil-may-care
Expression implanted in eyes brown as berries;
Skin like an Indian—lips red as cherries.

Barefooted boy, I envy your freedom!
Your lack of fine clothes, wish I didn't need 'em;
But custom say "Wear 'em" and so I must suffer
In collar and tie like any old duffer.

When I was a boy just as young as yourself,
Happy and carefree, a sturdy wild elf.
Shoeless, like you, I would wander along,
Keeping time in my heart to the lilt of a song.

But now—glory be!—I look back with a sigh,
To the innocent fun of the days long gone by.
I'd give all that I know and my very last sou,
If I could be young and barefooted like you.

—A. R.

* * *

AND "SKIPPY" WILL SURELY remind you of those dear innocent days. Tune in on these broadcasts, emanating from the Columbia studios in Chicago and heard over WABC in the East. You'll like them, and so will the children.

* * *

The Radio Rialto

Gee! It rained today, but that made no difference—our your little scribe went to roam the Radio Rialto in search of local color. Dodging under the marquee of the Strand Theatre, whom should I run into but Don Carney ("Uncle Don" to the kiddies), looking fine and tanned from summering at the beach. . . . . Too wet to linger; up the Main Stem to Witmark's; greeted by Bob Miller with the news of some great songs to be heard over the air-waves in the near future, culled from the talkie-fillum, "The Crooner." . . . Ran into the charming blind soprano, Mary Coward, accompanied by her companion and secretary. Mary has a gorgeous voice and will be heard over the air this winter on a major network. . . . As usual, Johnny McLaughlin's room is full of Irish tenors—John Fogarty, John Quillan, Joe White, Walter Scanlon, Tommy Weir, just to mention a few, and all radio favorites. It was Jessie Deppen who said that a body couldn't go into Johnny's room without falling over an Irish tenor—and she was right. . . . Let's pop into Harms' next door and see what we can find: debonair Will Rockwell, the Beau Brummel of songland, is manager there—whom's he got up his sleeves? . . . The Pebeco Playboys are rehearsing their six-handed piano act; can those boys play!—well, if you don't believe me, listen in some Tuesday or Thursday morning at 8:45 on WABC.

Well, time for lunch and I've got a date with Irving Bibo, song publisher. We go to the Tavern—good eating place; well, well, look who's sitting opposite us—so Lindy's isn't the only place where you can find band leaders! Here are two—Howard Lanin, "Evening in Paris" maestro, and Freddie Rich, of Columbia. "Hello, boys; nice day for ducks, isn't it!" . . . Out we go into the rain again . . . Who's that under the big umbrella? Well, I never—Lanny Ross, of Maxwell House Tune Blenders; the three of us huddle under two umbrellas while Lanny shows us a manuscript copy of "My Silver Rose," a song he hopes to use as his theme; he hums it for us; sounds very good. . . . Into a cab; "485 Madison Avenue, please,"—yes, that's the Columbia Broadcasting Company; here we are—another cab stops—out come those darling girls, the Boswells and into the elevator. Nat Shilkret is there ahead of us—he and the girls have a Chesterfield program to rehearse. Nat is so modest and retiring. To look at him one would never credit the fact that he is one of the giants of present-day orchestar leaders. Up to the twenty-second floor. There's Dr. Hugo Riesenfeld wandering around as though lost. What's he doing here—giving an audition? Your studio's downstairs on the floor below, number three. "Thank you," answers the doctor. . . . Where there's a radio station you're bound to find a song publisher—Mel White of Robbins'—looking after his contacts; Bob Buttenuth, trying to place "In a Little Blue Canoe" with Helen Nugent, who promises to see what she can do with it. . . . Evan Evans dashes madly into studio two; late for rehearsal.

