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The First National Radio Weekly

RADIO WORLD

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—57 and 6C6 as Negative Resistance Tubes

—Britain Favors Electrical Scanning

—Locating Overload Point of Amplifier

—Short Wave Coils

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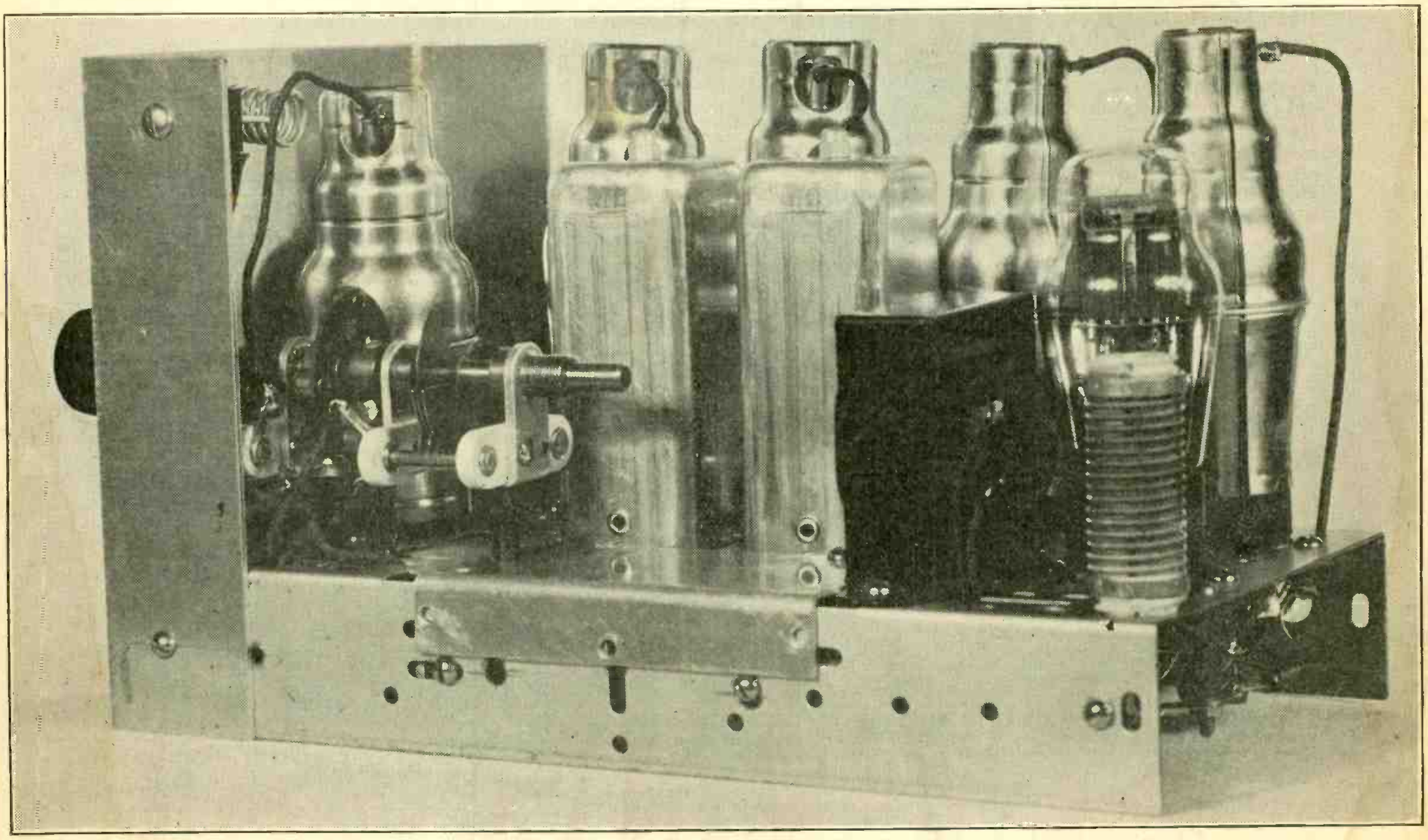

