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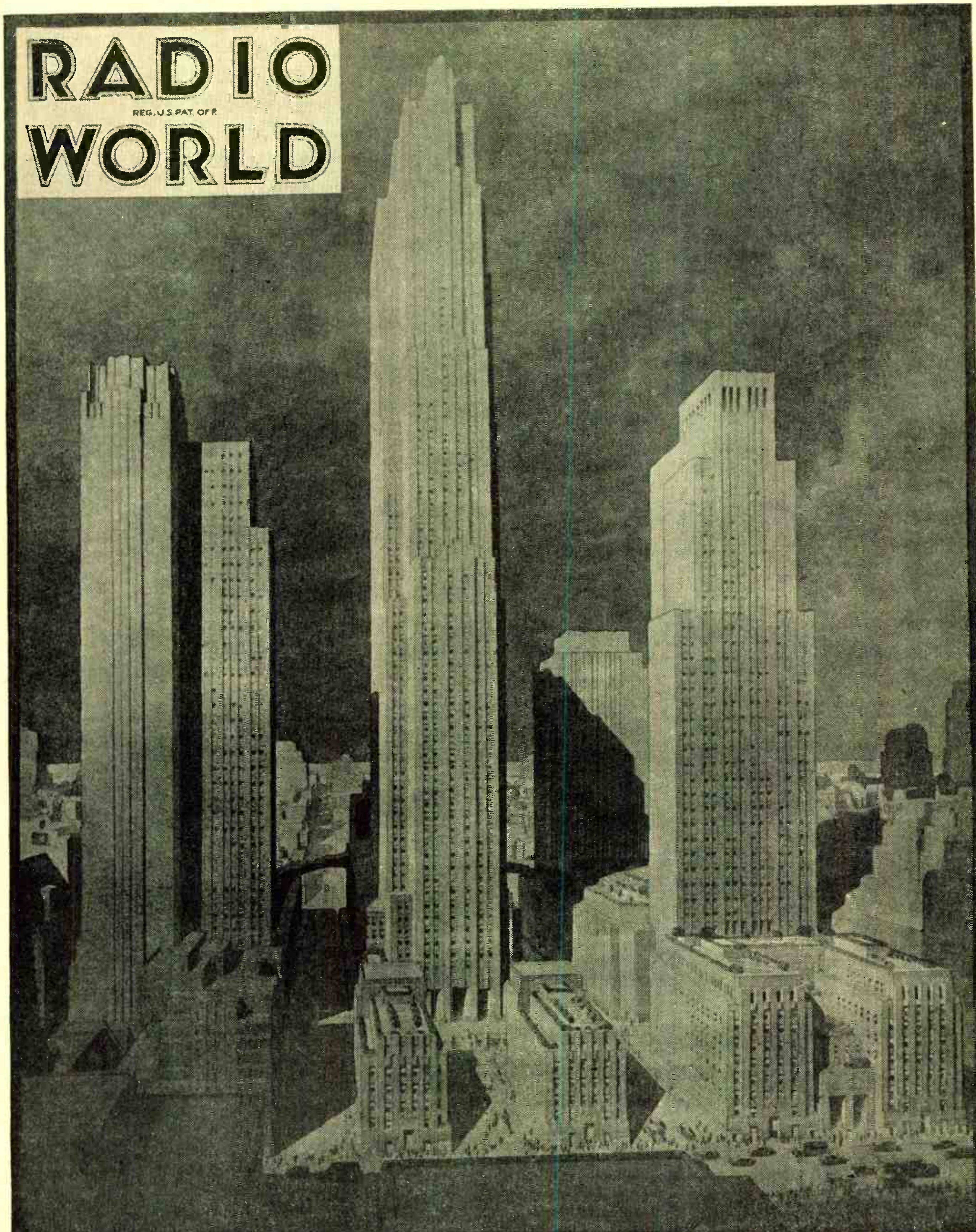

Architect's drawing of Rockefeller Center, including existing and projected buildings. The view is from the east and therefore you are looking toward the west. North is to the right. The artery in the foreground, partly hidden by rooftops, and with automobiles in the street, is Fifth Avenue. The RKO Building, now totally completed and occupied, is shown at right rear. It is 31 stories high and faces Sixth Avenue, the westerly boundary of the development, between Fiftieth and Fifty-first Streets. Just before the RKO Building, as if in a shadow, not one of the tall buildings, is the Radio City Music Hall that opened recently. The central high structure is the 70-story RCA Building, the most spacious office building in the world. Just in front of it are (left) the French Building and (right) the British Empire Building. At extreme right are two similar buildings with a common arcade. They are the Italian Building (left) and the proposed German Building (right). At extreme left is a contemplated 45-story office building, and at right another contemplated erection, but concerning which no decision has yet been made.

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Numerous Valuable Uses for Shielded SEMI-TUNED COUPLERS In Super and T-R-F Receivers

By Croyden J. Masefield

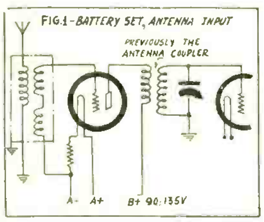


FIG. 1 - BATTERY SET, ANTENNA INPUT

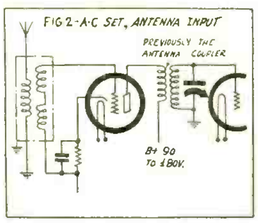


FIG. 2 - A-C SET, ANTENNA INPUT

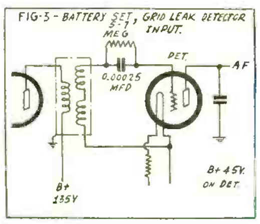


FIG. 3 - BATTERY SET, GRID LEAK DETECTOR INPUT.

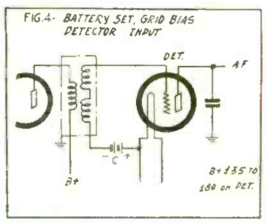


FIG. 4 - BATTERY SET, GRID BIAS DETECTOR INPUT

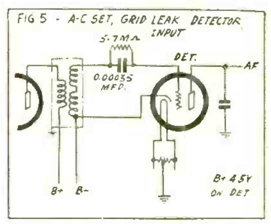


FIG. 5 - A-C SET, GRID LEAK DETECTOR INPUT

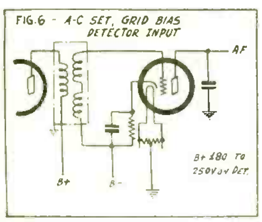


FIG. 6 - A-C SET, GRID BIAS DETECTOR INPUT

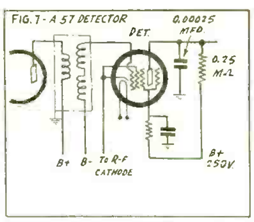


FIG. 7 - A 57 DETECTOR

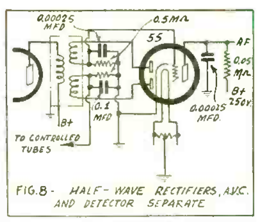


FIG. 8 - HALF-WAVE RECTIFIERS, A.V.C. AND DETECTOR SEPARATE

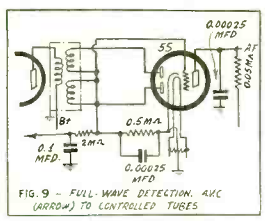


FIG. 9 - FULL-WAVE DETECTION, A.V.C. (ARROW) TO CONTROLLED TUBES

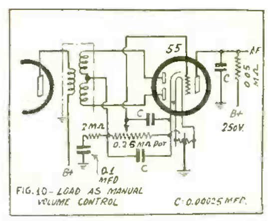


FIG. 10 - LOAD AS MANUAL VOLUME CONTROL

SEMI-TUNED radio frequency transformers may be put to a variety of helpful uses. For instance, in tuned radio frequency sets the amplification is much greater at the high frequencies than at the low ones, so if a transformer is used that is broadly tuned to a low radio frequency, the amplification will be much more nearly even. Then low radio frequency stations will come in far louder than before, and if the receiver squealed at the high radio frequencies it is quite likely these squeals will disappear.

A commercial transformer of this type, recently introduced, consists of three separate windings, of which one is the primary, a honeycomb coil of about 2.5 millihenries inductance, and the two others are equal secondaries of the same individual inductance as the primary. The primary coupling is loose.

If the primary is used in the antenna circuit, then the natural period, allowing for an antenna capacity of 0.0002 mfd., which is a supposedly average value, and the one used in dummy antenna input systems, then the natural period will be about 225 kc. This is far enough outside the broadcast band not to cause any unwanted regenerative effects at low broadcast frequencies. Then the secondary, where the total capacity is much less, may consist of the two separate secondaries joined together. This gives an inductance of nearly 10 millihenries and the natural period is around 350 kc.

Advantages Stated

The secondary's natural period is somewhat higher than the primary's. That is as it should be, for a difference in frequencies in the two circuits avoids the double-hump effect otherwise encountered where semi-tuned transformers are used.

With a semi-tuned input used in this way an extra tube is included, as a so-called untuned stage of r-f, although it must be realized that the stage really is not untuned. One advantage, in addition to the levelling of the amplification of the radio frequencies, is that the condenser-tuned stages that follow work into closely similar if not identical circuits, and the detuning due to antenna capacity and perhaps to non-uniform change in inducance over the dial spread is avoided.

The inductance difficulty arises when the primaries are considerably dissimilar, wherefore the mutual impedance is different. Skinny primaries tend to preserve the tuning as it would be without any primary, large primaries tend to contract the wave band coverage, because of increased distributed capacity, and there is loss of inductance by the secondary due to the tight coupling.

Unusual Effects

Choke coil primaries, where the chokes are peaked at a frequency at or outside the high frequency end of the broadcast band, extend the wave band or frequency coverage, because they have a strong mutual inductive coupling to the secondary at the high end and there shrink the inductance of the secondary, but at the

(Continued on next page)

Unbalance Correction in Duo-Diode

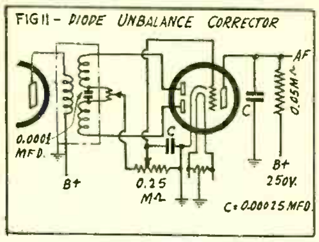


FIG. 11 - DIODE UNBALANCE CORRECTOR

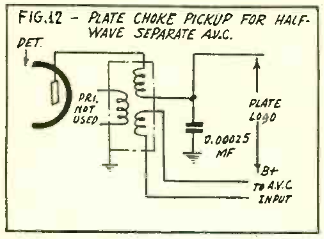


FIG. 12 - PLATE CHOKE PICKUP FOR HALF-WAVE SEPARATE A.V.C.

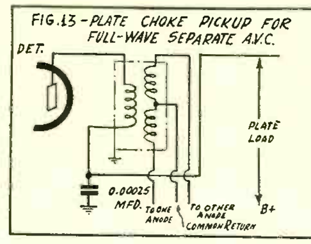


FIG. 13 - PLATE CHOKE PICKUP FOR FULL-WAVE SEPARATE A.V.C.

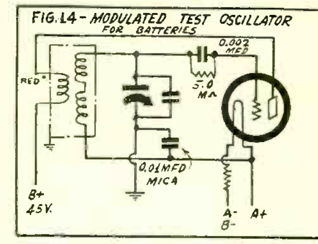


FIG. 14 - MODULATED TEST OSCILLATOR FOR BATTERIES

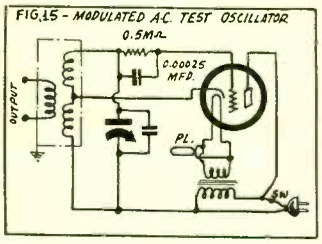


FIG. 15 - MODULATED A.C. TEST OSCILLATOR

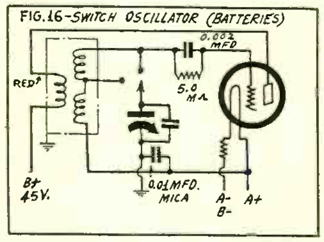


FIG. 16 - SWITCH OSCILLATOR (BATTERIES)

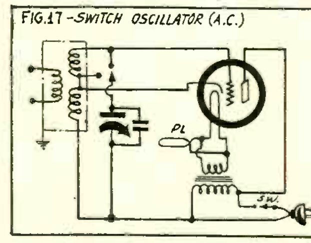


FIG. 17 - SWITCH OSCILLATOR (A.C.)

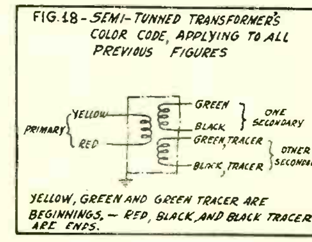


FIG. 18 - SEMI-TUNNED TRANSFORMER'S COLOR CODE, APPLYING TO ALL PREVIOUS FIGURES

YELLOW, GREEN AND GREEN TRACER ARE BEGINNINGS. — RED, BLACK AND BLACK TRACER ARE ENDS.

(*Continued from preceding page*)

low end hardly reduce the inductance at all, so a condition of varying inductance exists, the variation depending on frequency. So if dissimilar primaries are used, particularly a choke primary compared to a skinny primary, the tuned circuits would be greatly dissimilar. And there is no practical way to compensate for the inductance differences. It can not be done by compensating condensers or any other fixed condensers.

In Fig. 1 is shown the diagram of a semi-tuned transformer, with primary in the antenna circuit and secondary, consisting of the two separate secondaries interconnected, in the grid circuit of a battery-operated tube. If the tube has other elements besides those shown, it still has a control grid, a plate and a filament, so the diagram covers the essential requirements for a battery set.

The connections for an a-c receiver are shown in Fig. 2, and are substantially the same. The cathode biasing resistor is supplied additionally, as is the bypass condenser across it, for we have added another tube.

In both instances the former antenna coupler, if of the same general type of primary as exists in the following stages, is used as an interstage coupler. If the primary is much different on this coil, of course a primary like that on the following coils may be wound by the experimenter, the other removed.

The Broad Peak

These two diagrams take care of virtually all instances of the use of such a coupler in the antenna circuit, the computations show that since the secondary is resonant to a higher frequency, the broad peak may be said to extend well below the low end of the broadcast band. This is satisfactory for the intended purpose, as selectivity of any serious order would be objectionable because of the severe attenuation of the high frequency end of the tuning spectrum.

In far more numerous instances such a coupler would be used to feed the detector tube, when the primary would be broadly resonant at about 500 kc and the secondary at about 350 kc. If a t-r-f set has a five or six-gang condenser, one of the tuned sections may be omitted from the circuit and a semi-tuned transformer put in, replacing the tunable transformer, thus not adding any tubes. But generally the constructor will with a t-r-f set have a three-gang condenser, and either the audio channel may be readjusted or extra room made for a new socket to contain the detector tube because the former detector socket now houses an r-f amplifier, with proper voltages.

Fig. 3 shows the use of the semi-tuned transformer in a battery-operated set to feed grid leak type detection, while Fig. 4 illustrates the same type of circuit with grid bias detection (biasing voltage normally 6 volts).

In Fig. 5 is a representation of the same system applied to an a-c set with grid leak detection and in Fig. 6 is a diagram of the hookup where power detection is used in an a-c receiver.

A Quality 57 Detector

The a-c tubes with power detection may have extra elements, but these need not be considered, either, except that in reference to Fig. 7, exceptionally fine quality will result if the 57 tube is used as detector, with normal plate load of 0.25 meg., 250 volts applied, the screen returned to the same high voltage through a very high resistance (marked 5 meg.) and this screen resistor bypassed suitably, using not less than 0.1 mfd., and preferably much higher capacity. The negative bias for the tube may be around 4.5 volts, and is readily obtainable from an r-f tube, by biasing an r-f tube that much, and connecting cathode of detector to cathode of the r-f tube. This is an excellent biasing voltage for quality, and the high resistance in the screen leg is a further aid to quality.

If the detector is a '24 the same system of high resistance in the screen leg may be followed, and the bias may be the same, although the recommended bias for both the 57 and '24, as found in the tube charts, is 6 volts. The 4.5-volt recommendation is based on quality only, and presupposes a volume control ahead of the detector, to enable prevention of detector overloading.

Diode Uses

When we look at Fig. 8 we see at once that the diode-triode tube is used. It is marked 55, but may be an 85, the automotive series equivalent. Previously we may have wondered why the coil has two separate secondaries that are to be united as one. Why not simply one secondary, and have done with it? The reason may now become apparent. If we have separate secondaries we always may join them directly, so there's nothing lost there, and if any special circumstances arise that require us to join them, say, unequally, we may do that provided they are separate secondaries.

Let us look carefully at Fig. 8. The primary of the semi-tuned transformer is in the plate circuit. The two secondaries here are used separately, one to feed one anode for detection, and the other to feed the second anode for automatic volume control. So the two functions are separate. The detector is a single-sided or half-wave diode detector. So is the a-v-c diode.

In Fig. 8 we connect the return of the secondary for the true detector to the grid, or cap, and thus have a diode-biased triode. The negative bias on the triode is equal to the voltage drop in the 0.5 meg. load resistor.

Full-Wave Detection

Next we come to a full-wave diode detector, Fig. 9. In this instance it is favorable to take the a-v-c control voltage from the high side of the 0.5 meg. load resistor, provided we put a high resistance in series with the line to the controlled tubes. Each controlled circuit should have a high resistance, bypassed by a condenser of 0.05 mfd. to 0.3 mfd., so that the grid is returned in reality to the a-v-c voltage through a bypassed high resistance.

In Fig. 10 a potentiometer of 0.25 meg. is the load resistor of a full-wave diode detector, the moving arm being connected to grid, so that volume is controlled by the amount of voltage taken off the load. This control works excellently.

On very strong signals, with powerful sets, the triode section may saturate but only under conditions where the volume of sound is altogether excessive, not only as to ear comfort but also as to power tube overload, so the volume control must be retarded to work the tube below saturation. If a-v-c is complete this saturation will not take place, but many circuits contain some a-v-c without pressing it to completeness because of the several and serious troubles that complete a-v-c brings.

Unbalance Corrective

Now, although we may have a diode, or any other tube, hooked up in an intentionally symmetrical circuit, it does not necessarily follow that the circuit is symmetrical. From experience one may say that it is not likely to be. For instance, if the two halves of the secondary may not be exactly alike, the two separate tubes, whether in one envelope or two envelopes, may be somewhat dissimilar, hence there are two possibilities of unbalance. Correction for static unbalance in most intended symmetrical circuits may be made by making the biases different, until the current through one tube's plate circuit is exactly the same as that through the mate tube's plate circuit, and with the duplex diode we have the same situation. Curves recently printed in these columns showed the duplex diode static unbalance, that is, for a given input of d-c the current was greater through one diode than through the other, perhaps due to unequal proximity to the cathodes. The difference in the resistances, at no load, was 4,800 ohms, so a 10,000-ohm potentiometer is used. It is not desirable to have a much higher value, as any voltage through the potentiometer is not communicated to the audio circuit.

By using a modulated test oscillator, or even a station signal where the volume isn't changing very much, the currents may be adjusted to equality on a dynamic basis by putting a d-c current meter first in one anode leg, then in the other, with the potentiometer set to an extreme position. Then by moving the arm slightly, remeasuring each anode current, and repeating the process, equality may be established.

As an auxiliary test it may be found that a circuit tends to be regenerative. If the set is t-r-f the regeneration would be probably at some high broadcast frequencies. With no bypass condenser across the load potentiometer (0.25 meg.), the regeneration or oscillation may disappear. This would be true when the detector circuit is dynamically balanced as previously explained, so that perhaps the test of eliminating squealing would work out just as well as the meter method, if squealing is present. No bypass condenser should be required across the load resistor of a truly symmetrical circuit. Indeed, the squeal-elimination test would also dispense with the bypass condensers marked C in Fig. 11, one being from arm to ground, the other from plate to ground.