Over a few blocks and into 711 Fifth Ave.—the NBC. Always run into a few old friends here. There's Ed Whitney, who plays old Cap'n Jimmy Norton in "Harbor Lights"; he's on his way upstairs for a "Death Valley" rehearsal. . . . Well, well! Look who's coming down the passage—Ed (Thundering) Thorgerson, who's not so thundery now-a-days; he's announcing the Stanco program tonight over at the Times Square Studio atop the New Amsterdam Roof. . . . There's Jane Pickens; what a stunning figure that girl had! And bless my heart, there's Whispering Jack Smith; you're getting too fat, Jack; better take off some of it; maybe a little Absorbine will help you to reduce. Let's see—what time is it: goodness gracious! must get home or Octavia (that's my very nice cook) will have a fit. Still raining—but what I care? I'm used to it by this time: out into the muddy street, just in time to bump into May Singhi Breen, the Ukulele Lady; and her song writing husband, Peter de Rose. "Hello, Goodbye"—and the end of a perfect day.

* * *

News of the Studios

WABC

Daily reports from the Women's National Tennis Tournament at the West Side Tennis Club in Forest Hills, Long Island, will be broadcast by Ted Husing over the WABC-Columbia network from August 15 to 20th. Officials and stars of the court also will be represented in a series of pre-tourney broadcasts over the same network, beginning Monday, August 8th, and again at the close.

If you are able to judge a man's character by the company he keeps, so should you be able to draw at least some conclusions from the books he reads. A recent survey among a few Columbia artists disclosed the following avowed preferences: Freddie Rich and Colonel Stoopnagle, "Main Street," by Sinclair Lewis, and Eddie Duchin, "Babbit," by the same author; Jack Miller, "Oliver Twist," by Dickens; Nat Brusiloff, "Bar X Ranch," by Zane Grey; William Hall, "The Sea Wolf," by Jack London; Fred Berren, "Magic Mountain," by Thomas Mann; David Ross, Dostoiyevsky's "Brothers Karamazov"; Bill Brenton, "War and Peace," by Tolstoi; Sandra Phillips, "Anna Karenina," by the same author. Helen Nugent likes Willa Cather's "Shadows on the Rock," while Peggy Keenan prefers "The Red Lily," by Anatole France; Fred Uttal cares in a big way for the immortal Voltaire; Edwards Reese is simply wild about Hug Walpole's "Fortitude"; Ken Roberts has a secret ven for "Of Human Bondage," by Maugham; and, of all things, Hamsun's "Growth of the Soil" has a check against it for Louis Dean. Nat Shilkret likes Scott's "Ivanhoe"; and, believe it or not, Ted Husing's favorite volume is Frank Mencke's "Sports Record Book." What do I prefer? Well, to tell you the truth, it is too great a task to pick one out of many, but I do like Pearl Buck's "The Good Earth," Mary Roberts Rinehart's "Book of Tish," and Samuel Butler's "The Way of All Flesh,"

* * *

NBC

Pat Barnes, the versatile actor, who plays all the parts in a series of skits sponsored by Swift & Comany, has published a book, written by himself, called "Sketches of Life." Into the book has gone Jimmy and Grandad, principal characters in the skits; tributes given by the author over the radio to such personages as Abraham Lincoln, Thomas Edison, George Washington, Knute Rockne and others, and here and there philosophical paragraphs heard in the Barnes broadcasts.

* * *

The old-time dramatic favorites, presented as an experiment by the Radio Guild over NBC networks, have been so generously welcomed by Coast-to-Coast NBC listeners, that the series may be regularly incorporated into the Guild's annual program. Such old-timers as "Uncle Tom's Cabin," "Rip Van Winkle," "The Corsican Brothers," "The Bells," "Caste," "The Lady of Lyons," "A Scrap of Paper," "The Hunchback," and "The Cricket on the Hearth," have been heard during the past season. If you'd like to hear some more old-timers during the coming season, why not drop Vernon Radcliffe, director of the Radio Guild, a postcard, naming your favorite. Send it to NBC, 711 Fifth Ave., New York.

* * *

Billy Jones and Ernie Hare are getting a lot of fun out of their campaigning for president and vice-president on their Best Foods "slenderizing platform." They have already stumped the State of Perplexity, and the State of Coma, and are now waiting for their listeners to suggest the next move; which leaves them in the State of Uncertainty: that's a joke, in case you don't know.