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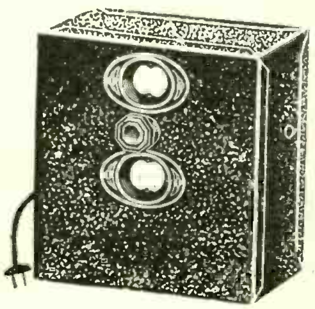

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The First National Radio Weekly
THIRTEENTH YEAR

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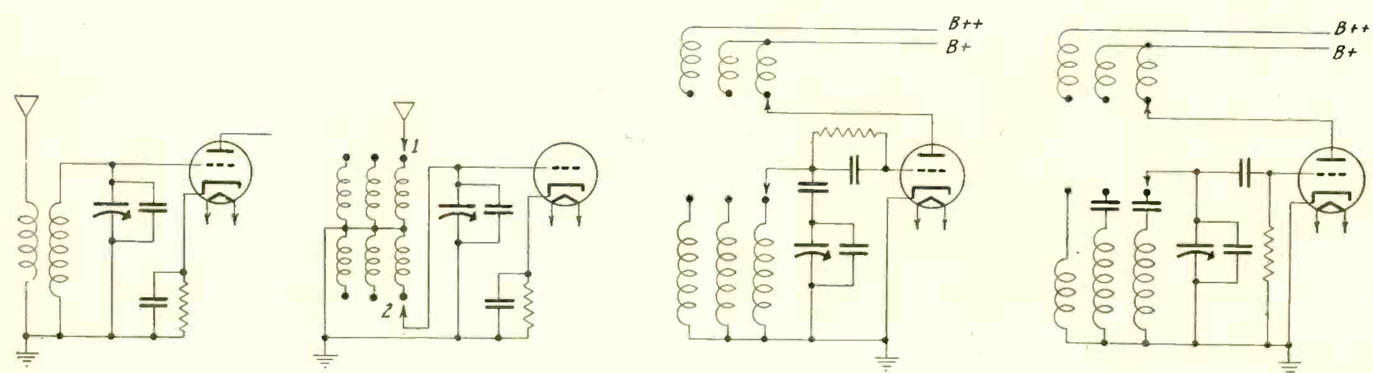
Adding Bands to Set

Standard Broadcast Receivers Made All Wave

By Leonard C. Wood



The first diagram, at left, represents, a conventional stage in a receiver for single-band coverage (broadcast band assumed). The next diagram shows why two decks of a switch are needed for each stage. Three throws will be sufficient. The third diagram represents an oscillator padded for the broadcast band, but the same padding condenser is picked up, which will not do. At right, different condensers are used in two stages, but the method reduces the input voltage and may stop oscillation.

THOSE who have standard broadcast band receivers and want to add higher frequency coverage may do so by inserting a switch having two or three throws and twice as many decks as the number of stages. Thus, assuming a superheterodyne, if the receiver has a three-gang condenser the switch would have to be of the six pole, triple throw type. The "high" ends of primaries and secondaries would be switched. For padding inclusion sometimes an extra deck is needed on the switch, number of throws the same.

Switching Tip

Fortunately the tuning condensers have approximately the same capacity in receivers, or, the frequency ratio is about the same, usually slightly exceeding 3 to 1. Thus for the broadcast band the tuning is from 540 to 1700 kc. Two more bands would require that the second cover 1700 to 5100 kc and the third 5,000 to 15,000 kc. Actually, since the ratio will be higher than 3, the maximum frequency would be nearer 18,000 to 20,000 kc, which is in general high enough.

There is little room for the extra coils, which is one problem. One way out is to use a tapped coil for the so-called police band, then use separate coils for the only remaining band. The tapped coil method is not as good as the separate coil method, but it serves the purpose well enough for those who can not accommodate six extra coils but have room for three extra coils.

Therefore it would be necessary either to rewind the secondaries to put in the tap for the r-f coils at about 25 turns from the bottom (grounded end), or buy new coils that have taps on them, including the oscillator, which for intermediate frequencies around 465 kc may have 20 turns between tap and ground and for intermediate frequencies around 175 kc may have 23 turns.