Of course, though the circuit is balanced, squealing may continue because there is too much feedback ahead of the detector, over which detector adjustment will not have satisfactory control.

In the full-wave circuits the cathode is shown as being grounded, assumptively the same lead as B minus. So the tubes controlled by the a.v.c. may have their usual cathode resistors returned to B minus, condensers across those resistors, and no danger of positive bias or zero bias under any circumstances will be present. Also the circuit is somewhat simplified that way.

Fortunately, the constants are such that in every one of the previously-cited instances the semi-tuned transformer can be used not only in t-r-f sets but in supers as well, provided the intermediate frequency is not much lower than 175 kc. Of course Figs. 1 and 2 apply in any instances, but Figs. 3 to 10 may be used for supers as well as for t-r-f sets and also moreover for inclusion of full-wave detection, a-v-c. and the other features, including a.v-c. choke feed to be discussed presently.

A-V-C Chokes

Those seeking an input to an automatic volume control tube may find it in Fig. 12, where one secondary is used as a plate circuit choke, no bypass condenser directly from plate to ground, but the condenser from the other end of the winding to ground, while the other secondary is the pickup winding. If the input to the a-v-c tube is to be grounded, then of course one terminal of the pickup secondary is grounded. Leaving both terminals free permits of input to any half-wave type of a.v.c.

For full-wave rectification in the a-v-c tube the primary of the semi-tuned transformer may be in the detector plate circuit and the secondary used for feeding the a.v.c. tube. Thus the two separate secondaries would be joined, as before, when full-wave detection was used, the joint being the return lead, and the extremes going to the respective anodes. This is illustrated in Fig. 13.

Oscillators

As for oscillators, the semi-tuned transformer of course is concerted into a tuned transformer. Fig. 14 shows a battery model, grid circuit oscillator, where the winding ordinarily called the primary is used for the plate feedback coil. While the B voltage is shown as 45 volts, because of grid leak detection it may be necessary to increase this somewhat to insure oscillation all over the dial.

Again the two separate secondary windings are interconnected, and with a tuning condenser of 0.00037 mfd. (commercial condensers rated at 0.00035 mfd. and of recent manufacture usually are nearer 0.00037 mfd.) the frequencies of oscillation will be from around 90 kc to 270 kc, and therefore the important intermediate frequencies of 130, 172.5, 175, 177.5 and 260 will be covered on the fundamental, while 400 and 450 kc intermediates may be adjusted by using the second harmonic of 200 kc and 225 kc. The calibration of the fundamental may be made with broadcasting stations used as standards. This method was described in the December 17th and October 15, both 1932.

No output is shown, but a few turns of bell wire near the bottom of the socket will provide sufficient coupling, and may be brought out to a binding post; or, a very small condenser, say, 20 mmfd., may be connected from either side of the grid condenser to an output binding post.

The modulation in the battery models is due to intentional grid blocking and produces a squealing sound. Any battery type tube may be used.

In Fig. 15 the same frequencies are covered in an a-c type oscillator, and the diagram is complete, for it provides the hum frequency of the line as modulation. The tube may be a '27 or 56.

Figs. 16 and 17 are battery and a-c types of oscillators, where a switch with insulated shaft is used for changing the inductance in the tuned circuit. The condenser stator connection is switched from the total inductance to approximately one-quarter the total inductance. Although the number of turns is half, the quantity of inductance is one-quarter. The inductive comparison between similar types of coils of different numbers of turns is that the inductance is proportional to the square of the number of turns.

So the coverage would be from about 170 to about 510 kc, and the third harmonic could be used conveniently for broadcast frequency adjustments (510 to 1520 kc), as well as fundamentals used for some intermediate frequencies, and fundamentals with the full inductance in circuit for lower intermediate for frequencies.

Radio University

Use of Tracking Condenser

WOULD you recommend the use of a tracking condenser in preference to a padded oscillator circuit? Are there any advantages in the use of such a condenser? In other words, is it possible to track better with a specially cut condenser than with the padded circuit?—B. W. R., Nashville, Tenn.

If you are willing to adjust the oscillator circuit inductance experimentally so that you get close tracking at the low frequency end of the tuning band then a tracking condenser may be preferable. Theoretically it should be possible to track better with a tracking condenser than with a padded circuit but the adjustment is more difficult. In making the adjustment of the coil the tracking is affected at both ends of the tuning range. If the adjustment is made first at the low frequency end with the coil and then with the trimmer at the high frequency end it should be possible to effect very good tracking. If you are not familiar with coil adjustments and the use of a calibrated oscillator it is preferable to use the padding method of tracking.

* * *

Beat Note Audio Oscillator

PLEASE explain the principle of the beat note audio oscillator and give directions for making one. How could it be calibrated?—M. M., Stamford, Conn.

Two high frequency oscillators of very nearly equal frequency are set up and the outputs coupled loosely to a detector circuit as in a superheterodyne mixer. If the difference frequency between the two oscillators is made to cover the audio range the output of the mixer will contain the audio frequencies. One of the high frequency oscillators should be fixed in frequency and the other should be variable over a small range, say from zero beat to 10,000 cycles. The condenser used for varying the beat frequency should be a small portion of the total capacity in the variable oscillator circuit. In other words, it should be a manual trimmer, and it should be provided with a very good dial. It is essential to shield thoroughly the two oscillators from each other and from the rest of the circuit and it is also essential that the dial be such that there is no body capacity. The calibration can be done against a piano, a set of tuning forks, or even against the 60-cycle hum from a power line. If the hum is used it is necessary to employ harmonics to get the higher audio frequencies. Since the hum is 60 cycles and a frequency of 10,000 cycles is desired it is necessary to use very high harmonics. If the trimmer condenser is small compared with the total capacity in the oscillator circuit the trimmer should be of the straight line capacity type to give a straight line frequency curve for the beat note.

* * *

Hartley Oscillator

CAN an audio oscillator of the Hartley type as modified by Shiepe be built successfully with an audio transformer?—C. W. Y., Albany, N. Y.

It depends on where the tap on the winding is. If a high ratio step-up transformer is used and the tap is the junction of the two windings connected in series-aiding there is likely to be no oscillation because one of the windings is too small. Also, if the resistance of the transformer is very high the resistance between the cathode and the ground will be excessive and that might start oscillation. A one-to-one output transformer should work all right.

* * *

A-C on Plate of Oscillator

WHEN a-c is applied to the plate of an oscillator tube does the circuit oscillate all the time or only during the half-cycle when the plate is positive with respect to the cathode?—G. W. Q., Rockford, Ill.

It oscillates only during that half-cycle when the plate is positive with respect to the cathode. Indeed, it oscillates only a part of that half-cycle for it will not oscillate unless the voltage exceeds a certain value. If there is some capacity in the plate circuit which can charge up during the active half-cycle the time during which the oscillation takes place is extended.

INDUCTANCE TEST

Measurement Method and Formula

By J. E. Anderson

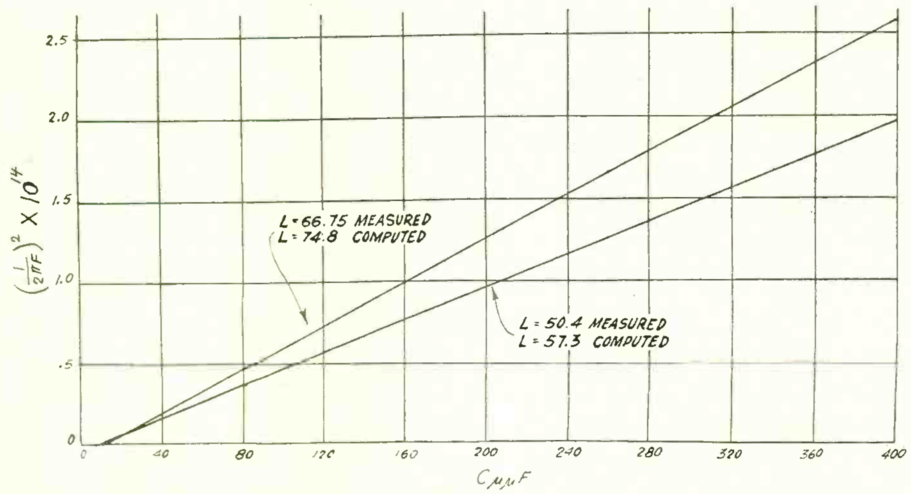


FIG. 1
This graph illustrates how the inductance of a coil can be measured with a calibrated condenser and a calibrated oscillator.

BY MEANS of a calibrated oscillator, a thermo-galvanometer, and a calibrated condenser the inductance of a coil may be easily measured. The condenser, the coil, and the galvanometer are connected in series and the coil is coupled loosely by means of a small primary to the output of the oscillator. The calibrated condenser is set at any convenient value, say 40 mmfd. and the frequency of the calibrated oscillator varied until the thermo-galvanometer shows greatest deflection. The corresponding frequency of the oscillator is obtained from the calibration curve. The quantity $(\frac{1}{2}\pi F)^2$ is computed and this is entered on a graph against the value of capacity. This is repeated for many other settings of the calibrated condenser.

The points on the curve thus obtained will lie on a straight line, barring errors in calibration, computation and observation. A straight line is drawn through the points, producing the line until it cuts the axis of capacity. In case there are errors some of the points will not quite fall on the line, but in that case the line should be drawn so as to fall on as many of the observed points as possible. The slope of the line is the inductance required.

The Curves

In Fig. 1 are two such lines taken on two different inductance coils. The upper curve was taken on a coil with a computed inductance of 74.8 microhenries. The measured inductance is 66.75 microhenries. It will be noticed that the upper line cuts the capacity axis at 12 mmfd. The distance, in capacity units, between this point at the 400 mmfd. point is 388 mmfd. At 400 mmfd. the distance to the curve is 2.59 divided by 10 to the fourteenth power. The ratio gives 66.75 microhenries.

The distance between the origin and the point where the curve cuts the capacity axis is supposed to be the distributed capacity of the circuit, that is, capacity in the circuit not contained in the calibrated condenser. In this case the distributed capacity is negative. This points to a constant error in the calibration of the condenser, an error amounting to the distributed capacity in the circuit plus 12 mmfd. This error does not necessarily introduce an error in the measured inductance, for the inductance depends only on the slope of the line and not on its position. If the rate of change of the capacity is correct as indicated by the calibration the inductance will be correct.

Cause of Error

A constant error in the condenser could represent a displacement of the dial on the condenser shaft after the calibration had been done, provided that the condenser used is of the straight line capacity type. This type of condenser was used in the present case. Hence the value of the inductance obtained is correct, for the calibration of the oscillator was checked before the measurements were made.

The lower curve is for a coil with a computed inductance of 57.3 microhenries. The measured inductance was 50.4 microhenries. In this case the distributed capacity was only 8 mmfd., but as before, in the wrong direction.

Large Discrepancy

The large discrepancy between the computed and the measured values of inductance is not due to errors in the measurement. In the first place, the computation of the inductance was only approximate, for in both cases corrections which would have made the inductance less were omitted. In the second place, the coils were measured inside aluminum shields 2.5 inches high and 2.125 inches in diameter, the diameter of the coils being one inch. They were computed with no allowance for shielding. The shields reduce the inductance. In view of these two facts the measured and the computed inductances check as well as could be expected. The accuracy of the measurements was checked by measuring a coil of known inductance and the agreement was better than one per cent.

When the inductance of the larger coil was determined from computed curves in which corrections had been made it was 72 microhenries. The smaller coils gave an inductance of 55 microhenries. Therefore the shield reduced the larger coil by 5.25 mmfd. and the smaller coil by 4.6 mmfd.

Purpose of Coils

The values of $(\frac{1}{2}\pi F)^2$ given along the the axis of ordinates have been multiplied by 10 to the fourteenth power. Therefore when they are applied they should be divided by this power of ten. This was done in the example above.

The two coils measured were made for a television superheterodyne receiver designed to cover the frequency range from 1,500 to 3,270 kc. with a condenser having a maximum value of 140 mmfd. The larger coil was first made to cover the desired band, that is, from 1,500 kc up. The upper frequency happened to be 3,170 kc when the trimmer condenser was set at a medium value. The smaller coil was then computed on the basis of the measured value of the larger coil so as to give exact tracking at 1,630, 2,300, and 3,100 kc for an intermediate frequency of 450 kc. The required oscillator inductance was 50.3 microhenries, but 50.4 was close enough.

Measuring Natural Frequency

The natural frequency of a coil can be measured by the same method as the inductance, but in this case it is essential that there be no constant error in the calibration of the condenser, nor any other error. The natural frequency is obtained from the intercept on the ordinate axis. Suppose the straight line obtained for a given coil cuts the vertical axis at $(\frac{1}{2}\pi F)^2 \times 10^{14} = 0.1$. All that is necessary is to find F from this equation. Solving we find that $F = 5.025$ megacycles. If the oscillator used can reach this frequency the natural frequency can be checked directly by removing the calibrated condenser and finding at what frequency the coil alone resonates.

A Check

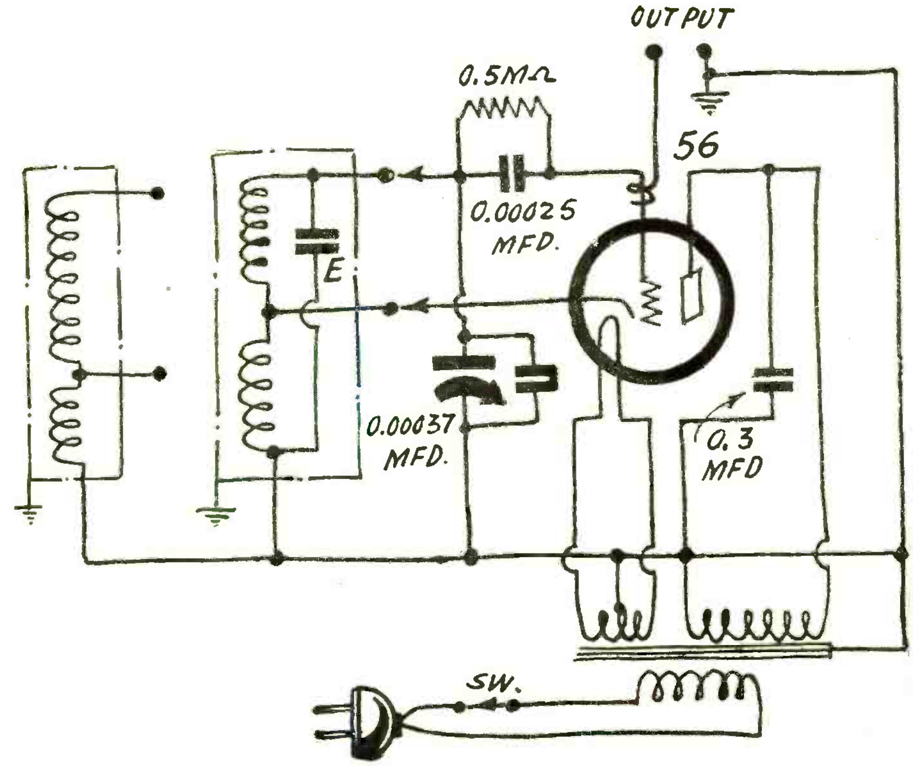
Another way of doing it is to determine the distributed capacity from the capacity intercept and then compute the natural frequency with this capacity and the measured inductance. Of course, there must be no error in the calibrated condenser. Suppose we find that the distributed capacity is 10 mmfd. and that the inductance is 66.75 microhenries. If we put these values in the frequency formula and solve for F we find 6.15 megacycles.

Knowledge of the natural frequency of a coil is useful when it is to be used as a choke. It will not act as a choke at frequencies above the natural frequency, but rather as a small condenser.

Single Calibration for Two Ranges in SWITCH OSCILLATOR

A SWITCH type test oscillator may be built that has a dial calibrated in kilocycles, one switch setting causing the tuning of a honeycomb coil for low frequencies and the other switch setting the tuning of a broadcast coil for the broadcast frequencies. If the fundamentals of the low frequency tuning are 50 to 150 kc, then some intermediate frequencies may be adjusted on test oscillator fundamentals, others on harmonics, whereas when the broadcast coil is switched into service, that band is accounted for by fundamentals only. Any use of harmonics of the broadcast coil would of course bring one into short waves. While the short-wave feature is perfectly feasible, the main reason for including the broadcast coil was not to rely on it for any harmonics and therefore the discussion will be confined to that situation.

The type of oscillator used is familiar to readers of these columns, as for different values of tuning capacity and inductances the same fundamental circuit has been discussed several times in the past few months. While a simple filament transformer could be used, as was done previously, here we show a special transformer, the plate winding having a 1-to-1 ratio in respect to the primary. Thus the line is conductively isolated from the plate voltage feed. Besides, a small condenser, 0.3 mfd., is connected from plate to ground, and this reduces a little the quantity of hum in the modulation. The oscillator has a-c on the plate, hence is constantly modulated that way, approximately 100 per cent.



Two coil systems are used in a switch oscillator. One overs 150 to 50 kc with a given tuning condenser. The other covers 1500 to 500 kc with the same condenser. Therefore a frequency-calibrated dial may refer accurately to both ranges with one calibration.

One Calibration for Both

The main idea is to use a single calibration. That is not difficult at all. In the first place, a coil to register fundamentals with a 0.00037 mfd. condenser, whereby the broadcast band would be the tenth harmonic of fundamental settings, would require an inductance of 20 millihenries. This is conveniently obtained in honeycomb coil form of winding, even though this is not a type of winding that the constructor can make at home. The inductance for the broadcast band to cause the frequencies to be ten times as great as those marked on the dial is 250 microhenries, and then the sole adjustment is one of capacity.

Of course the distributed capacities are not quite the same. A honeycomb coil of so great inductance has less distributed capacity than has the broadcast coil. The reason is that the greater the number of turns, the more series capacity, for the capacity of each turn is in series with the effective or net capacity of the other turns. So a small equalizing condenser, say, 20 mmfd., may be used to make the capacities in the two alike, and would be permanently across the honeycomb total. When the main compensator across the tuning condenser is adjusted for the broadcast band, by coinciding the dial with a high frequency broadcast frequency setting, the same is then done in the other circuit by using the equalizer or compensator that is permanently across the total honeycomb coil.

Where to Locate Tap

Instead of this system the equalizers may be two in number, as now, but one put across the total honeycomb winding and the other across the total solenoid winding, each adjusted permanently.

The broadcast coil may be checked against broadcast stations as standards, and so may the low frequency coil, using tenth harmonics of its fundamentals, for these are the very same broadcast frequencies. Indeed, when the dial is at any given position, using one coil, a beat established with a broadcast station should reappear when the dial is unmolested and the switch merely turned to cut in the other coil. This is a method of checking up coincidence between one coil and another, in respect to the settings after the preliminary adjustments are made at or near the high frequency end of either coil.

Both coils are shown as being tapped, with cathode to tap. The tap location is not critical, but it is well to have less than half the total number of turns between the cathode and ground ends, which means greater inductance between grid and cathode than between cathode and grid return.

Diode-Biased Circuit

The coils are shielded and the shields are grounded. However, due to the various wires carrying the oscillation voltage (even though unintentionally), there is some radiation, particularly at the low frequency settings. As to both coils the oscillation is stronger at the low frequency end, because as the frequency increases, the effect of the r-f resistance becomes greater. Thus the plate current rises as the frequency rises, for as the oscillation intensity wanes the rectified voltage across the grid leak declines, the bias becomes less, and the plate current increases.

The tube should be a 56 preferably, although a '27 may be used. As hooked up it is practically a diode-biased triode, wherein the grid-to-cathode circuit consists of the diode, and the plate to cathode circuit the triode. The grid leak is common to both diode and triode. Until recently this view was rarely if ever expressed, and practically nothing said about the grid leak type of detection being nothing other than a diode-biased triode.