* * *

Biographical Brevities

ABOUT JAMES MELTON

In July, 1927, a young man came from Florida to New York, with boundless ambition in his heart. He had worked his way through three Southern colleges by singing with glee clubs and campus orchestras. He was two years at the Uni-

(Continued on next page)

Japan May Open Short-Wave Market

Washington.

The Department of Commerce issued the following:

Evidence of steadily rising interest in radio in Japan, particularly in the rural districts, is reported by Assistant Commercial Attache W. S. Dowd, Tokyo.

During the month of April there was a net increase of more than 45,000 receiving sets, making the total number in use throughout the Empire at the end of that month 1,103,548. Private operators in Japan, it is pointed out, pay a monthly fee of 25 cents.

A government prohibition against the use of the short waves in Japan prevents private owners of radio sets from receiving foreign broadcasts. Notwithstanding, Japanese interest in international broadcasting is very keen. International broadcasts from Tokyo have served to educate the public in the value of the short wave and it is hoped that eventually its use will be permitted by private operators. Should this happen, it would for a time at least be certain to stimulate imports of American receiving sets, it is pointed out. While domestic manufacturers are now supplying almost exclusively the demand for long-wave sets and these, for the time being at least would have to be obtained in the United States or from other foreign sources.

Immediate action by the government in connection with a change in regulations applicable to radio, however, should not be anticipated by United States manufacturers, Dowd declares. Such matters, he points out, move very slowly in the Far East and the present situation is not propitious for speedy action in this direction.

Station Sparks

(*Continued from preceding page*)

versity of Florida, one year at the University of Georgia, and one year at Vanderbilt University. The young man's name was James Melton, and he came to New York to continue his voice culture and to try his best to land a job with "Roxy's Gang," under S. L. Rothafel. He got the job and worked hard at it.

In November, 1927, Melton joined the famous Revelers Quartet, and that was his start toward fame. Their first job together was the Palm-Olive Hour and he's been going ever since. He is now reckoned among the notables of the air and has sung on nearly all of the most important NBC network programs.

He is Florida's favorite entry in the nation's singing sweepstakes, and is a constant course of concern to California's native singing sons. Once upon a time he played the lowly saxophone, but discarded that instrument for good when he left college. He has sung for musical pictures but sidetracked stage work to conserve his energy for radio; once in a while he takes a flyer into vaudeville. Makes lots of recorded programs, and is a best-selling recording artist.

He has Gus Haenschen and Frank Black to thank for a great deal of his success; he knows it and is duly grateful, for Jimmy has not allowed money and fame to go to his head.

He is married—happily. Is a tall, very good-looking chap; dark hair and eyes, a sunny smile, disclosing perfect teeth; not as slender as he was in 1927, but not yet worried about his **waistline.**

RCA GROSS $36,542,163

Total gross income of $36,542.163 and net income of $219.405 for the Radio Corporation of America and its subsidiaries for the first six months of the year 1932 were announced by David Sarnoff, President of the corporation.

Tradiograms

By J. Murray Barron

INTEREST IN NEW TUBES

Already circuits for the new tubes are eagerly sought, or specific information asked of those who cater to the experimenter and serviceman. A number of mail order and retail stores who sell parts are preparing parts kits incorporating the new 56, 58 and 55 tubes. A New York retail store specializing in parts had on demonstration this week a new superheterodyne receiver using the 58, 56 and 55 tubes, and the 247 and 280. It created a considerable interest and if the general interest and opinion that prevailed was any indication of how the experimenter felt about building the latest in radio, then the retailer can prepare to get in line at an early date without any fear of making a mistake.

The serviceman is not behind in his interest in these new tubes. Daily the specific inquiries from serious minded are increasing and literally thousands have been awaiting the release of the 55 tube. Within the next few weeks the radio districts will see a great number of new parts kits with circuits to use these new tubes.

* * *

The radio industry reported an employment increase in June over May equalling 4.8 per cent. Forty-two manufacturers reported 16.230 *on the* $330.128 *weely payroll.*

* * *

The Second Annual Radio and Refrigeration Show to be held by the Hotel Edison, 47th Street just West of Broadway, N. Y. City, will take place September 19th to 25th and will be open to the trade only. The grand ball room and the mezzanine surrounding it together with the lobby will be utilized for exhibition purposes. Harry Goldman will have charge of the exposition.