Since the third band is to be served by separate coils, the switching necessary for this attainment requires that the larger part of the secondaries for the police band be left open and the switch picking up the tap, communicating to it the condenser stator and the grid of the tube served. It is not possible without extra switch deck to move the condenser alone, as that would require tying the grid permanently to the full winding, which would defeat the objective in the third band, of having the grid go to a separate winding.

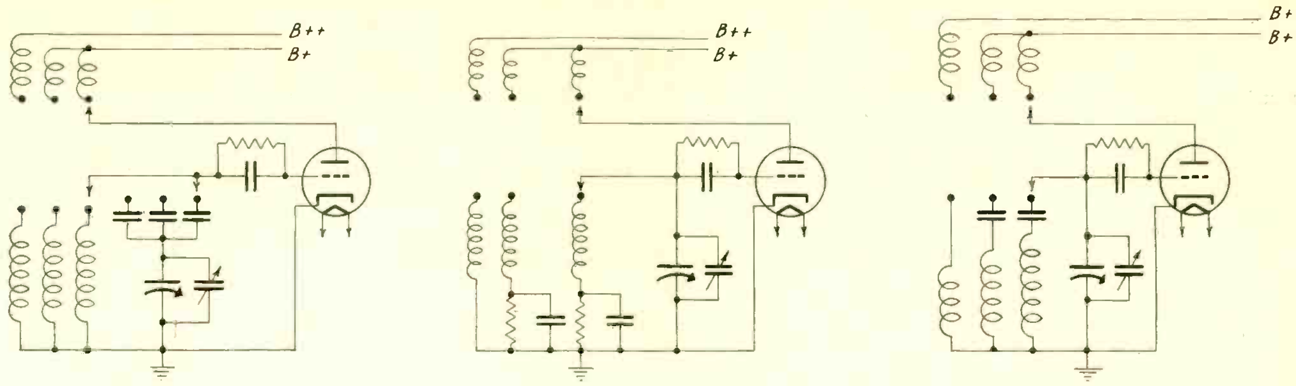
Padding Considerations

Besides the foregoing considerations, padding has to be taken into account. The broadcast band is the most important and the padding for that band is made as good as possible. For other bands larger series padding condensers would have to be used in the oscillator circuit. For the highest frequency band it is permissible to omit the padding condenser entirely.

Then there is the most difficult case of the tracking section. This consists of one section of the gang condenser having specially cut plates, obviating the need for a padding capacity. For i.f. around 175 kc the maximum capacity of this section would be around 300 mfd., for 456 the maximum would be around 190 and for 465 around 180 mmfd.

A tracking section is good for only one

(Continued on next page)



If another switch deck is used, three different padding condensers may be included in a method that does not sacrifice input, as all the voltage across the coil is delivered to the grid. The middle diagram shows a method of avoiding the extra switch deck, the padding condensers being at bottom, but loss again incurred. At right, r-f padding where one has a tracking section also reduces the voltage input, unless an extra deck is used for each such stage as in diagram at extreme left.

(*Continued from preceding page*)
band, with the r-f sections unmolested. The reason is that the plates of the tracking section are cut to provide, with suitable inductance and high-frequency trimming, oscillator frequencies higher than the r-f radio frequencies by a progressive or retrogressive percentage. The absolute difference in frequencies, r.f. compared to oscillator, is equal to the intermediate frequency, but this absolute quantity is based on percentages.

Too Much Frequency Difference

Take the lowest extreme of the broadcast band as 530 kc. If the i.f. is 175 kc the oscillator has to generate 530+175 or 705 kc. At the high end, say, 1700 kc, the oscillator should generate 1875 kc. The oscillator frequency at the low end is 1.33 times the r.f., while at the high end 1.1, and the retrogressive percentages (taking the ascending order of frequencies of r.f.) are related to the rate of change of capacity.

If we go to higher frequencies, since percentages will apply, if we tie down the tracking section at one point (now in another band) we can track at only that point, because the same percentages apply as before, and these make the frequency differences between the r.f. and the oscillator different for each setting, whereas they should be the same for each setting. Series padding or parallel padding of the tracking section will not help.

Can't Change the I. F.