The circuit may be arranged on the basis of a pre-calibrated dial, as stated, but many will not have such a dial, but merely one that reads from 100-0 or 0-100. In that instance graph paper should be obtained, preferably ten squares of ten, and the frequencies written on an upright margin and the dial settings on the lower horizontal margin. Thereupon after a sufficient number of points is registered the curve may be completed, and should be referred to every time a reading is taken. The same curve will apply to both coils after the parallel capacity is adjusted as previously explained. The pre-calibrated dial, however, dispenses with any chart or need of reference to anything save the dial.

Oddity of Frequency Increase

No meter is shown, nor is any biasing resistor in the cathode leg, and neither should be included after a calibration is run, or at all if the pre-calibrated dial is to be used. An added resistance between cathode and tap would tend to stop oscillation unless bypassed by a condenser of 0.002 mfd. or greater capacity, and besides the frequency would be in-

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THEORY OF CONVERTERS

Short-Wave Analysis, with One Circuit Treated Constructionally

By Brunsten Brunn

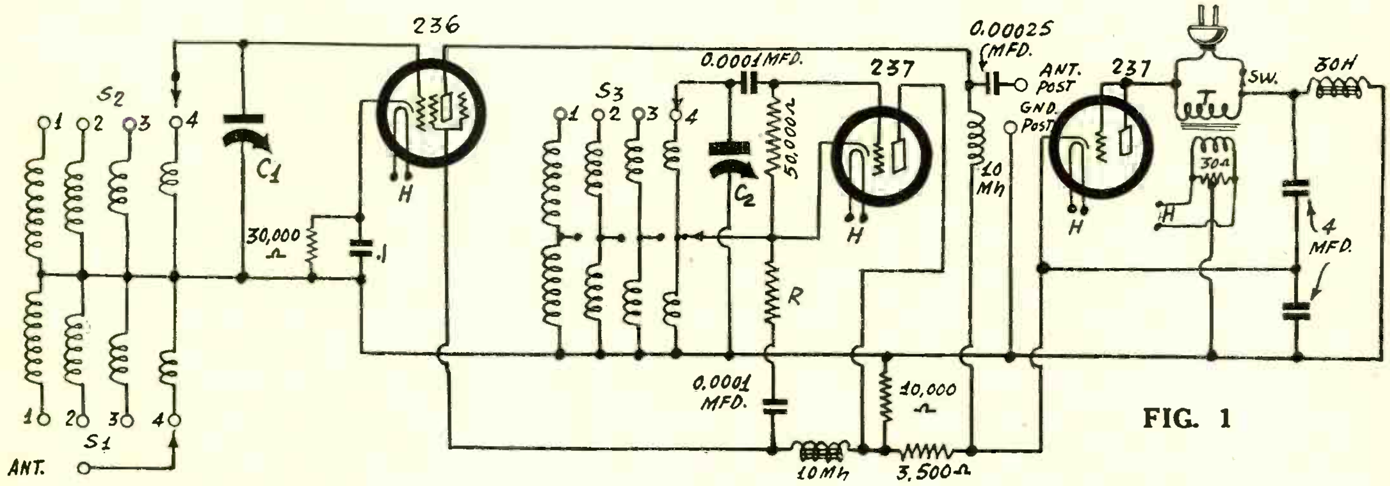

FIG. 1

THE principle of the short-wave converter is exactly the same as that of the superheterodyne. Indeed, the converter is the frequency-changing part of a superheterodyne. There may be a radio-frequency amplifier in the converter, but ordinarily this is omitted because of the difficulty of handling tandem resonant circuits operating at very high frequencies. The detector, or mixer, is never omitted, but in some cases it may be combined with the oscillator, just as this is done in some broadcast superheterodynes. The oscillator, of course, is never omitted for it is that which causes the frequency changing.

In some converters a stage of intermediate-frequency amplification is inserted. This is not essential to the converter but offers a means of increasing the sensitivity of the converter-receiver combination when there is not sufficient gain in the radio-frequency part of the broadcast set with which the converter is used.

Sometimes a power supply is built in as an integral part of the converter. This is a convenience that obviates the necessity of entering the broadcast set for the necessary voltages or the necessity of providing batteries. Of course, when the converter is designed to operate on direct current it is necessary to make provision for batteries.

Problems

A problem that always arises during the design of a short-wave converter is the type of coupling to be used between the converter and the broadcast set. If the input impedance of all broadcast sets were the same this problem would not arise for it would be necessary only to design a coupler that would match the output impedance of the mixer tube reasonably well with the impedance of the input circuit of the set. But hardly two receivers are alike in this respect and the coupling problem has to be solved for each receiver experimentally. Of course, it may be assumed that input circuit of the antenna has been designed to match a standard antenna, but this does not always work out satisfactorily.

The simplest form of coupling, which may be called universal because it can be used with all sets at all intermediate frequencies that are likely to be used, is the radio-frequency choke and stopping condenser as illustrated in Fig. 1. It virtually places a load on the mixer tube equal to the impedance of the input circuit of the broadcast set. This is all right if the input impedance is high, or if it consists of a primary closely coupled to a tuned circuit.

A better arrangement is to have a tuned circuit in place of the choke coil, provided this tuned circuit is made to resonate at the same frequency as the tuner in the broadcast set. The condenser in this tuned circuit will act as a by-pass condenser for the high signal and oscillator frequencies, which aids in detection. When the choke is used, there is only the stray capacity in the circuit to effect by-passing.

Tuned Output Illustrated

The tuned output circuit is illustrated in Fig. 2. In this case the stopping con-

Coupling of Switch Oscillator

(*Continued from preceding page*)

creased if the plate resistance were increased that way. So, too, a meter, even if in the plate circuit, would increase the frequency beyond what it would be without the meter, assuming that the meter has appreciable resistance. A 0-5 milliammeter, resistance a little more than 2,000 ohms, was used, and a frequency of 540 kc was increased to 560 kc.

The plate current changes considerably, due to changes in the bias, or oscillation intensity, but this change does not unstabilize the frequency in respect to the pre-calibrated dial or the executed graph, because the points have been registered on the basis of the changes in plate current exactly as they occur at the specified frequencies.

If any difficulty is experienced regarding consistent oscillation at any and all dial settings a somewhat higher value of grid leak may be used. Or, if there is indication of oscillation, accompanied by inability to register decisive squeals with broadcasting stations, or accompanied by a steady growling type of oscillation, at resonance, the smaller inductance is in the grid-to-cathode circuit, and the extremes of the winding should be reversed.

This is one of the best and most consistent oscillators, being a Hartley as modified by Edward M. Shiepe (Massachusetts Institute of Technology). The oscillation intensity at the low frequencies, even with shielded coils, and due to the oscillation voltage in the wiring and the transformers, will be sufficient to effectuate coupling with a receiver by mere radiation, despite a distance of several feet between receiver and test oscillator.

However, as the frequencies increase, toward the middle of the dial the coupling disappears, or is too weak to be noticeable, hence it is necessary to use an output. This may be a binding post coupled to the oscillator merely by a lead paralleling the short one between grid of socket and grid condenser in the circuit itself. Twisted pair may be used, if desired. But only one end of this output wire goes to any definitive destination—the binding post—whereas the other end is not conductively coupled to anything. The only coupling used is the small capacity between the parallel or twisted pair wires, and this is abundant.

No ground post actually is required, except for some special radio frequency testing purposes. The ground lead in the test oscillator may be a common one uniting the grid returns, center of 2.5-volt secondary, and core or frame of the transformer with the ground post.

LIST OF PARTS

Coils

One set of radio-frequency coils as described
One set of oscillator coils as described
Two 10-millihenry choke coils
One filament transformer to give tubes proper heater voltage
One 30-henry choke coil

Condensers

C1, C2—Two 140 mmfd. tuning condensers with vernier dials
Two 0.1 mfd. by-pass condensers
Two 0.0001 mfd. condensers
One 0.00025 mfd. condenser
Two 4 mfd. by-pass condensers

Resistors

One 30,000-ohm bias resistance
One 50,000-ohm grid leak
One 10,000-ohm resistor
One 3,500-ohm resistor
One 30-ohm, centertapped resistor
R—One coupling resistor to be found experimentally (50,000 ohms or more)

Other Requirements

One gang of four single pole, four throw switches
One on-off switch
Three binding posts
One grid clip
Three UY sockets

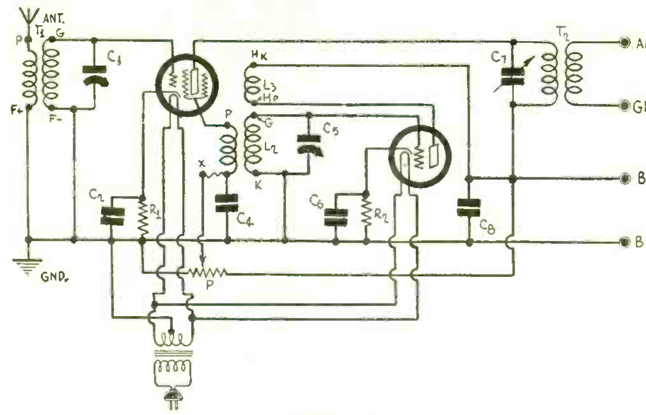

FIG. 2

The diagram of a two-tube short-wave converter intended for plug-in coils. The plate voltage may be taken from a battery or from the set with which the converter is used.

denser is not used but a secondary winding is used in its place. If the stopping condenser and the primary of the coil in the broadcast set were connected in series and then across the tuned circuit in the converter the tuned coupler would not be as good as the simple choke-condenser coupler unless the stopping condenser were made very small. When the secondary winding is used it should be coupled loosely to the tuned circuit in the converter so that the two tuned circuits coupled by this secondary and the primary in the broadcast set could be tuned independently.

The tuned coupler is not so convenient as the choke-condenser coupler because every time the intermediate frequency is changed by changing the setting of the tuner in the broadcast set it is necessary also to retune the coupling circuit. But when it is properly tuned and when the coupling is adjusted to the correct value it gives greater sensitivity.

In cases where impedance or resistance coupling is used between the antenna and the first tube of the broadcast set the tuned coupler as illustrated in Fig. 2 is preferable because then the secondary of the tuned coupler is connected directly to the grid of the first tube in the broadcast set and there are no complications.

One reason why the coupling often is inefficient is that the coupling device will detune the first tuned circuit in the broadcast set. When the tuning condensers are ganged there is no means of compensating for this detuning except by manipulation of the coupler. The choke-condenser coupler illustrated in Fig. 1 detunes relatively little.

Different Combinations

A few of the many possible combinations of converter and broadcast set are illustrated in Figs. 3 to 9. Fig. 3 results when the choke-condenser output coupler is connected to a broadcast set having direct coupling between the antenna and the first grid of the circuit. In this case a resistance R is used but it may be replaced by a radio-frequency choke without altering the circuit. In this case the stopping condenser C is not critical. This circuit is not efficient.

Fig. 4 results when the choke-condenser coupler is connected to a receiver in which an ordinary radio-frequency input transformer is used. This coupler is as efficient as any and the value of the stopping condenser C is not critical.

In Fig. 5 the converter has a tuned impedance and a stopping condenser and the antenna of the broadcast set is coupled directly to the grid of the first tube. In this case C is not critical and the resistance R may be replaced by a radio-frequency choke. The coupler is efficient but requires tuning of the coupler circuit to the same frequency as the tuned circuits in the broadcast set.

The combination illustrated in Fig. 6 results when the tuned impedance-condenser coupler is used in the converter and the input circuit to the broadcast set is an ordinary radio-frequency transformer. This combination is likely to be quite unsatisfactory unless the stopping condenser C has an extremely small value. If the condenser is large the two tuned circuit will be too closely coupled. The tuning of the two will not be independent and the selectivity and the voltage transfer may be low. The value of C should not be more than 20 mmfd. and preferably much less.

A Good Combination

In Fig. 7 the converter has a primary-tuned output transformer and it is coupled to a receiver having direct coupling to the antenna. As in the preceding cases of direct coupling, R may be replaced with a radio-frequency choke. This coupler is satisfactory for there is only one tuned circuit between the tubes and there will be no tuning complications. However, if a large voltage transfer is to be effected the secondary winding of the transformer should be at least as large as the primary winding. It is assumed that the resistance R has a high value, say 100,000 ohms or more. If it has a much lower value it might be well to increase it.

The circuit in Fig. 8 results when the tuned primary transformer is used in the converter and when the broadcast set uses an ordinary tuned radio-frequency transformer between the antenna and the first tube. This combination, like that in Fig. 6, is likely to be quite unsatisfactory because the coupling between the two tuned circuits may be too close. In order that it should be successful the secondary of the converter transformer should be loosely coupled to the primary and the primary of the receiver transformer should be loosely coupled to the secondary. Only a few turns should be used for the two windings constituting the coupling loop. If the coupling is loose the circuit is satisfactory. It may be loosened by putting a small condenser between the antenna post and the secondary of the converter transformer secondary.

An Exceptional Case

In a small number of cases the primary winding of the broadcast set input transformer is not connected to ground but is left entirely free. In such cases a simple and efficient coupler can be arranged as in Fig. 9. B plus of the converter is then connected to the ground post of the set and no ground is connected to the post. This arrangement requires a third connection between the converter and the receiver for it is desirable to have a common ground. In cases where the ground post on the receiver is connected to the chassis or to B minus of the receiver by means of a condenser but otherwise is insulated this connection is possible, and in that case it is not necessary to make the third connection for ground.

When the ground post on the set is not used for ground, as in Fig. 9, the ground should be connected to the converter chassis or B minus.

Broadcast Interference

In many cases there is interference between broadcast stations and the short-wave signals. So strong is this interference at times that only broadcast stations can be received with the converter, the short-wave signals being blanketed. Indeed, at times the only effect the converter has is to make the broadcast set more sensitive to broadcast signals.

When interference of this kind is experienced the cause is lack of shielding. The converter acts as an antenna for the set. Even when both the broadcast set and the converter are shielded the interference may occur. The cause is obviously the leads used for connecting the converter to the broadcast set. Many broadcast receivers are so sensitive that it requires only a few inches of antenna wire to bring in all the local stations with full volume. The unshielded leads connecting the converter and the set may in some instances be several feet long. Therefore to stop any interference from broadcast stations that may occur after the two parts of the combination have been shielded, the connecting leads should be made as short as practicable and they should be themselves shielded.

The converter should not be condemned because broadcast stations can be picked up after shielding precautions have been taken. It is always possible to select an intermediate frequency on which there is no interference. For example, if there should be interference on 1,000 kc after this frequency has been selected as intermediate, the frequency may be changed to 1,010 kc or 990 kc and

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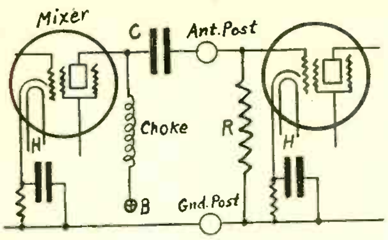


FIG. 3

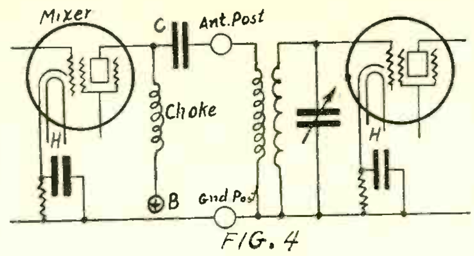


FIG. 4

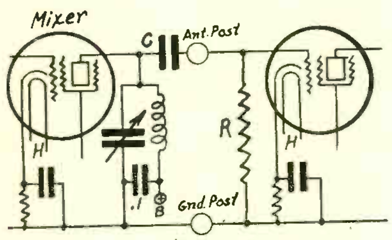


FIG. 5

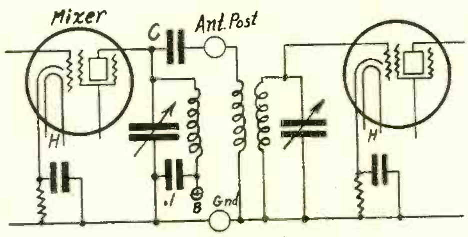


FIG. 6

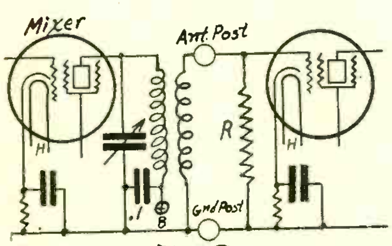


FIG. 7

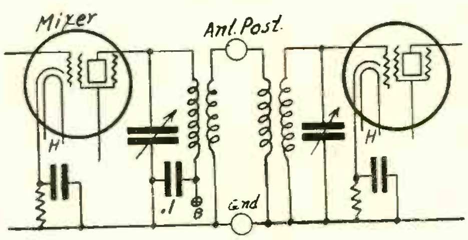


FIG. 8

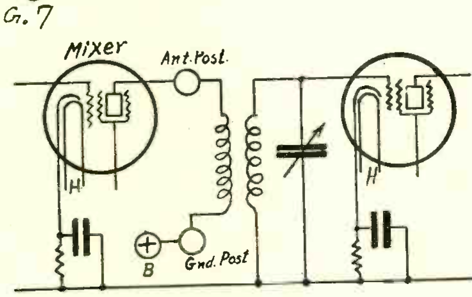


FIG. 9

Different coupling combinations resulting from connecting a short-wave converter and a broadcast set, depending on the type of output of the converter and the type of input of the receiver.

(*Continued from preceding page*)

the interference will be avoided. Any frequency within the tuning range of the broadcast set may be used as intermediate frequency and in every case at least one can be used free of interference. Indeed, at least 75 of the 96 channels will be clear. Moreover, we are not limited to the channel frequencies, so there should be little difficulty in finding a frequency free of interference anywhere.

Another Problem

Another problem that arises in the design of short-wave converters relates to the method of changing the frequency coverage of the short-wave tuner. A converter should be able to cover the range from 1,500 kc to at least 30,000 kc. It is impossible to cover this band with a single inductance. Hence we must resort to some switching scheme. We may use a single coil with a number of suitably placed taps, or we may use plug-in coils, or again we may use individual coils picked up by means of switches.

The simplest of these from the point of view of construction is the single coil with taps on it. But this is the least desirable from the point of view of efficiency. The next simplest from the point of view of construction is the plug-in coil system, and this is probably the best from the point of view of efficiency. However, the scheme is objectionable because of the inconvenience of plugging in when a different band of frequencies is to be covered. Practically it necessitates placing the coils outside the container where they are accessible. There is one other serious objection; the coils are subject to damage during handling, or at least change of inductance. Such a change would alter the dial readings for given frequencies.

The system of individual coils picked up with switches is a compromise between the other two systems. It has the convenience of the tapped coils and in respect to efficiency it can be made as good as that of the plug-in system provided the several coils are suitably placed. Perhaps the main objection to this method is that it takes much more room than either of the other schemes. All things considered, the system using several coils picked up by switches is perhaps the most satisfactory.

Coils Required

The number of coils required in any case depends on the size of the tuning condenser and on the desired band coverage. A given coil covers a frequency band depending on the ratio of the maximum and minimum capacity in the circuit, the frequency ratio being equal to the square root of the capacity ratio.

By using a large tuning condenser we can make the capacity ratio large and thus make a single coil cover a wide band. This would reduce the total number of coils required. But when we use a large condenser the tuning becomes difficult on the higher frequencies in each band. It is better to use a small condenser and more coils than to use a large condenser and fewer coils, provided room is available for the many coils required. Moreover, the tuning condenser should be of the straight line frequency type, or at least one in which the capacity changes slowly for low values of capacity and more rapidly for large values.