* * *

Paul Low, of Orchestra Guild. Inc., 1776 Broadway, N. Y. C., announces removal to 22 East Fortieth Street.

* * *

The Manufacturers Sales Co., 570 Lexington Avenue, N. Y. C., has descriptive matter interested in B eliminators for automobile radio receivers.

* * *

Federated Purchaser Inc., 25 Park Place. N. Y. City, has just issued its new 104 page Mid-Summer Radio Bargain News.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor. Radio World, 145 *West 45th Street, New York, N. Y.*

G. Merriman, Hon. Editor "DX" VS6AH, P. O. Box 651, Hongkong, China.
Lester Levy, 552 Parkside Ave., Brooklyn, N. Y.
Louis J. Kern, 4215 79th St., Elmhurst, New York City.
Edwin B. Upson, 434 Calumet Blvd., Harvey, Ill.
Geo. A. Hawpe, Jr. (assembled radios and parts). 1218 Tennessee St., Dallas, Texas.
A. L. Domin, 23 Warren Ave., Reading, Mass.
A. Skaggs, So. Ft. Smith, Ark.
Walter N. Brown, Jr., 15 Pembroke St., Garrett Park. Md.
Howard Chandler, Lima State Hospital. Lima, Ohio.
R. H. Maglathlin, 43 Meadowbrook Rd., Longmeadow. Mass.
T. Mentel, 2216 Burnet. Cincinnati, Ohio.
Sun Electric Co., H. O. Casby, 105 E. 23rd St., Houston, Texas.
Max J. Silvers, R. No. 4, Raleigh, N. C.
P. R. Fernando Menna, Hotel Italia, Laveno. Varese, Italy.

Paskman Heads Unit for Service in Radio

Right after the sale of his station. WGBS, (now WINS), New York, to William Randolph Hearst, Dailey Paskman, one of radio's best known pioneer directors, formed a new organization, Dailey Paskman and Associates, and opened his offices at 230 Park Avenue, New York City.

This unique organization is divided into three separate units. One is a department exclusively devoted to representing radio stations located throughout the United States and Canada. Cooperating with this unit is a staff of program builders, continuity writers and advertising and merchandising experts, who conceive, plan and stage programs designed to sell the advertisers products. The third department is an artists' bureau.

Garden Corporation Backing N. Y. Show

The official name of the public radio show to be held in New York City, September 16th to 24th, inclusive, is Combined Radio, Refrigeration and Electrical Exposition. The event will be held in Madison Square Garden. W. F. Carey, president of the Madison Square Garden Corporation, is sponsoring the affair financially, and Joseph Bernhardt is the show manager.

NEW INCORPORATIONS

Amplifier Equipment Corp., New York City, radios—Attys., Schneider & Herdes, 128 West 66th Street, New York City.
Di Tuccia Brothers Refrigeration Co., New York City—Atty., P. P. Rao, 369 Lexington Ave., New York City.
Nationwide News, Inc., Bronx, New York City, collect, formulate and transmit news by telegraph, cable, radio, telephone—Attys., Corporation Trust Co., Dover, Del.
Clickit Pen Corp., Queens, New York, electrical appliances—Attys., Posen, Katcher & Driesen, 295 Madison Ave., New York City.

BANKRUPTCY PROCEEDINGS

Petitions Filed—By

Ross McLean, radio artist, 41 West 72nd St., New York City—Liabilities, $1,348; no assets.

CORPORATION REPORTS

Electrical Products Corporation of Washington—Six months ended June 30: Net income after taxes and other charges, $46,136, equal to 46 cents a share on 100,000 shares, against $44,226, or 44 cents a share, for the first half of 1931. Quarter ended June 30: Net income of $23.952, equal to 24 cents a share, against $22,184, or 22 cents a share, for first quarter of current year.

CORPORATE CHANGES

Designation

Thomas A. Edison, New Jersey, electrical appliances, $3,000,000.