Medium Size Condenser

A condenser that is usually employed for short-wave sets has a maximum rated capacity of 140 mmfd. Actually the maximum capacity in the circuit of such a condenser is around 150 mmfd. while the minimum may be of the order of 30 mmfd. If we assume these extreme values the capacity ratio will be 5 and the frequency ratio will be 2.24. Thus if we want to cover the range from 1,500 to 30,000 kc we must use 4 coils. Theoretically this would cover the band from 1,500 kc to 37,500 kc, but some overlap is needed between adjacent coils to insure a continuous coverage. A set of four coils might be made to cover the following frequency ranges: (1), 1,500-3,360 kc; (2), 3,170-7,100 kc; (3), 6,700-15,000; and (4), 14,140-31,600 kc. Since the overlap is small it is necessary to adjust the inductances carefully and for best results this should be done experimentally after the coils have been installed in the circuit. It can easily be done with the aid of a calibrated and modulated oscillator, using harmonics to get the higher frequencies.

Oscillator Coupling

When plug-in coils are used the question of coupling between the oscillator and the mixer is easily answered. It is only necessary to put a third winding on the oscillator form and then connect this in the cathode, screen grid, or plate leads of the mixer tube. If the tube is of the heater type the best place for the pick-up winding is in the cathode lead. If it is of the filament type the best place is in the screen grid lead. If the tube has neither a cathode nor a screen, the connection may be made in the plate circuit.

Fig. 2 is the circuit of one of the earliest short-wave converters ever described. It is still as good a circuit as there is, except that no provision is made for the B supply except a couple of binding posts, which may be connected either to a battery or to suitable points on the voltage divider in the broadcast set. This circuit was designed before six-contact sockets and six-pin coil forms were available and for that reason one of the terminals of the pick-up winding, here placed in the screen lead, was connected to a flexible lead provided with a tip for insertion in a tip-jack X. If the same circuit were to be made now a six-contact socket and a six-pin form would be used and the lead now going to X would be connected to the screen pin of the form. However, the pick-up winding would be placed in the cathode lead rather than in the screen lead. The screen would go directly to the proper voltage.

Difficulties in Coupling

When switches are used for changing frequency bands the pick-up is somewhat of a problem. If a pick-up winding is used on the oscillator coil a separate section of the switch must be used for it. This complicates the switch and the wiring. Some method of universal coupling is desirable, and one of this type is shown in Fig. 1. Between the cathode of the oscillator tube and the screen of the mixer are a resistor R and a 0.0001 mfd. condenser, the two being connected in series. The screen must be connected to a positive voltage and to prevent a short of the oscillation through the supply lead, a 10-millihenry choke is put in the screen lead.

The cathode of the oscillator is at a high radio-frequency potential with respect to ground. Hence the screen voltage on the mixer will be modulated by the output of the oscillator. By varying the value of resistance R the degree of modulation, or the degree of coupling between the oscillator and the mixer, will be varied. The resistance must not be too small for then it will affect the frequency of oscillation and it will make the coupling between the two circuits too close. Neither must it be too large for then the coupling will be too loose and the converter will not be sensitive. A value of 50,000 ohms should be all right, but different values should be tried in an effort to get the best value in each case.

The Switching

The switch used in the circuit contains four decks with four stops on each deck. The first deck, S1, picks up the antenna windings of the radio-frequency coils, the second, S2, picks up the tuned windings of the same coil, the third deck picks up the grid ends of the oscillator coils, and the fourth deck the taps on these coils.

If we were to have a pick-up winding on each oscillator coil it would be necessary to have still another deck which would pick up the live end of the pick-up. In order to select the pick-up by means of a single deck it would be necessary to connect one side of it to ground and the other to the cathode return of the mixer tube. That is, the 0.1 mfd. condenser and the 30,000-ohm bias resistor would be connected next to the tube and the side now connected to ground would be connected to the arm of the switch.

The switch amounts to a gang of four single pole, four throw switches, all placed on a common shaft. The difficulty of getting a suitable switch for this purpose is one of the reasons why this type of arrangement is not used almost exclusively. Switches may be had where the first two decks are at one end of the shaft and where the other two decks are at the opposite end, the distance between the two pairs being about five inches. As far as the distance between the two pairs is concerned the switch is satisfactory, but the two decks of each pair are very close together, and is not so good. There is too much capacity between the points of adjacent decks. While this does not matter at 1,500 kc it is serious at 30,000 kc. It is essential that the decks be at least an inch apart.

Selection of Switch

Another objection to some switches available is that the capacity between the shaft and the moving arm is quite large. This becomes serious as the frequency becomes high.

When the switch is selected these points should be observed. Is the capacity between ground and any stop when the arm is set on that stop negligible at 30,000 kc? Is the capacity between two corresponding stops, when the arms are set on those stops, negligible at 30,000 kc? Are the decks used for the radio-frequency coils and the oscillator coils far apart or so arranged that a metal shield may be placed between them? Are the contacts positive and are they self-cleaning, that is, are they of the wiping type? Are the detents definite so that there is no uncertainty when the arm is on the contact?

When laying out a set of this kind the parts belonging to the radio-frequency amplifier should be carefully shielded from those belonging to the oscillator. If the parts are not inclosed in separate metal containers there should at least be a metal partition. The smallest coil in each set should be nearest the condenser and the tube and the largest coil farthest from them. But all should be as close as practical. The drawing indicates the relative positions of the coils, No. 1 in each group being the largest and No. 4 the smallest.

It is best that the two tuning condensers C1 and C2 be entirely independent for then the two circuits can be tuned most accurately. The sensitivity of the converter depends largely on the close tuning of the circuits to the desired frequency. This is much more important in a short-wave tuner than in a broadcast set for most of the short-wave signals will be weak.

Design of Coils

The following coils are based on the assumptions that the intermediate frequency is 1,000 kc and that the maximum value of each tuning capacity is 150 mmfd. The diameter of the form of each coil is one inch. N1 is the number of turns on the primary of the radio-frequency coil, N2 is the number of turns on the secondary of that coil, N3 is the number of turns between ground and the tap on the oscillator coil, and N4 is the total number of turns on the oscillator coil. L2 is the inductance of the radio-frequency coil in microhenries and L4 is the inductance of the entire oscillator coil in microhenries.

Short-Wave Coil Data

Coil	L_2	N_1	N_2	L_4	N_3	N_4	Wire
1	75	12	63.5	27	15	32.5	No. 28 enam.
2	16.8	7.5	33.5	9.68	10	22.5	No. 20 enam.
3	3.77	3.5	15.75	2.84	5	11.25	No. 16 enam.
4	.842	1.2	5.45	.735	2.5	4.95	No. 14 enam.

The turns are given on the supposition that there is no space between adjacent turns except that of the insulation. If a slightly greater separation is used, and it is desirable for the smaller coils, the number of turns should be increased slightly. The percentage of increase in the turns should not be greater than the percentage increase in the length of the coil due to the wider spacing. Where the number of turns is given as a small fraction, the nearest quarter turn should be used, but the oscillator and the radio-frequency coils should be changed in the same direction. For example, the smallest radio-frequency coil may be increased to 5.5 turns and the corresponding oscillator coil to 5 turns.

Only the turns on the two tuned windings are critical, that is, on N2 and N4. The number of turns on the tickler, that is, on N3, should be a little less than half the total number of turns on the oscillator winding. The number of primary turns on the radio-frequency coil is approximately one-fifth of the number of secondary turns, or a little less than one-fifth. For greater selectivity the ratio may be made greater than one-fifth. In the case of the smaller coils where fractional primary turns are called for, the number may be increased slightly if necessary provided that the distance between the secondary and primary turns is increased. The assumption is that the primary and secondary turns are made in one continuous winding with a tap for the ground connection. After the tap has been made it is always possible to work the primary turns farther away from the secondary. The oscillator windings should be made continuously with a tap for the cathode, but it is permissible to separate the turns at the grid end a little for the purpose of adjusting the inductance.

Tracking

Close adjustment of the turns is not necessary because the adjustment can only be made for one intermediate frequency and any frequency within the tuning range of the broadcast set may be used. Hence if the adjustment is made at 1,000 kc it will be out at any other frequency. It is because the two condensers are independently tuned that any intermediate frequency may be used.

The oscillator and radio-frequency inductances have been determined so that the circuits will track approximately at the low frequency end of each band. On the smaller coils the tracking will be close all the way but on the larger there will be a large discrepancy at the high frequency end. Thus at the high frequency end of the largest coil the required capacity is 29.9 mmfd. in the radio-frequency circuit and 49.2 mmfd. in the oscillator circuit.

Kranz Features Parts And Increases Sales

Mike Kranz, of Thor Radio Company, 167 Greenwich Street, New York City, who operates the store as well as Thor's Bargain Basement, makes some interesting remarks about the parts business and the radio industry.

In 1920 he opened what is considered the first radio store in the street and which was known as City Radio. This place later he sold. From the beginning he says he always specialized in parts, although naturally carrying other radio merchandise. During all these years he has conducted stores at various addresses, and often branch establishments, but still he kept parts.

Some time later, when many of the stores that had since come into the field figured the parts business was through and went in for factory-made radio receiver, Kranz still specialized in parts, so naturally what call there was for parts came his way. His store became one of the few featuring parts, and was one of the longest established where a large and varied stock of parts could be bought. In this way over a long period he developed a following that is almost unbelievable.

As a kits distributor to the consumer or experimenter no one in the Cortlandt Street area can approach his volume of business, both in counter sales and the mail order. He reports a substantial increase in business for 1932 over 1931, with every indication of a greater increase for 1933.

During the past year he has specialized in a seven-tube superheterodyne and six-tube t-r-f kit and has placed them in every part of the United States and in many foreign countries. He has what is considered the most complete parts, replacement parts and kit establishment in the country and caters to the experimenter, serviceman and the amateur. He says there are great things in store for the Winter and Spring of 1933 and plans to bring out some special features at an early date.

A THOUGHT FOR THE WEEK

PERRITON MAXWELL, editor and writer, and adventurer in the field of radio journalism, is responsible for "The Lady Friends of Amos 'n' Andy," a feature of the January number of Good Housekeeping. Mr. Maxwell has taken a whimsical slant on a whimsical pair, and his story about the admirers of the comedians is pungent with the characteristic humor that shines out "Underneath the Harlem Moon." The author takes us close to the kernel in the oddly-constructed shell of things Harlemesque.

NEW CORPORATIONS

Guided Radio Systems, Inc., Brooklyn, N. Y., wireless telephone, wireless telegraph—Attys., Corporation Trust Co., Dover, Del.

United Electrical Manufacturing Co., Newark, N. J., electrical appliances—Atty., Joseph J Corn, Newark, N. J.

NOISE SUPPRES

Where It Is Needed

By Flemin

WHEN automatic volume control is used so that it governs two or more tubes, the absence of an appreciable carrier voltage at the antenna deprives the a.v.c. of its source of supply, and hence leaves it ineffective. Since it is only a carrier voltage that produces the extra negative bias that constitutes the control, the negative bias is least, the amplification greatest, when there is no appreciable carrier. So between channels the receiver is most sensitive and may become regenerative or even oscillatory, due to deprivation of the required extra bias to insure complete stability. The feedback condition makes the set noisy between stations, and this inter-channel noise has been a severe drawback. In fact, only within recent months has a.v.c. risen to heights of acceptability, for nearly all preceding uses introduced a remedy that was probably worse than the evil that it sought to cure.

The earliest form of so-called automatic volume control was introduced commercially several years ago about the time that a-c receivers were trying to make their bow. Many will remember the a-c Ware that was demonstrated at the annual public radio show in New York City, before a-c tubes were introduced, and how badly it hummed. The designer of that receiver also introduced, in another model, a 199 tube, filament fed by the receiver's plate current, and this tube functioning as a control of the bias.

A.V.C. as Fading Reducer

Primarily the object was to keep the reception steady under conditions where otherwise it would be unsteady. This meant that an attempt was being made to circuit a receiver so that the effect of fading would be virtually nullified. However, that particular form of a.v.c. was not very acceptable, because the action depended partly on the filament behavior, and this was too sluggish.

It should be borne in mind, therefore, that the primary object of introducing a.v.c. was to counteract fading.

Today the objectives may seem split. Some receivers have a.v.c. that causes even low values of carrier voltage to be somewhat effective on the control. Other receivers have included a bias elevation system whereby the a.v.c. does not become effective until the carrier input to the detector or a.v.c. tube reaches a certain predetermined level. This method is based on current flow in the control tube being prevented until the delay voltage is reached, but doesn't deny the remedy to fluctuating values of low-intensity carriers. As only weak stations are subject to noticeable fading, does the a.v.c. fail to help out in this direction? What it does is to act on the basis of control tube input voltage, and we have seen this is greatest when the carrier voltage is least. So the fading reduction remains.

Both Systems Need Suppressor

Nearly all receivers to-day that include a.v.c. are extremely sensitive, considerably better than 10 microvolts per meter, and many of them sensitive to fractional microvolts per meter at values hard to measure with any known instruments. Since a sensitive receiver amplifies greatly everything that is picked up, and since noise of various sorts is among the pickup, the receiver is inclined to be noisy, and unless a remedy is applied this noise may be greatest between reception channels. The racket is similar to that known as "hash" interference.

It can be realized that consistent design would call for inter-channel noise suppression in instances where the a.v.c. was not effective until a substantial voltage was put into the control tube, as well as when it is effective as soon as possible.

Although one system attempts to make the a.v.c. effective on small values of carrier input voltage, the other specifically seeks to avoid any control until the control tube input voltage is substantial, but as to both systems the input to the control tube is large at no carrier, hence both require suppression of inter-channel noise.

The automatic inter-channel noise suppressor was designed in tube laboratories. It makes use of the sharp cutoff of plate current in the 57 when the negative bias on that tube rises above amplification values, as to about 6 volts or more. Practically, the plate current does not cut off, but it becomes extremely small beyond 11 volts, although there is still a measurable quantity (using a 0-0.5 milliammeter) at 13 volts. However, the shape of the curve is such that the reduction in plate current becomes abrupt at around 6 volts and the tube ceases to amplify and indeed saturates.

Noise Present, Not Heard

Therefore since there is practically no transfer at high values of negative bias, if a circuit can be so arranged that when it is most sensitive at radio frequencies it is made least sensitive at audio frequencies, the result is virtually the cessation of audibility. The absence of a carrier, for instance, still will leave the receiver in its most sensitive operating condition at radio frequencies, and while maximum sensitivity is certainly not desired when there is no signal reception, whatever noise results can be cut out of that part of the audio amplifier following the noise suppressor tube by the cutoff characteristic of that tube. The noise is there but not heard.

Let us see what the problem is:

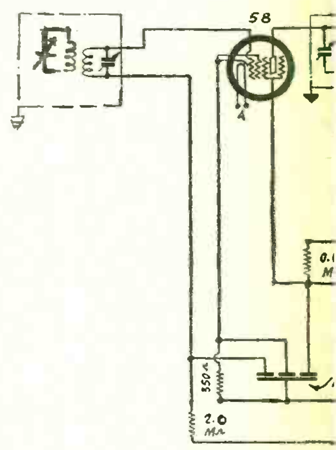
(1)—The weaker the carrier, the stronger the r-f amplification; the stronger the carrier, the weaker the r-f amplification. The reason for this condition is that the signal voltage increases the bias voltage hence decreases the amplification.

(2)—Since a.v.c. works approximately on the principle of inversion, so that strong stations are limited in their strength and weakest ones are not.

(3)—Therefore we desire to use a tube in such fashion that when the voltage on the detector or control tube exceeds a certain value, the quantity of sound output is cut down, so that substantially we have silence between received stations, or so-called silent tuning.

The interchannel automatic noise suppressor system is worked with a duplex diode-triode, represented by the 55 in a-c receivers, in conjunction with the 57 as suppressor tube, and the solution is as follows:

The triode unit of the 55 is used as d-c amplifier only, audio removed. That means that the tube is not used for a signal load, but only for the effect that the d-c plate current has on the load resistor. Therefore as the detector input voltage increases, the current through the voltage in the load resistor of the 55 rectifier circuit increases (0.25 meg. potentiometer in diagram), and as this voltage comprises the sole bias on the triode section of the 55, the plate current through the triode's load resistor (0.05 meg.) decreases, and the voltage drops. As this drop decreases, the voltage on the plate



increases. Therefore at strong detector input voltages we have higher bias in the audio amplifier, and as zero carrier voltage produces the greatest detector voltage input, we have an audio corrective for the radio shortcoming. Hence substantial carrier voltages will leave the audio control tube virtually free to function as an amplifier, for the resistance values are so chosen that the 57 bias will be satisfactory for amplification. Hence substantial carrier voltage, consistent with reduced detector input voltage, for that is the manner in which a. v. c. works, will produce a large drop in the 55 triode's plate load resistor, and the bias will be less negative than in the previous example.

The resistance and voltage values are so chosen that the bias on the 57 constitutes the tube an amplifier, whereas when the bias is increased greatly, due to very weak or no carrier voltage, the functioning of the 57 tube is stopped.

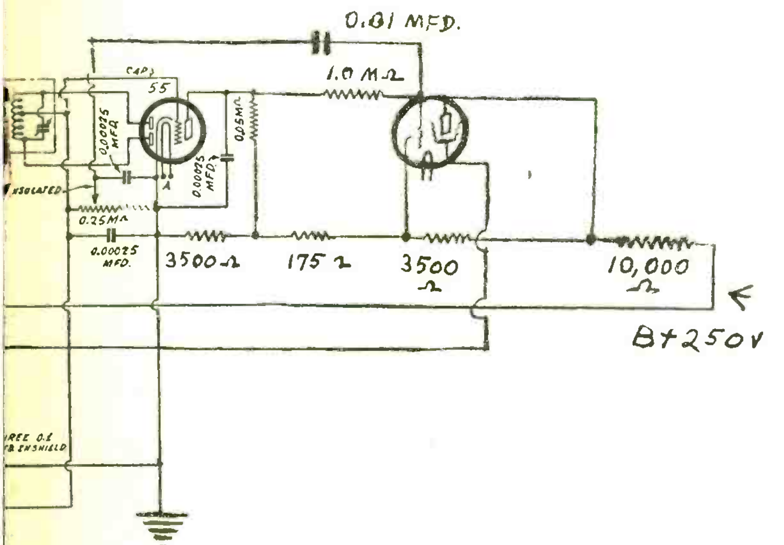
Therefore the diode unit is direct coupled to the triode and the triode is direct coupled to the noise suppressor tube for d-c purposes.

R-F Filtration

It is necessary to transfer the audio, otherwise nothing ever would be heard in the reproducer. If a condenser is connected between some point of the 55 load resistor (potentiometer) and grid of the noise-suppressor tube, then the audio frequencies are passed on to this suppressor tube. So they undergo the treatment and effects previously cited. The voltage may be taken off the slider of the potentiometer, in which case the slider is used as manual volume control.

It is necessary to keep the radio frequencies out of the audio channel. For most superheterodynes, and it is with only such receivers that the noise suppressor is used at present, the filtration may be sufficient if bypass condensers of 0.00025 mfd. are used, across the total potentiometer resistance, from cathode to arm of potentiometer and from cathode to plate of the triode unit of the 55. In

SION CONTROL
and How It Is Used
g Woolcott



this instance the cathode is grounded, so the bypass condensers go to ground.

If radio frequencies are not sufficiently kept out this way, a radio frequency choke of 2 millihenries inductance may be connected between the center-tap of the detector input transformer and grid of the 55 triode, or a resistance of 1.0 meg. or larger value may be put in the same position, and a condenser then connected between grid and ground of sufficient capacity to detour the audio frequencies. A value of 0.05 mfd. would be enough, but a larger capacity may be used.

Instability Desired Here

The 1.0 meg. resistor between control grid of the 57 and plate of the 55 triode holds up the input resistance in the 57 control grid circuit, which otherwise would be only 0.05 meg., too low a load for the 57 input.

Of course the resistor load on the plate circuit of the 57 is itself small, only 0.05 meg., compared to the usual 0.25 meg., but the reason is that the plate current changes are made more pronounced, and the noise suppressor tube, it will be remembered, functions on the basis of plate current instability. The higher the resistance of the load the smaller the percentage of the plate resistance to the total resistance in the plate circuit, and the more stable the current, since the variable resistance (plate to cathode) becomes too small a proportion of the total. While amplification is greatly reduced, the tube is not in service as an amplifier, but rather for a de-amplifier under conditions already related, and if it contributes only a little when not fulfilling its noise-suppression purpose (because there is no noise to suppress) we have no cause of complaint. Even so, a working gain of ten or so may be expected, and in days not so far distant we used to consider a working gain of 10 rather imposing.

The diagram shows a full-wave 55 detector, with automatic volume control affecting the intermediate amplifier ahead of a superheterodyne's second detector. It is assumed that more than one tube actually is controlled, for if only one is controlled the noise suppressor is hardly necessary, as the a.v.c. effect then is not so exceedingly pronounced.

Single-Sided Detector

The principle is applicable to single-sided detection, in which instance the other anode probably would be used for a.v.c., possibly being fed by a condenser of 0.002 mfd. from the plate circuit of the preceding tube to anode of the second anode, or a similar capacity condenser merely put between the two anodes.

The plate voltage on the 55 triode's 0.05 meg. resistor is low, around 25 volts being deemed sufficient, whereas the bias on 57 would be normally around 3 volts, when the current through the plate resistor is very small, while the screen voltage for the 57 may be the same as that applied to the screens of some other similar tube or tubes elsewhere in the circuit (an r-f or i-f amplifier, for instance).

It has been stated that the a.v.c. system is one of reducing sensitivity inversely to the carrier voltage, and it can be realized that the n.s.c. tube also reduces sensitivity in the same direction, for its output is greatest when the carrier voltage is least. Two sensitivity reducers may bring up the question: Is there any sensitivity left? When it is remembered that in high-gain receivers "losser" methods are introduced to effect stability, it can be appreciated that the excess over practical values of gain may well be devoted to a.v.c. and n.s.c., and the performance made much better than if the older methods of sheer "lossers" were introduced.

Noise suppression control is very effective.

Effect on Tuning

The introduction of the n.s.c. makes quite a difference in the apparent tuning. For instance, the receiver seems to become much more selective. In general, receiver selectivity is judged by the user on the basis of the smallness of space on the dial required to tune out the strongest local, and since at a position slightly off resonance the signal disappears, the set becomes "very selective" in consumer parlance.

This method of judging selectivity is really no method at all, yet it has to be considered, because it is practically the uniform basis adopted by purchasers. The reason that such tactics do not give any true indication is that the selectivity is a function of the resistance in the tuned circuit, and this resistance is not changed at all by the n.s.c.

So stations may pop in and out, without any warning of their approach or exit, and while on the broadcast band this is no disadvantage, in short-wave receivers a condition, already complained of for other reasons, becomes worse. How often has the advice been stated that the dial must be turned ever so slowly in short-wave tuning, otherwise you will pass over a station without even knowing it is there! Well, the passover will be much more likely with n.s.c.

Always Increases the Closeness

The minimum bias and other voltages on the 57 may be so arranged that the condition of quick appearance and disappearance of stations is made more or less pronounced, but at all hazards, no matter how small the effect, it is one of increasing the rapidity of appearance and disappearance of a signal in tuning, only in one instance it does not increase it as much as in the other.

If the n.s.c. is so gaited that its action makes the set seem as selective as can be, which may be described as close fixation of the resonance point, then no visual tuning device is actually needed. Heretofore the necessity of a visual indicator, usually a meter, sometimes a glow lamp, was stressed, because the volume of sound considerably off resonance was as great as that at resonance, in other words, the a.v.c. was working. This much is apparent from the levelling effect of a.v.c. on divergent values of carrier voltage input as affecting the ultimate quantity of sound at the reproducer.

When resonance is confined to a close spot on the dial, even as to the strongest local, then of course tuning by ear becomes quite satisfactory, even with a.v.c. This holds good on a short-wave set as well as on a broadcast set or even a so-called all-wave receiver.

Overbiasing any tube has an effect on quality, and it is not an improving effect, either. The 57 as n.s.c. is an overbiased tube when it is functioning as noise audibility eliminator. Therefore the quality will not be good. But here we may rightly consider quality in its theoretical aspect, since the real purpose of the 57 is to eliminate the signal from the audio amplifier when that signal is nothing but noise. So we don't care if the quality is good, bad or indifferent, because, as said before, the signal or interference is rendered inaudible, and the quality consideration has no practical value.

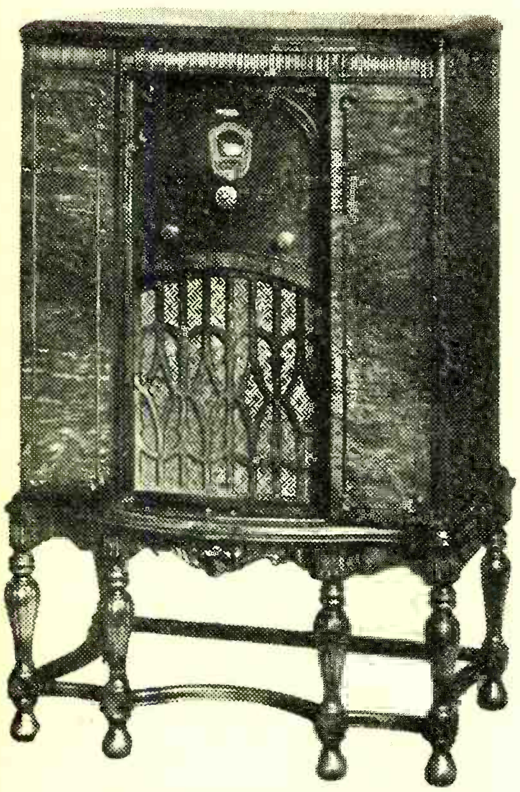
Reassurances to Quality Enthusiasts

So soon as a carrier comes along it actuates the bias on the 57 so that the bias is well within the desired working region consistent with quality, and we need waste no time worrying over the wretchedness of the quality affecting interference or noise that we don't hear, anyway.

The subject is brought up, however, because so many are interested in the very best quality of amplification and reproduction that they might hesitate to accept n.s.c. unless it was consistent with

(*Continued on next page*)

COMMERCIAL CIRCUITS
HOWARD MODEL M



Model M—14-Tube Chassis
(Used in cabinet No. 420)

THE Model M is a 14-tube-superheterodyne employing the new type Howard Triplex Control incorporating special tuned features in this control over that of the Duplex Control in the Model K, in the interest of reduction of noise level on the station, and in addition, better selectivity and duplex control.

The following circuits are employed in this receiver:

(a) A radio frequency amplifier system which incorporates the type 58 R-F Pentode tube.

(b) A 1st detector circuit or translator circuit employing the 58 tube, which circuit, in conjunction with beat frequency excitation from oscillator circuit employing 56 tube, converts the incoming frequency to the intermediate frequency of 175 kc.

(c) This frequency is amplified by the succeeding type 58 tube to a fairly high voltage level.

(d) The output of the preceding tube is delivered to a type 56 second detector tube, which converts the intermediate frequency to the musical or audio frequency.

(e) The output of the second detector is fed through a step-up audio transformer using push-pull connection directly into four type 42 tubes, and the output of these tubes feeds directly into the dynamic speaker through the medium of the speaker input transformer.

(f) For the special Triplex Control purposes a new system is employed, which includes a type 58 intermediate frequency special amplifier which has associated with its plate circuit, three coils inductively coupled to each other. The first coil is associated with the plate circuit amplifier, while the second coil provides voltage for the type 56 rectifier tube system. The third coil is associated with the type 55 tube, which provides the noise suppression voltage on the grid of the second detector tube through the medium of the voltage drop across the resistor 2369, which is in the plate circuit of the 55 tube.

(g) The power supply circuit consists of two type 80 tubes having the conventional filter circuits, shown in the schematic wiring diagram. A fuse is furnished in this chassis to protect power transformer from burnout due to defective type 80 tubes or short-circuits in power supply system.

Schematic Wiring Diagram

In the interest of simplicity in servicing receivers, the schematic wiring diagram 1492 shows the respective circuits used in this receiver, together with the part numbers, sub-assembly numbers, RMA color code, and in addition, the plate and cathode voltages of the respective tubes and power supply circuits. This method of presentation permits the service man immediately to check each respective circuit by means of a voltmeter, and determine which circuit does not obtain the correct voltage, or is short-circuited or open-circuited.

The capacity and resistance values are given in the parts list.

For further information concerning this diagram, may we state the following: The respective tuned circuits are housed in metal containers, and the complete system is thoroughly shielded to prevent radiation and at the same time protect the vital parts of the receiver. Access may be had to these units by removing chassis from cabinet and loosening the required nuts which hold on the protective containers. In most cases it is a rare incident to remove these containers, because all voltage checks on all circuits can be readily made at the proper tube and high voltage terminals, which are readily accessible and in plain view on the under-side of the chassis. The speaker field is part of the filter system and acts as a second choke coil.

Voltages referred to in diagram are measured from ground terminal to the respective plate and cathode circuits. These voltages will vary plus or minus 10% from readings quoted, due to variation of normal line voltage from the 115 volt AC reading shown on diagram.

Gaining

This receiver uses 175 kc for the intermediate frequency, and the method of gaining these intermediate frequency stages is the same as employed in standard type receivers. There are no over-coupled stages in this intermediate frequency amplifier system and the following method is recommended for gaining this stage:

Disconnect grid cap on type 58 first detector tube and connect between grid and ground of this tube the 175 kc. oscillator, and by means of either the ear or a meter connected across voice coil or plate circuit of output stage, adjust the trimming condensers associated with the two i-f transformer system for greatest output. We suggest that you make this adjustment with as small an input signal as can be obtained from your oscillator, in order to get away from the apparent detuning condition met with due to operation of automatic volume control system.

As the noise suppressor circuit and the

Noise Suppression Circuits Well Engineered

(*Continued from preceding page*)

good tone quality from the favorite stations.

In connection with n.s.c. and quality one should also consider the method known as automatic fidelity control. This results from an r-f or i-f 58 tube having its suppressor grid returned to the a-v-c voltage source (return or low potential of the secondary coil), so that the suppressor is negative in respect to the cathode, and the greater the carrier intensity the more negative the suppressor voltage, just as the more negative the grid bias voltage. Indeed, the two are returned to the same point, and therefore the voltage is the same.

This hookup operates on the basis of reduced plate impedance with greater negative bias on the suppressor. Therefore the selectivity is least when the carrier intensity is greatest, hence locals come in with fine quality. But as to distance reception, when the main trouble would be not enough selectivity and perhaps not all the desired sensitivity, the selectivity of course would increase, because the plate resistance would increase, and also the sensitivity increases because of the better transfer of voltage with the rated load on the tube. That load is based on a certain plate resistance, and it is the highest resistance possible within the scope of the automatic fidelity control, or automatic selectivity control.

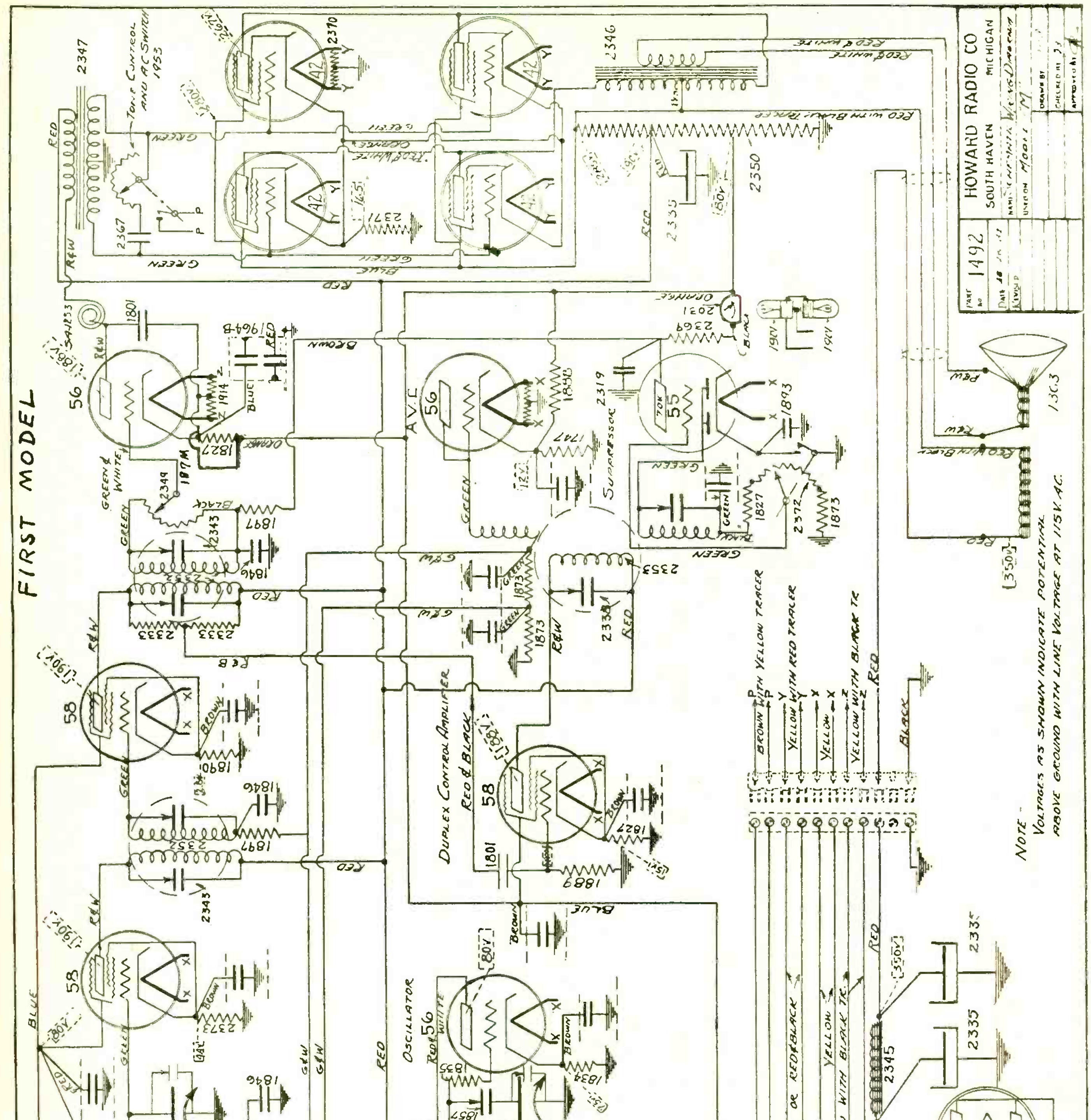
The word fidelity comes in because the fidelity is excellent on locals, but on DX sidebands likely would be cut, although then such practice does not matter. The aim or goal is to hear the station loudly, and without interference, rather than with the best possible quality, weakness and some interference.

Since sidebands are cut on weak signals, therefore noises are reduced on weak signals, because most of these noises are of a high audio frequency type, or on the outer fringe of the modulation envelope, which fringe is first affected by sideband cutting. So the a.f.c. further reduces noise, whether interchannel or otherwise, provided only that the carrier is weak or virtually absent, that is, too feeble to be recognized as existing at all.

However, a.f.c. is not a substitution for n.s.c., and the two are really distinct and intended for different purposes, although in the one respect cited they work together.

While a.f.c. has been described in the technical press, and announced theoretically by some tube manufacturers, it is not being used much, and indeed the present writer does not recall the name of a single factory-made receiver that uses a.f.c. The system does work, however, and may be used on sets that are very selective. On sets not highly selective the reduction in selectivity on local stations is too great to permit the reception of distant stations within several channels of the local.

A.f.c. is well worth experimenting with, although it can not be stated that all its ramifications have been solved. Much better progress has been made with n.s.c., possibly because it was so necessary with a.v.c. that much experimenting was done on it by so many sources that for one of the few times in radio technical history something came out that was up to snuff at the moment of introduction, instead of after about two years of "headaches."



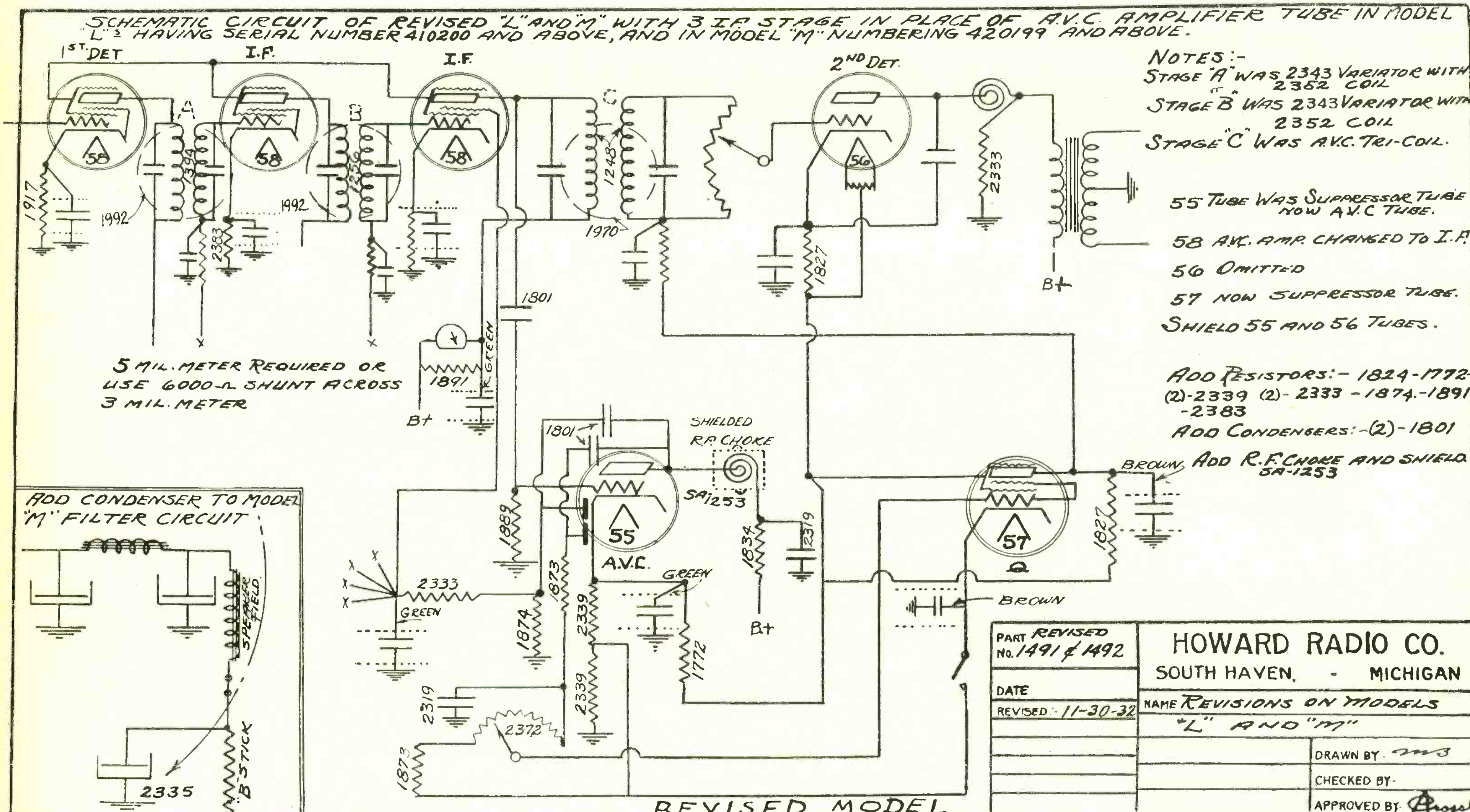
automatic volume control system are a tuned unit, it will be necessary to tune the plate circuit of the type 58 Triplex Control amplifier and also the tuned circuit which is associated with the type 55 tube. This circuit can be readily tuned to correct resonance by use of the 175 kc oscillator operated at the low input to the first detector tube type 58. All that is necessary is first to tune the plate circuit of the Triplex Control amplifier until the tuning meter needle swings to the right the greatest distance. Next, tune the suppressor or type 55 tube circuit until the meter swings to the greatest distance toward the right. It may be possible that both circuits are exactly in tune so that any additional adjustment of these two tuned circuits will not affect the meter swing.