Surrender of Authority

Edison Storage Battery Co., New Jersey.

RADIO WORLD'S Advertising Rates

	1 Inser.	4 consec. Inser. (ea.) 10%	13 consec. Inser. (ea.) 12½%	26 consec. Inser. (ea.) 15%	52 consec. Inser. (ea.) 20%
1 page	$150.00	$135.00	$131.25	$127.50	$120.00
½ page	75.00	67.50	65.62	63.75	60.00
⅓ page	50.00	45.00	43.75	42.50	40.00
¼ page	37.50	33.75	32.81	31.87	30.00
⅙ page	25.00	22.50	21.87	21.25	20.00
⅛ page	18.75	16.87	16.41	15.94	15.00
1 inch	5.00	4.50	4.37	4.25	4.00

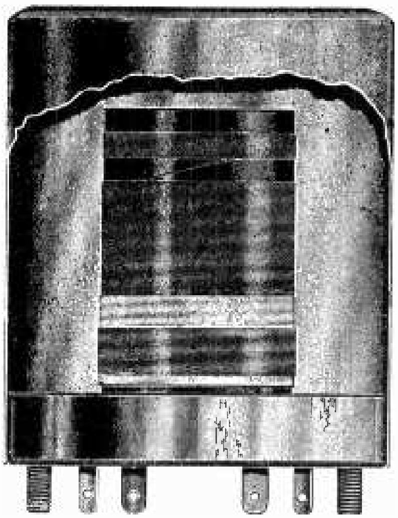
Classified advertisements, 7 cents a word; $1.00 minimum; must be paid in advance.

Advertising Department

Radio World, 145 West 45th St.,
New York City

Coils That Exceed Your Requirements for Precision

Secondary Inductances Accurate to plus or minus 0.6 microhenry



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. *5-day money-back guarantee. We pay postage on 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. The 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 modulater 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

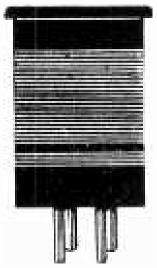
CAT. NO. 6—Same as Cat. No. 4, except that this set is for the 0.00046 mfd. Scovill condenser $1.80

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. 6—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

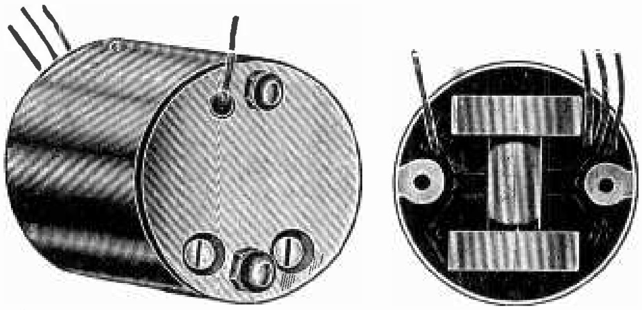


WOUND on 1.25 inch diameter finest bakelite forms, with flange for gripping, these short-wave plug-in coils afford high efficiency. Tube sockets serve as receptacles for these coils. The coverage with four coils is 13 to 200 meters with 0.00014 mfd. capacity. Also 0.00015 mfd. may be used without change. 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 oscillater tuning condenser. Capacity 700-1000 mmfd. Hammarlund, Isolantite base.

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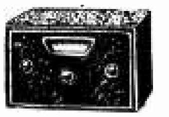

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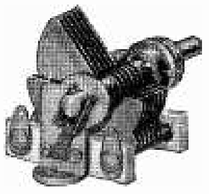

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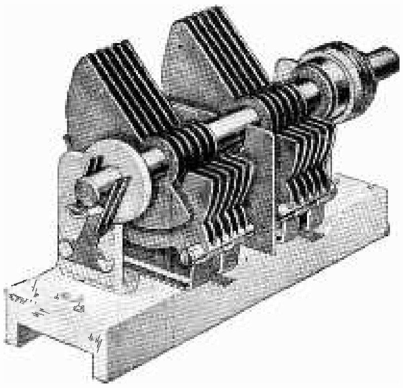

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