Be sure, when making this adjustment, that you snap on the switch associated with the noise suppression control potentiometer 2372. If this switch is not thrown on, the meter will not operate because it open circuits the type 55 tube cathode and no plate current will flow.

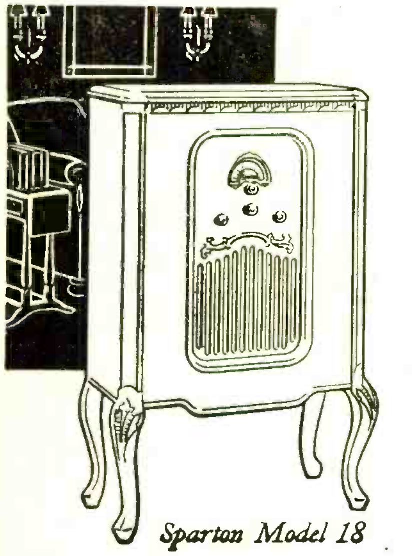
If it is not possible to obtain a low enough voltage in your oscillator to gain

(*Continued on page 17*)

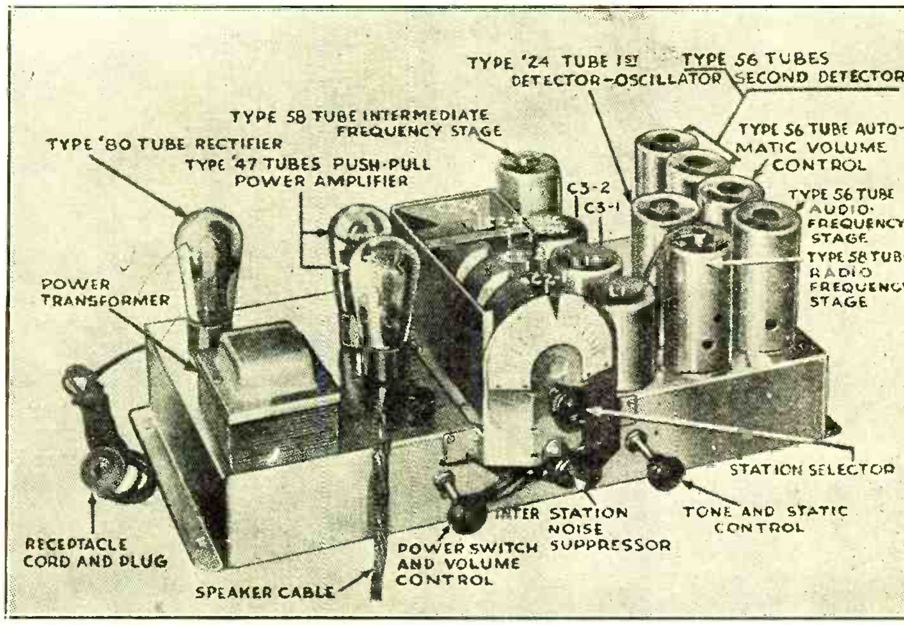
Revision for Howard "L" and "M" Circuits



SPARTON 14, 14A, 18



Sparton Model 18



SPARTON MODEL 18 CHASSIS

C2-1 Antenna Equalizing Condenser
C2-2 R. F. Stage Equalizing Condenser
C2-3 1st Detector Equalizing Condenser
C2-4 Oscillator Equalizing Condenser
C3-1 I. F. Input Stage Adjustable Condenser
C3-2 I. F. Output Stage Adjustable Condenser
L1 1st Tuning Coil
L14 R. F. Transformer

THE circuit of the Sparton Model 18 is composed of a Transformer Coupled Radio Frequency Stage, a combination first Detector-Oscillator, an Intermediate Frequency Stage, a Duolinear Second Detector, an Automatic Volume Control, a Resistance Coupled Audio Frequency Stage, a Transformer Coupled Pentode Push-Pull Power Output Stage, and a Full-Wave Rectifier system.

The combination power switch and volume control knob is located to the left of the dial. The first turn of this knob to the right switches on the power. Further turning to the right, increases the volume; turning to the left decreases it. The last movement of the control knob to the left switches off the power. The Lafoy Automatic Volume Control keeps volume constant at any desired level from any station which has sufficient power to produce that volume.

A new, exclusive development by Sparton engineers is this level control for the suppression of the static and hiss frequently encountered in tuning from one station to another. Positive action distinguishes this device from other types of noise suppressors now on the market. By the proper manipulation of the control knob located directly below the station selector knob, the user of Model 18 may adjust his set for geographical location or varying weather conditions. Tuning becomes practically as quiet in summer as in winter. The Inter-Station Noise Suppressor may be used also as a manual volume control, if desired.

(*Continued on page* 19)

(*Continued from page* 15)

this Triplex Control system, you can rotate the noise suppressor control potentiometer 2372 further to the right, wherein you will note that the meter needle swings away from the zero or maximum right position, and when this condition is obtained, you can again check the tuning of the two circuits in order to obtain the maximum right swing of the needle on this meter.

If your input signal from the oscillator is excessive, as previously stated, with the minimum right rotation of the noise suppressor control, you will note that when tuning to a station or to your oscillator, the tuning meter swings to the full right position, and in such a position you cannot tune the noise control circuits. Be sure, when tuning these circuits, that either your input signal from the oscillator is as small as possible, or if small voltage is not thus obtainable, rotate the noise suppressor control to the right until the meter swings away from the zero or maximum right position. The tuning of these two circuits is simple if you take precautions referred to above, and if these two circuits are properly tuned, you will note that by snapping on the switch on the Noise Suppressor Control, the inter-station noise will disappear and you will have quiet operation between stations. This tuning operation, when properly done, increases the apparent selectivity of the receiver and provides a beautifully operating receiver which has the latest advantage of the Duplex Control feature.

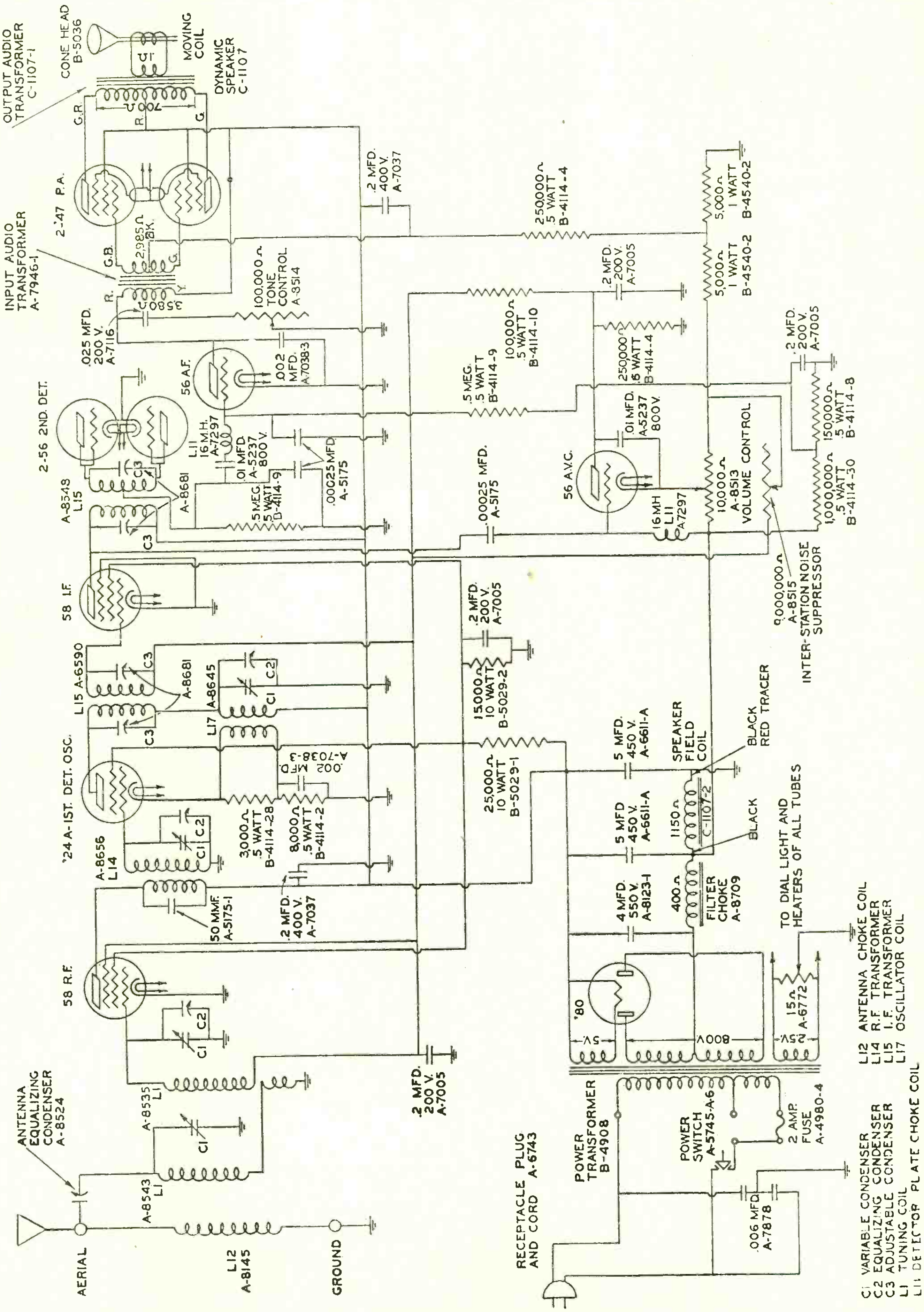
The receiver section having to do with the radio frequency circuit, particularly the three-gang variable condenser, has been very carefully adjusted at the factory, particularly the adjustment of the serrated plates, and these plates should not be touched. It is possible, however, that in transit some condition may have moved the placement of grid leads so that at the higher frequency end of the dial the receiver is slightly detuned. In such a case it is necessary to use an oscillator set at 1400 kc and connected to antenna and ground posts for this adjustment. Set receiver at 1400 kc on the dial and then adjust trimmer condensers of the variable condenser, adjusting first the oscillator condenser and then the antenna and r-f tuning condensers.

In cases where the receiver has seen considerable service and there is a doubt in the mind of the service man with respect to the condition of the receiver, it is permissible, after the 1400 kc adjustment has been made, to set the receiver at 600 kc and adjust the padding condenser associated with the oscillator system. This padding condenser is accessible through a hole in the upper part of the container which shields the variable condenser circuit. A fiber type of screwdriver is recommended for this adjustment, and if not available, can be readily made by filing down a piece of hard fiber to provide equivalent of screwdriver point characteristics. After the 600 kc adjustment has been made it is advisable to readjust the oscillator again at 1400 kc.

PARTS LIST
MODEL M HOWARD RECEIVER

Part No.	
2352	I. F. Transformer
1354	Variable Tuning Condenser
1351	Dial Drive Mechanism and Scale
1562	A. C. Line Cord and Plug
1702	Socket No. 80
2358	Socket No. 58
2356	Socket No. 56
2355	Socket No. 55
2342	Socket No. 42
1890	Resistor 500 ohms ½ watt
1897	Resistor 200,000 ohms ⅛ watt
2373	Resistor 1,100 ohms ½ watt
1827	Resistor 30,000 ohms ½ watt
1834	Resistor 2,000 ohms ½ watt
1835	Resistor 3,000 ohms ⅛ watt
1889	Resistor 2 meg ohms ½ watt
1873	Resistor 100,000 ohms ½ watt
2350	Resistor, voltage divider 9830 ohms
2371	Candohm, 105 ohms
1747	Resistor 50,000 ohms ½ watt
1888	Resistor 150,000 ohms ½ watt
1914	Resistor 10 ohms, center tapped
2369	Resistor 8,000 ohms ½ watt
2235	Fuse 5 amp
1857	Oscillator padding condenser
2375	By-pass Condenser Block
2319	By-pass Condenser .1 mfd.
1893	By-pass Condenser .05 mfd.
2335	Filter Condenser, Double gauze, 8 mfd. 450-V
1964B	By-Pass Condenser Block
2367	Tone Control Condenser .002
1901	Pilot Light 2.5 Volt
2351	Power Transformer
1953	Tone Control and power switch 1½ meg.
2343	I. F. Transformer tuning condenser
2345	Choke Coil (power pack)
2349	Volume Control 250,000
2347	Audio Transformer, 2 to 1 ratio
SA1355	Antenna Radio Frequency Transformer
SA1357	Oscillator tuning coil
SA1356	Radio Frequency Transformer
SA1253	Detector R. F. Choke
SA2031	Tuning Meter
SA2353	Tri Coil
SA2338	Variator
SA2346	Speaker Transformer
SA2370	30 ohm Center Tap
1363	Speaker 300 ohm
SA1801	.001 Type W
SA2328	Large Knob
SA2327	Small Knob
SA2125	Pyralin Indicator
SA1722	Resistor 200,000 ohms ½ watt

SCHEMATIC DIAGRAM
SPARTON MODEL 18 SUPER-HETERODYNE



(*Continued from page* 17)

This new Duolinear Second Detector is an application perfected by Sparton engineers, and employs two tubes in a full wave linear detector circuit. It is one of several balanced factors that contribute to exceptional naturalness of reproduction in the Model 18. It is the only detection system that rectifies and separates sound from the station wave without distorting the quality of the extracted music. The conventional type of detector adds to every program a background of the same program pitched an octave higher. This is called second harmonic distortion . . . a fault in ordinary reception which the new Sparton Duolinear Second Detector almost entirely eliminates. The result is almost unbelievable smoothness in the tone delivered to the audio amplifier.

The Tone and Static Control knob is located to the right of the dial. It enables the operator to vary tone pitch according to his preference. When the control knob is turned all the way to the right, the high notes are emphasized; and when turned all the way to the left, the low notes predominate. When static is excessive, a noticeable improvement in reception often can be obtained by turning this control towards the low-note position.

By means of this device the Model 18 is adjusted to operate with maximum efficiency on the individual aerial with which it is connected. The Antenna Equalizing Condenser, in other words, "custom builds" the set into the particular location where it is to be operated.

Complete Tube Equipment

Ten precision-built, factory tested and factory-matched Sparton tubes of the latest type are shipped with each Model 18. They are:

One Sparton, type 24-A Detector-Amplifier Screen Grid Tube.

Two Sparton, type 47 Pentode Power Output Tubes.

Four Sparton, type 56 Super-Triode Amplifier Tubes.

Two Sparton, type 58 Triple-Grid Super-Control Amplifier Tubes.

One Sparton, type 80 Full-Wave Rectifier Tube.

One type 58 tube is employed in the Radio Frequency Stage; one type 58 tube in the Intermediate Frequency Stage; one type 56 tube in the Audio Frequency Stage; the type 24-A tube is used as the first Detector-Oscillator; two type 56 tubes as the Duolinear Second Detector; one type 56 tube as the Automatic Volume Control; the two type 47 tubes in the Power Output Stage; and the type 80 tube in the Full-Wave Rectifier Filter system.

Cabinet Dimensions

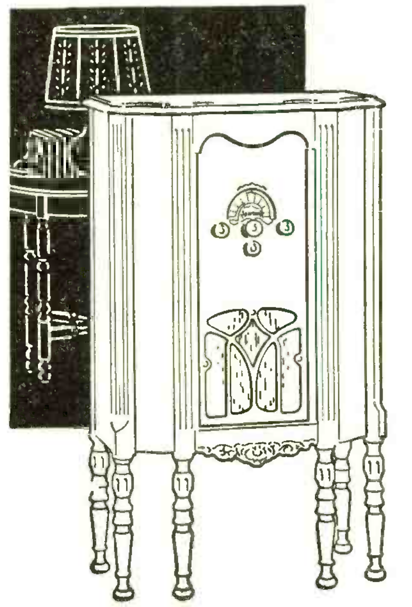
Height, 43 inches. Width, 26½ inches. Depth, 13 inches. Weight, 92 lbs.

The Sparton Model 14

The circuit of the Model 14 is composed of a Transformer Coupled Radio Frequency Stage, a combination first Detector-Oscillator, an Intermediate Frequency Stage, a Duolinear Second Detector, a First Audio Stage, a Resistance Coupled Pentode Power Output Stage and a Full-Wave Rectifier System.

In recent comparative tests conducted by independent engineers, Sparton Automatic Volume Control surpassed other makes in its ability to hold stations to an even level of output. The Automatic Volume Control used in the Model 14, as well as in the other 1932-33 Models, possesses all the original Sparton advantages with the addition of quicker recovery from static impulses.

A new, exclusive development by Sparton engineers is this level control for the suppression of the static and hiss frequently encountered in tuning from one station to another. Positive action distinguishes this device from other types of noise suppressors now on the market. By the proper manipu-



Sparton Model 14

lation of the control knob located directly below the station selector knob, the user of Model 14 may adjust his set for geographical location or varying weather conditions. Tuning becomes practically as quiet in summer as in winter. The Inter-Station Noise Suppressor may be used also as a manual volume control, if desired.

This new Duolinear Second Detector is an application perfected by Sparton engineers and employs two tubes in a full wave linear detector circuit. It is one of several balanced factors that contribute to exceptional naturalness of reproduction in the Model 14. It is the only detection system that rectifies and separates sound from the station wave without distorting the quality of the extracted music. The conventional type of detector adds to every program a background of the same program pitched an octave higher. This is called second harmonic distortion . . . a fault in ordinary reception which the new Sparton Duolinear Second Detector entirely eliminates. The result is almost unbelievable smoothness in the tone delivered to the audio amplifier.

The combination power switch and Tone and Static Control knob is located to the left of the dial. The first turn of this knob to the right switches on the power. After allowing a few seconds for the tubes to heat up, the operator may use this control to vary the tonal pitch as desired. When the knob is turned to the left, the high notes are emphasized. When it is turned all the way to the right the low notes are emphasized. Under conditions involving excessive static, a marked improvement in reception can often be effected by turning this control towards the low-note position.

To the right of the dial is the volume control knob. Turning it to the right increases the volume; turning it to the left decreases the volume. The Lafoy Automatic Volume Control keeps volume constant at any desired level from any station which has sufficient power to produce that volume.

By means of this device the Model 14 is adjusted to operate with maximum efficiency on the individual aerial with which it is connected. The Antenna Equalizing Condenser, in other words, "custom builds" the set into the particular location where it is to be operated.

Complete Tube Equipment

Eight precision-built, factory-tested and factory-matched Sparton tubes of the latest type are shipped with each Model 14. They are:

One Sparton, type 24-A Detector-Amplifier Screen Grid Tube.

One Sparton, type 47 Pentode Power Output Tube.

Three Sparton, type 56 Super-Triode Amplifier Tubes.

Two Sparton, type 58 Triple-Grid Super-Control Amplifier Tubes.

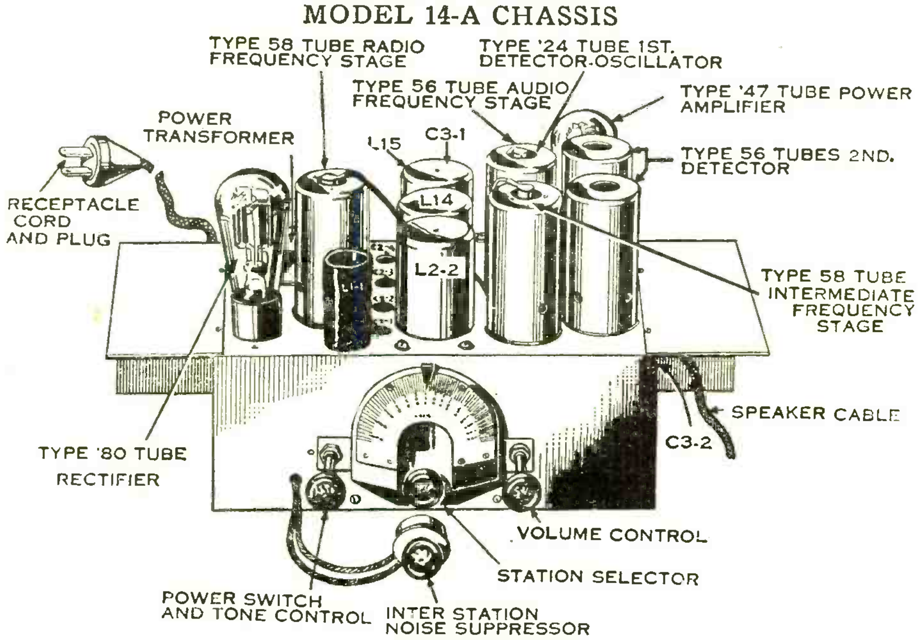
One Sparton, type 80 Full-Wave Rectifier Tube.

One type 58 tube is employed in the Radio Frequency Stage; one type 58 tube in the Intermediate Frequency Stage; one type 56 tube in the Audio Frequency Stage; the type 24-A tube is used as the first Detector-Oscillator; the two type 56 tubes as the Duolinear Second Detector; the type 47 tube in the Power Output Stage; and the type 80 tube in the Full-Wave Rectifier Filter system.

Cabinet Dimensions

Height, 38 inches. Width, 23 inches. Depth, 11½ inches. Weight, 75 lbs.

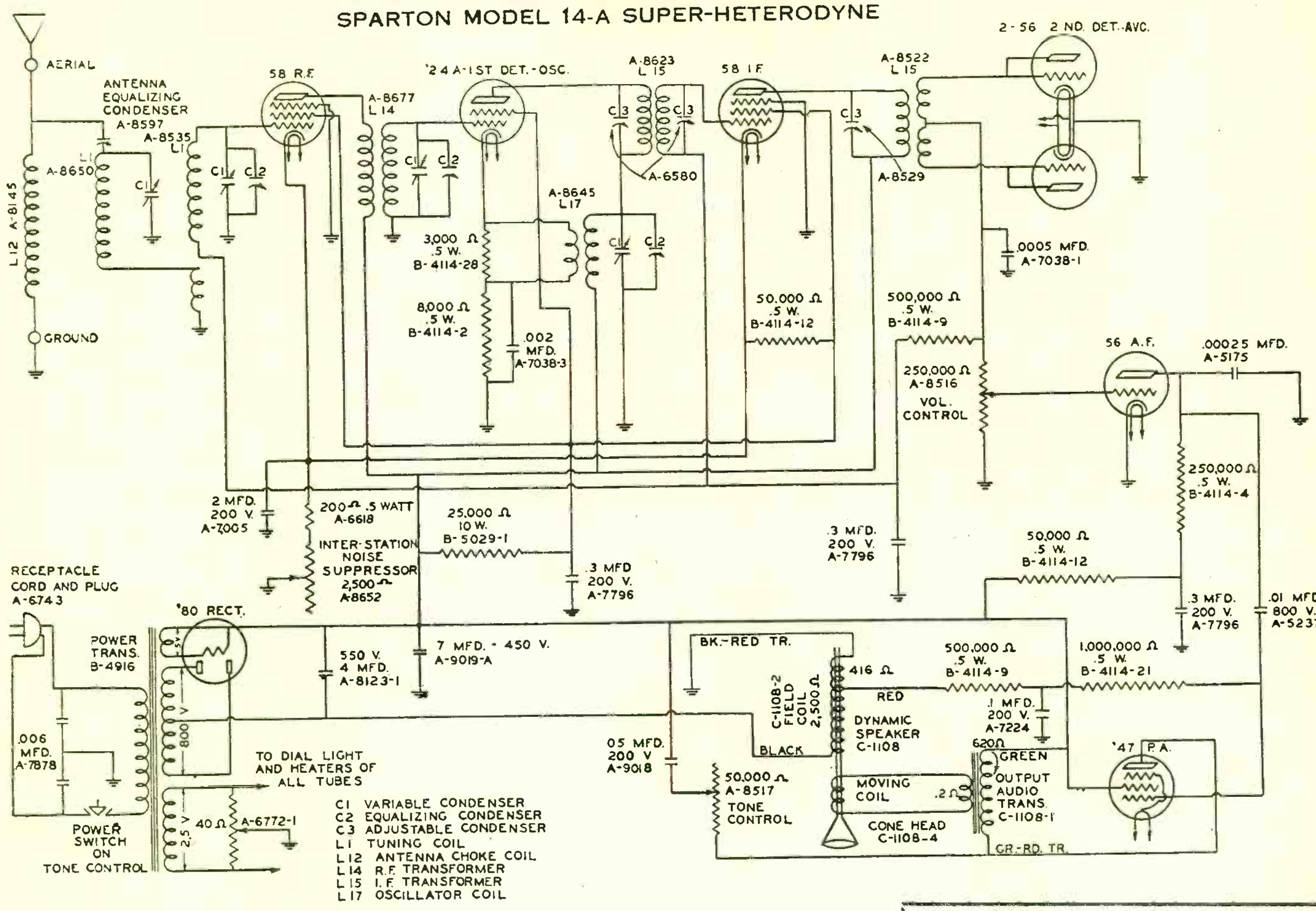
MODEL 14 CHASSIS
MODEL 14-A CHASSIS



SPARTON

C2-1 Antenna Equalizing Condenser
C2-2 R. F. Stage Equalizing Condenser
C2-3 1st Detector Equalizing Condenser
C2-4 Oscillator Equalizing Condenser
C3-1 I. F. Input Stage Adjustable Condenser
C3-2 I. F. Output Stage Adjustable Condenser
L1 1st Tuning Coil
L2 Second Tuning Coil
L14 R. F. Transformer
L15 I. F. Transformer

SCHEMATIC DIAGRAM
SPARTON MODEL 14 SUPER-HETERODYNE
SPARTON MODEL 14-A SUPER-HETERODYNE



SPARTON MODEL 14-A SUPER-HETERODYNE
SPARTON MODEL 14 SUPER-HETERODYNE

VOLTAGE ANALYSIS

Line Voltage 115—Position of Voltage Compensator 100-115—Position of Volume Control Full

Tube	*Location*	*Heater or Filament*	*Plate*	*Control Grid —*	*Screen Grid +*	*Plate Current M. A.*
58	R. F. Stage	2.2—2.5	218—242	2—4	95—105	5.5—7.0
'24	1st Det.-Osc.	2.2—2.5	218—242	——	95—105	0.7—8.0
58	I. F. Stage	2.2—2.5	218—242	2—4	95—105	5.5—7.0
56	2nd Det.-AVC	2.2—2.5	*	*	——	*
56	2nd Det.-AVC	2.2—2.5	*	*	——	*
56	A. F. Stage	2.2—2.5	20—40	Zero	——	0.5—0.7
'47	Power Stage	2.2—2.5	205—225	†18—20	218—242	20—24
'80	Rectifier	4.5—5.0	315—345	——	——	.19—23 per Plate

* Present only when signal is applied.
† Measured from tap on field coil to ground.

Picture Diagram of Super Diamond, with Test Data, Next Week (Jan. 14th)

Below is shown the schematic diagram of the Super Diamond. Numerical coding is used. Next week, issue of January 14th, the voltage and resistance values between numbered leads will be given in tabulated form, also a full-scale picture diagram of the wiring will be printed then. All who intend to build a high-class receiver should look over next week's presentation.

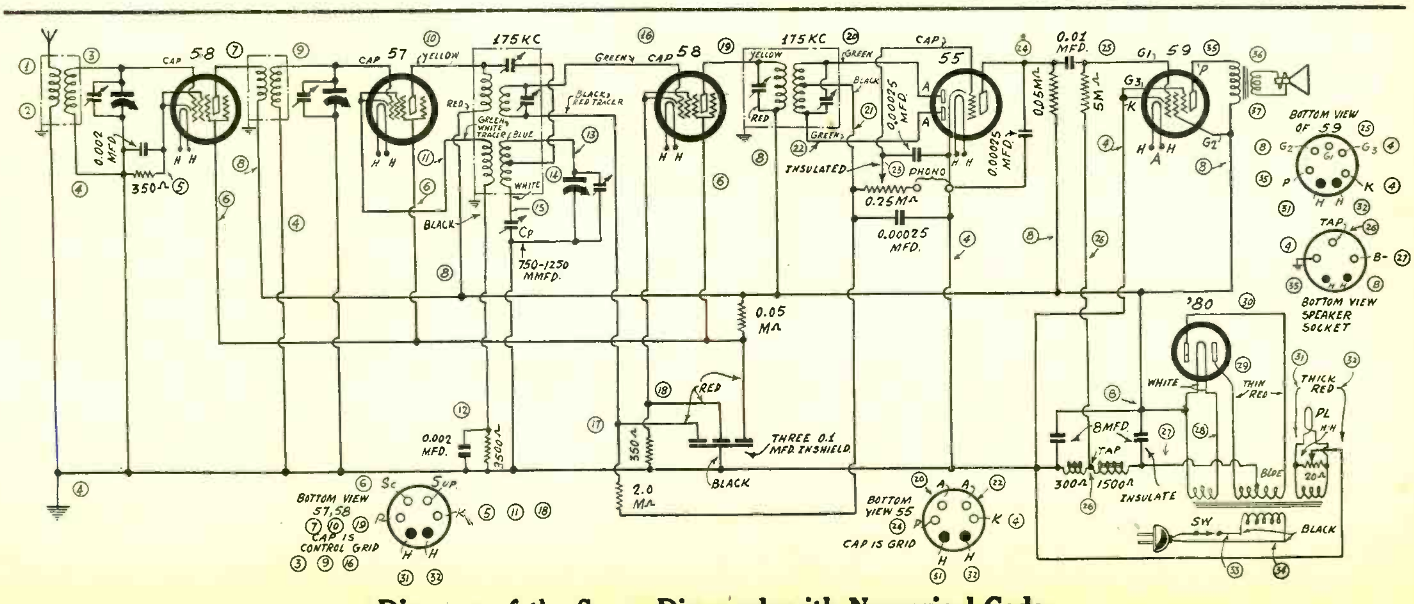
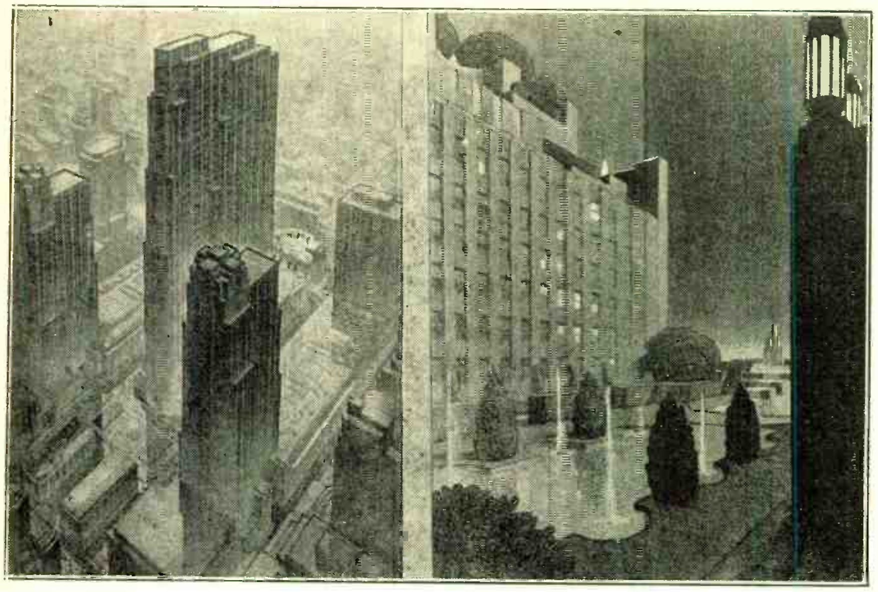


Diagram of the Super Diamond, with Numerical Code.



TRADIOGRAMS

By J. Murray Barron

E. T. Cunningham, President of R. C. Radiotron Company, Inc., has announced the appointment by the Board of Directors of J. M. Smith and J. C. Warner as Vice-Presidents of the Corporation. Mr. Smith heads the manufacturing organization. He has been engaged in manufacturing radio tubes since he joined the General Electric Company at Nela Park in 1914. He is a native of Ohio, a graduate of Bethanu College, in West Virginia, and now resides in Summit, N. J. Mr. Warner has been in charge of the Research and Development Laboratory of R. C. A. Radiotron Company since 1931. He was born in Freeport, Ill., and now resides at Verona, New Jersey. He was a member of the Signal Corps during the war, taught physics at the University of Kansas, and was Assistant physicist in the Bureau of Standards. From 1920 to 1931 he was engaged in research work and vacuum tube engineering for the General Electric Company. He holds degrees from Washburn and from Union College and also from the University of Kansas.

* * *

Brodco Radio Corporation, 142 Liberty Street, New York City, reports a healthy increase in general business with a good indication for a fine start for the coming year. Brunswick replacement parts are in good demand and contact with the serviceman is showing improvement.

* * *

Walter A. Coogan, Export Manager of the Arcturus Radio Tube Company, Newark, N. J., has returned from Europe after an absence of ten weeks. The trip covered more than 15,000 miles and necessitated travel through seventeen countries. He reports the American-made tube is considered superior to the European make by many abroad.

* * *

R. H. McMann, Inc., 12 Warren St., New York City is now distributing the new Essex Receivers for the Metropolitan and Northern New Jersey territory. The line covers from 4- to 10-tube receivers.

* * *

Announcement is made of the organization of Broadcasting Records of America, Incorporated, by W. H. Voeller, President. With offices at 1560 Broadway, New York City, the corporation will cater to the radio and theatrical fields. It controls patents for special equipment for recording broadcasts on an unbreakable disc that can be mailed.

* * *

Sun Radio Company, 64 Vesey Street, New York City, is now conducting an unusual sale of standard radio merchandise as a cleaning out process for the removal from the present site on which Uncle Sam will build a Post Office.

* * *

At this particular writing the radio business in New York City has been very fine. The offerings this season are varied, with many excellent receivers at the lowest prices of any year and the greatest values. Many midgets and miniature receivers were bought by those already having a large radio receiver and the business in crystal sets for the young fellow would surprise many. They were the largest crystal-set sales since "the old days." Short-wave converters sold well at some stores. Kits went over exceptionally strong and it looked as if a lot of fellows were either giving themselves that long-promised special job or else surprising some dear one. Increased sales in tubes were noted.

* * *

A large demand has evidenced itself for modulated test oscillators in the low-price range.

STATION SPARKS

By Alice Remsen

Songbirds and Roses

For Jessica Dragonette

WEAF, every Friday, 8:00 p.m.

'Twas in the month of roses you came, my dear, to me;
You met me in a garden, we sat beneath a tree,
A nightingale was singing upon that night in June,
You told me that you loved me beneath a silvery moon.

Songbirds and roses, a garden in bloom,
Soft shimm'ring moonlight, a rosebud's perfume;
Whispering winds and a star-spangled night—
These bring me dreams, dear, which fade with the light.

Roses have withered, the songbirds have flown,
Now in the garden I wander alone;
But deep in my heart, dear, your love still shall be
A mem'ry of songbirds and roses to me.
—A. H.

* * *

I HAVE BEEN REQUESTED to repeat the foregoing verses dedicated to sweet little Jessica Dragonette, and if you listen in to her singing you will surely visualize lovers wandering in the moonlight, a nightingale warbling in a rose garden, and romance in all its aspects. The Cities Service Hour has always been delightful; Rosario Bourdon's orchestra is the best of its kind. It still is one of the most enjoyable periods on the air. Don't miss it.

* * *

The Radio Rialto

We're having the funniest weather here in Cincinnati. It snowed like the very deuce last week, and it was cold as billy-be-darned; now at the present writing a soft spring rain is falling; shouldn't be surprised to see the crocuses and violets springing up when I go out, though it's just as likely to be freezing at midnight . . . Great doings here at Christmas time. Powell Crosley, Jr., gave his annual Christmas party at the Music Hall, a very large auditorium; it was packed to the doors twice yesterday with poor kiddies, who enjoyed themselves thoroughly . . . There was a clown band, and an orchestra directed by William Stoess, the genial music head of WLW; all sorts of acts, from flying trapeze and weight lifting, to Tony Cabooch and adagio dancers, charmed the kiddies, who shouted with glee. Harry Molcomb played Santa Claus to perfection, and Sidney Ten Eyck did a good job of the radio announcing in spite of the fact that kiddy parties are entirely out of his line. . . . By the way; have you ever listened to Sid and the Doodlesockers over WLW? If not, do so by all means; it's a very funny program; Saturdays at 11:00 p.m. . . .

Christmas cards and gifts are pouring in. Gee, but it's great to be remembered when you're away from home! I never realized it so much in my life before; now when I get a card from an old pal, the tears start to slop over; guess it's old age creeping on. . . . Billie Dauscha received sad news yesterday. Her grandmother passed away. . . . It's almost impossible to get inside the post-office here. . . . Shops are crowded, too; quite a bit of money being spent, which is a good sign. . . Do you remember Lee Evans, operatic tenor? He is here in town and will open a nifty little private club after the holidays. . . . A local trade paper is predicting who will be the new stars of 1933 in the radio field. Andrea Marsh, Dorothy Joyce, Mary Steele, and Jackie Heller, are at the top of the list. . . . It is quite likely that Andrea Marsh and Mary Steele will rise to stardom if they are handled properly; both girls are young, good looking and, what is more important, they can sing. . . . But radio is peculiar; I wouldn't even try to predict its future; a radio personality may be "built up" by a station or sponsor to the "n'th" degree and still fail to click with the listeners; there is one thing which is absolutely essential in radio work, and that is, sincerity, combined with a subtle something, which, for lack of a better name we call "personality"; with these two things, sooner or later, a radio artist is bound to succeed. . . .

Station WOR, noted for its altruistic attempts at better programs, now has three fine piano programs; Vera Brodsky and Harold Trigg are presenting a two piano series on Friday at 8:15 p.m.; Lee Cronican is heard Monday nights at 10:30, and now Pauline Alpert has been added to the list, and will be featured. . . . A recent broadcast by George Burns and Gracie Allen came from Baltimore; evidently the dumb-crackers had visited the U. S. Naval Academy at Annapolis, forty miles from the Maryland metropolis. It turned out that Gracie's brother had once been in the navy, when the admiral shouted "All hands on deck"; Gracie said her brother put his hands on the floor and got 'em stepped on. . . . "Oh, well," she insisted, "an Annapolis a day keeps the doctor away." . . . Believe me, that's Gracie Allen's and not mine. . . . Singin' Sam will be out this way for the holidays; his home is in Richmond, Indiana. He made a hit singing over WLW before reaching the bright lights of the Rialto. . . .

Columbia lists over seventy-eight outstanding broadcasts in 1932, which includes such widely diversified programs as: A Scandinavian re-broadcast to America from Norway, Sweden and Denmark; Father Cox and Senator James J. Davis of Pennsylvania discussing the unemployed march on Washington; Groundhog's debut for the season described from Philadelphia Zoo; devastation of the Santiago earthquake described from Cuba as the earth still trembled; Andre Tardieu making a radio plea for world police force from Geneva; description of National Ping Pong Tournament broadcast from Hotel Algonquin, New York; a performance of Haydn's opera, "Life on the Moon," broadcast from the Staatheatre, Schwerin, Germany; Pope Pius XI heard in the Beatification Service at the Vatican; Miss Alice Hargreaves, the original "Alice in Wonderland," spoke from New York; the Grenadier Guards Bands heard in concert from London; New York Beer Parade described from street marquee; Prince of Wales and President Le Brun of France heard speaking at the unveiling of the War Memorial at Thiepval, France; and so on; a fine showing for the year. . . .

Ben Alley and Helen Nugent, known as "Sweethearts of the Air" since the early days of radio, have been singing together for over eight years. They are two of the most popular Columbia artists. They are both graduates of the Cincinnati Conservatory of Music, and both became staff soloists of WSA in Cincinnati and both joined the staff of Columbia at WABC, New York, in 1929, and, in point of service, are the oldest members of the present staff. . . . Jane Ace refused to make any New Year's resolutions, because they just go in one year and out the other. . . . Another Columbia artist to come from this part of the country is Edward Nell, Jr., baritone lead of the Aborn Light Opera Company, over WABC-CBS. His home is Indianapolis, where his father was that city's foremost voice instructor. . . . It might interest you to know that "Bones," on the N. B. C. dramatic feature, "Moonshine and Honeysuckle," is not a real dog; the noises are made by Bradley Barker. . . . Claude McArthur, of the N. B. C. music department, is having a lot of success with his Westchester singers, a choral group, which he organized and directs. . . . John P. Medbury, the comical gag writer, finds that his best time for creative writing is between the hours of 8:00 p.m. and 5:00 a.m. Mr. Medbury, by the way, was born in Utica, New York, grew up in Alameda, California, and ran away from home when he was seventeen. He's an all-'round man, writing jokes and continuity, film scenarios and a syndicated daily column, recording his own voice for his famous "Travelaughs," and producing wholesale gags for world-wide distribution; in his odd moments he supplies lines and patter for famous funsters; oh, yes, he also does a Sunday syndicated story and commutes by plane to San Francisco from Hollywood for his Demi Tasse broadcast over KGO-NBC networks Monday nights. . . . "Waltzing in a Dream" is a new song which is catching on fast. Abe Olman publishes it.

* * *

Biographical Brevities

About Ted Weems

Thursdays, 8:15 p.m. WABC; nightly, WJZ

Ted Weems, the originator of Piccolo Pete, was born in Pittsburgh, and attended the Lincoln Grammar School there; while at this school he organized a kid band, and equipped it with mouth organs, broken combs and improvised drums. The teacher decided that the fire drills would be more interesting if Ted's noise makers played as the pupils filed out of the classroom when the alarm sounded, so she offered Ted a penny for each band member for this service; right there was where the Weems business instinct asserted itself, Ted not only pocketed the money but charged every boy in his orchestra a cent for the privilege of playing. However, he used the income to provide better instruments. . . .

Later the Weems family moved to Philadelphia, where Ted joined the band of the West Philadelphia High School; from there he went to the U. of P. and became director of the Varsity band. His brother, Art, was with him, and also was a member of the orchestra. Tiring of academic restrictions, the two Weems boys organized their famous "All American Band." For it they recruited the best college musicians obtainable from Columbia, Ohio State, Princeton and other colleges. Then followed a series of tours throughout the union, and hotel and radio engagements, which culminated in his present contract with Canada Dry and the Hotel Pennsylvania.

Tall, blonde, intellectual, with an innate air of refinement, a ready grin, a true university type, is Ted Weems, and his great-great grandfather, by the way, was Parson Weems, who was one of George Washington's first and most enthusiastic biographers.

* * *

(If you should like to know something of your favorite radio artist, orchestra leader, announcer, or speaker, drop a card to the conductor of this page. Address her Alice Remsen, care of RADIO WORLD, *145 W. 45th St., New York, N. Y.)*

Modulated Oscillators

Covering Both Broadcast and Intermediate Frequencies

KIT

(Not Calibrated)

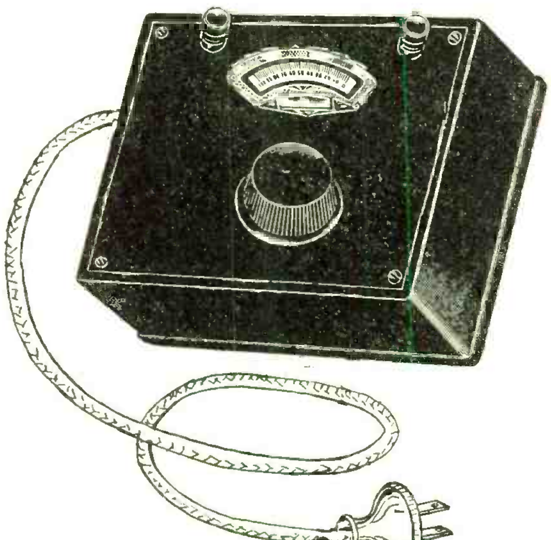
COMPLETE Parts including cabinet (less tube) for building an a-c operated (110-volt, 50-60 cycle) modulated test oscillator, with wiring diagram. Fundamental frequencies of oscillation will be from about 100 to 300 kc, so that some intermediate frequencies may be tested on the fundamental, others on the second harmonic, while the broadcast band is taken care of by the fifth harmonic. Sharp tuning, clear squeals in heterodyning, and strong modulation by the 60-cycle line frequency. No hum except at resonance. Frequency stability is of a high order, due to stabilized grid circuit. The oscillator is Shiepe's modification of the Hartley. Either a 56 or a '27 tube is to be used.

No calibration is provided, but a 0-100 vernier dial, 6-to-1 ratio, and directions given for calibrating against broadcasting stations.

Complete parts, diagram and calibration instructions free with a one-year subscription for RADIO WORLD (52 issues, one each week) at the regular rate, $6.00. Order Cat. PRE-ACOK.

Same as above, except for a tuned grid oscillator for battery operation, indicator-escutcheon of smaller size, with high audio frequency modulation, and requiring 3-volt dry battery and 22.5 volt B battery (not furnished). Tube (not supplied) is the '30. Free with one year's subscription at $6. Order Cat. PRE-BATOK.

[Those desiring wired, calibrated models are asked, please, to read the details in the opposite column.]



The modulated oscillator has vernier dial calibrated directly in frequencies, covering broadcasts and intermediate. The tube is inserted by removing the panel. Output post is at left, ground post at right.

WIRED

(Calibrated)

THE built-up a-c operated modulated test oscillator has dial calibrated in broadcast frequencies (little above 1500 kc to little below 540 kc), and also has the calibration, on another tier of the same scale, of the principal commercially used intermediate frequencies, e. g., 115, 130, 172.5, 175, 177.5, 260, 400, and 450 kc. There is no need to read a numerical dial setting and then refer to a curve to obtain the frequency, because, as stated, the frequencies are imprinted right on the dial scale, made possible by adjusting both for the capacity and the inductance in the construction of the oscillator. The frequency standards used in calibrating are accurate to better than 1 per cent., while the oscillator itself is accurate to a higher degree than a dial can be read. Moreover, the grid-stabilized circuit renders the oscillator accuracy immune from frequency change due to normal differences in a-c line voltage.

The parts alone are supplied by us on the basis of the kit offer (Cat. PRE-ACOK, see opposite column), while we would have the wiring and calibration done for you at a precision laboratory at $1.50 extra. If wired, calibrated a-c model is desired, send $7.50, of which $6 is for subscription (parts free) and extra $1.50 is turned over by us to the outside laboratory. Order Cat. PRE-ACOW.

The battery model (for '30 tubes), wired, calibrated, same terms as above. Order Cat. PRE-BATOW.

Necessary for Construction and Servicing

THE type of oscillators covered by the subscription premiums as listed above is exceptionally valuable, in that the fundamental frequencies are low, and therefore harmonics are readily useful. The intensity of oscillation is sufficient to provide a good response up to about the fiftieth harmonic, to establish a recognizable beat with a carrier of equal amplitude.

Primarily the oscillators are intended for service work and home, shop and school construction of receivers, and therefore the broadcast band calibration is given first preference as to detail, with frequencies in numerical order, while the intermediate frequencies registered are fundamentals or second harmonics of the oscillator, therefore will not appear in numerical order.

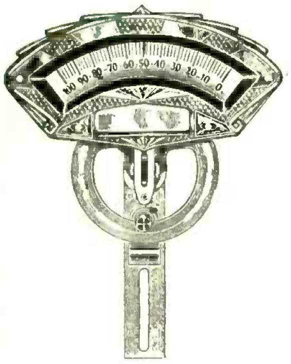
The test oscillators may be used for lining up tuned radio frequency sets, and also r-f, oscillator and intermediate frequency levels of superheterodynes. With the test oscillator as input, receivers may be lined up or otherwise tested either by listening or by using an output meter, since the modulation is steady.

Particularly in constructing and servicing superheterodynes are oscillators necessary. In fact, it is folly to attempt to build or service a superheterodyne without an oscillator.

While the intermediate and broadcast frequencies are stressed, of course the oscillator may be used for all frequencies up to the fiftieth harmonic (15,000 kc, 20 meters), but some idea of the frequency range of the tested circuit then is necessary, as well as some experience in determining harmonics.

While out of all comparison to the usual cost involved, these oscillators nevertheless are of a very high order of excellence, having been designed and developed by Herman Bernard, managing editor of RADIO WORLD, especially for subscribers.

Individual Parts for the Oscillators



Dial and escutcheon used in on the a-c model. The traveling light, behind a stationary scale, casts a shadow.

DIAL (a-c use). Traveling light type vernier dial, 6-to-1 ratio, enabling accurate dial reading because of projected shadow that prevents parallax. Equipped with bracket and 2.5-volt pilot light. The scale is stationary. The light and index move. Same dial takes ⅜ or ¼ inch shafts. Escutheon supplied. Sent free with a 16-weeks subscription (16 issues) at $2. Order Cat. PRE-DJDAC. and state whether condenser closes to left or right.

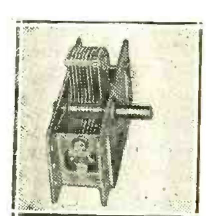
DIAL (battery use). On account of the high current drain of a pilot lamp the traveling light type of dial is not economically suitable for battery operation, therefore the same dial mechanism is used with self-visible outside pointer. The same dial takes ⅜ or ¼ inch shaft. Escutheon supplied. Sent free with a 16-weeks subscription (16 issues) at $2. Order Cat. PRE-DJDBAT and state whether condenser closes to left or right.

CONDENSER.. The tuning condenser used in the test oscillators is of 0.000375 mfd. maximum capacity, 23 mmfd. minimum capacity (not including equalizer capacity). The condenser, however, is equipped with a 35 mmfd. equalizer. Moreover, the brass shaft rotates in a ball race at front and back, thus giving the smooth turning for which ball bearings are noted. The aluminum plates close to the right. The frequency curve is approximately midline. The shaft is ⅜ inch diameter, ⅝ inch long. Sent free with three months subscription (13 issues, one each week) at $1.50. Order Cat. PRE-DJAS.

OSCILLATION TRANSFORMERS. For the a-c model a special combination of duolateral wound coils is used, consisting of two separate coils to be placed on end with holes through their dowel cores, enabling both to be mounted with a single screw. Sent free with an 8-weeks trial subscription at $1. Order Cat. PRE-ACCH. For the battery model, $1 subscription, order Cat. PRE-BATCH.

FILAMENT TRANSFORMER. Primary, 105 to 120 volts; secondary 2.5 volts, not center-tapped. For 50-60 cycles. Free with $1.50 for three months subscription (13 issues, 13 weeks). Order Cat. PRE-FLT.

Here is an especially attractive offer of a 3-to-1 frequency ratio capacitance.

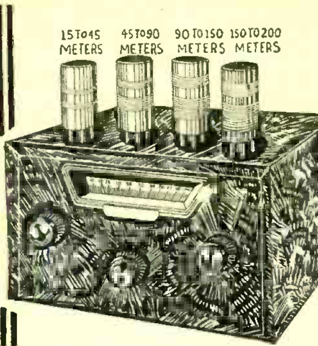


The tuning condenser used in the test oscillators has shaped plates that lend themselves admirably to the harmonic type of oscillators concerned, because of the better distribution of frequencies across the dial than ordinarily prevails. There are three bottom-mounting holes tapped for 8/32 and two plain holes for front panel engagement. The extreme plates are slotted for any special compensation the constructor desires to make.

RADIO WORLD

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

We Pay Postage On All Products Listed On This Page (Except Oscillators, Kit or Wired)



The New ECONOMICAL A-C Short-Wave Set

Earphone Model, Covers 15 to 200 Meters

THRILLING DISTANCE! ALL ON THREE TUBES!

NO matter if you are a fan interested in the whole wide sweep of the short-wave band from 15 to 200 meters, or an amateur interested only in the "ham" bands, you will enjoy the results from the new ECONOMICAL A-C Short-Wave Set. This receiver has a sensitized 57 detector and a stage of 56 audio, while the rectifier is an '80. The filtration is fine, so that the pleasure of listening to far-distant stations, including foreign ones, is not marred by hum.

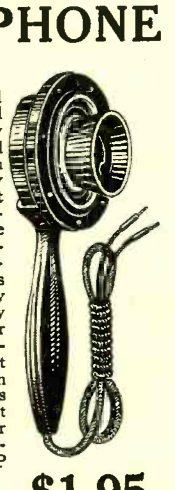
The highest efficiency was the aim in designing the set, therefore plug-in coils were used, and these are specially wound to insure adequate overlap of wavelengths between coils for succeeding bands, and to provide highest sensitivity. One coil is used for each of the four bands.

The receiver is housed in a crackle-finish shield cabinet, with back open so that the desired plug-in coil may be handily inserted in the receptacle provided for it on the chassis proper.

The circuit consists of a sensitized detector tuned by a Hammarlund junior midline short-wave condenser with stage of audio and B supply. The same high quality of parts and workmanship prevail throughout. The coupling between detector and audio tube is through a transformer, the plate current being at a low value to hold up the primary inductance, which is of itself high, and therefore make practical the use of a gainful transformer working out of a 57.

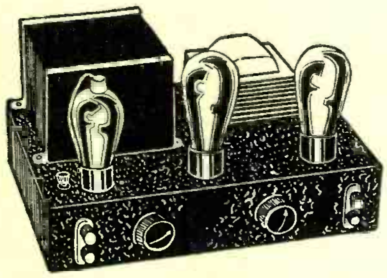
The ECONOMICAL Short-Wave A-C Receiver is a brand-new, specially-made product, now offered to the public for the first time, and bringing within the reach of all a dependable short-wave outfit that has an easy-tuning full-vision dial, with knob below; a sensitivity control and a switch. The receiver is sold complete with tubes (one 57, one 56 and one '80). Order CAT. TMACSW-T (price includes tubes)........................ **$18.95**

KELLOGG MICROPHONE



Kellogg Switchboard Company is well known for the quality of its products, and the microphone from its precision factory is one of excellent performance, representing one of the best bargains in microphones. The response curve renders this microphone fully suitable for use by amateurs and for home recording or reproduction. It is not to be confused with toy microphones, as this is a real product from a manufacturer of real standing. Order CAT. TM-TMP at **$1.95**

POWER AMPLIFIERS



THERE is money to be made in renting or selling power amplifiers, as churches, academies, auditoriums, clubs, societies, stores, rinks and the like are constantly using and buying such equipment. Moreover, as the user's business grows, larger-sized power amplifiers are required, and you grow with your customers. Therefore it is profitable to get organizations and businesses started in the use of power amplifiers, and they will be surprised at the very low cost at which you can sell and install them.

In the design and construction of these public address systems a liberal safety factor has been allowed. They may be used with single or twin speakers.

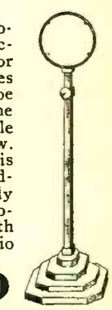
Each one consists of a first stage of '24 audio transformer coupled to a single-sided output, and includes a husky B supply fully filtered.

CAT. TM-PA-45, consisting of a power amplifier and B supply, using one '24, one '45 and one '80. Power consumption, 40 watts. Maximum undistorted power output, 2 watts. Suitable for gatherings of up to 500 persons. Price (less tubes)........**$10.95**

CAT. TM-PA-47, consisting of a power amplifier and B supply, using one '24, one '47 and one '80. Power consumption, 40 watts. Maximum undistorted power output, 3 watts. Suitable for gatherings of up to 700 persons. Price (less tubes).........**$12.95**

CAT. TM-PA-50, consisting of a power amplifier and B supply, using one '24, one '50 and one '81. Power consumption, 50 watts. Maximum undistorted power output, 5 watts. Suitable for gatherings of up to 1,000 persons. Price (less tubes)........**$15.95**

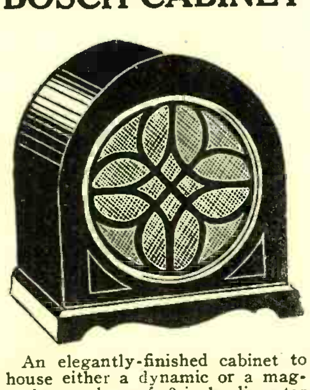
MICROPHONE FLOOR STAND



Here is a chrome-plated microphone floor stand, of rigid construction, that will neither sway nor vibrate. The top ring is 6½ inches in diameter. The height can be adjusted from 40 to 70 inches. The clamp lock is engaged by a simple but tightly-gripping thumb screw.

Not only in professional work is this microphone floor stand an advantage, but owing to the extremely low price many who have microphones in their homes, for use with the audio amplifier of their radio set, will want this stand. Order CAT. TM-MFS at **$4.50**

BOSCH CABINET



An elegantly-finished cabinet to house either a dynamic or a magnetic speaker of 8-inch diameter cone. This is an excellent cabinet into which to put a spare speaker. Order CAT. TM-BCAB at **$2.25**

RESISTORS

WE have a wide assortment of the finest types of commercial pigtail resistors made. These are manufactured for us in quantity and are sold at prices far below those prevailing elsewhere. Each resistor is guaranteed to be in excellent condition, and is of the type that does not change in resistance value appreciably with temperature. The rating is 1 watt except where otherwise specified.

	Color Code Body	End	Dot		Color Code Body	End	Dot
175 ohms	Brown	Violet	Brown	50,000 ohms	Green	Black	Orange
350 ohms	Orange	Green	Brown	60.000 ohms	Blue	Black	Orange
800 ohms	Gray	Black	Brown	100,000 ohms	Brown	Black	Yellow
1,200 ohms	Brown	Red	Red	250.000 ohms	Red	Green	Yellow
3,500 ohms	Orange	Green	Red	500,000 ohms	Green	Black	Yellow
10,000 ohms	Brown	Black	Orange	2,000.000 ohms	Red	Black	Green
20,000 ohms	Red	Black	Orange	5.000.000 ohms	Green	Black	Green

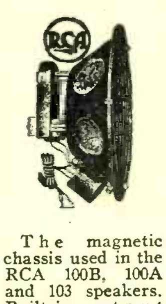
ANY FOUR OF ABOVE RESISTORS, 30c

3.500 ohms, 2 watts. for reducing the maximum B voltage to about 180 volts for r-f tubes. Price. 11c.

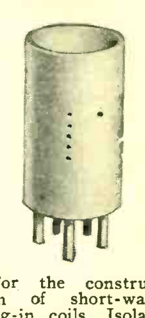
DIRECT RADIO CO.

143 WEST 45th STREET
NEW YORK, N. Y.

SPECIALS



The magnetic chassis used in the RCA 100B, 100A and 103 speakers. Built-in output transformer permits use of up to 400 volts. Corrugated cone, 9 inches diameter. Large permanent magnets. CAT. TM-RCA **$3.75**



For the construction of short-wave plug-in coils, Isolantite forms permit of high efficiency, due to minimized losses. These forms have UX (four-pin) bases and strongly - embedded prongs. CAT. TM-ICF (each)........**39c**