If we desired to retain the same tracking section, as we progressed to higher bands we would have to increase the intermediate frecuency at the same rate that the radio frequencies were increased compared to the previous band. That is, though the second band attains the same frequency ratio, the frequencies are three times as high, and for the tracking section to be retained the i.f.: would have to be trebled, and for the third band multiplied by 9, compared to the first band. This changing of the i.f. is entirely impractical.

What can be done, however, with some measure of success, though at the expense of somewhat contracting the frequency ratio of tuning at the higher than broadcast frequencies, is to pad the r-f sections with the series condensers. The tracking would not be perfect but could be good, because the inductances are selected for the high frequency end of each band, while the series condensers in the r-f circuits only would be selected to create the maximum response at, or rather near, the low-frequency end. The tie-down points always should be a bit inside the extremes of tuning any bands, never literally the terminal frequencies.

Omission of Police Band

The higher the band frequencies the larger the series condensers. For i.f. around 465 kc, using tracking section, pad the r.f. with 0.0005 mfd. For higher i.f. use padding capacity somewhat lower than 0.0005 mfd. For 175 kc i.f. use padding capacity that is around 0.0012 mfd. In a given instance, 177.5 kc i.f., with r-f condenser sections 400 mmfd. and oscillator tracking section (as trimmed) 320 mmfd. the r-f series padder was .0015 mfd. commercial rating and worked all right. An extra switch deck is advisable for each such padded circuit to avoid reduction of voltage input.

Lacking room, one might omit the police band and constitute the receiver one of the skip band type, since the principal short wave foreign stations come in on the third band. For gang condensers with equal sections series padding may be omitted for this band but then parallel trimmers across the secondaries of all coils would be required.

The Oscillator Coil

The first coil to consider is the oscillator. While its inductance should be about the same as that of the r-f coil secondaries, the tickler will have to be pretty large, and the reason for trying the oscillator coil first is to be sure that the tube oscillates. An easy way of attaining this end is to wind a coil on whatever diameter you have, tickler interwound with secondary, and having about two-thirds the number of secondary turns. For 0.5 inch diameter, for the highest frequency band, 17 turns of No. 24 wire were used satisfactorily, spaced about half the wire diameter, the interwound tickler consisting of 11 turns.

To test for oscillation, put a current meter in series with the oscillator plate, any fixed condenser across the meter, and watch the readings as the dial is turned from one end to the other. The current will change largely, if the tube is oscillating, but will not change if the tube is not oscillating. Also, by putting your finger on the oscillator grid there will be a sudden change of plate current if the tube is oscillating, no change if the tube is not oscillating.

Higher Voltage on One Band

Since oscillation failure is a common trouble in these makeovers, all efforts should be centered first on making the oscillator generate, and then to see that it generates sufficiently. The drop in oscillation intensity is naturally large in the highest frequency band. However, the plate return may be tied anywhere, so instead of using a lower B voltage (B+ in diagrams) as in the previous ranges of frequencies, the power tube voltage (B++) may be used, if necessary, even though oscillator tube life is thereby reduced.

After the oscillator is satisfactorily oscillating it should be possible to pick up some response from a signal generator, or even bring in some stations by loosely coupling antenna to the oscillator coil. Tight coupling will result in stoppage of oscillation due to the antenna resistance being introduced.

The next step is to wind the coil for the modulator input, and the secondary inductance may be the same as for the oscillator, or, at least the number of turns may be the same. Then the primary may be wound the same way, too, in between the secondary. A good rule to follow is that the primary should have sufficient turns to be effective as a tickler if the tube were to be used as an oscillator, therefore copy the practice of the oscillator coil. The only inductance consideration beyond that is the secondary. If the same parallel padding is to be retained as found in a previous band, the wire on the new r-f coil may be pushed closer together for increase of inductance or the turns spread out for diminishing the inductance, until maximum response in the r-f stages prevails. If the coils are practically alike, r-f and oscillator, parallel trimmers will take up the difference and usually are easier to handle than inductive changes.

The Antenna Coil

By connecting antenna to plate of the r-f tube (if such a tube is in the set) the two-coil system is used for the band under consideration.

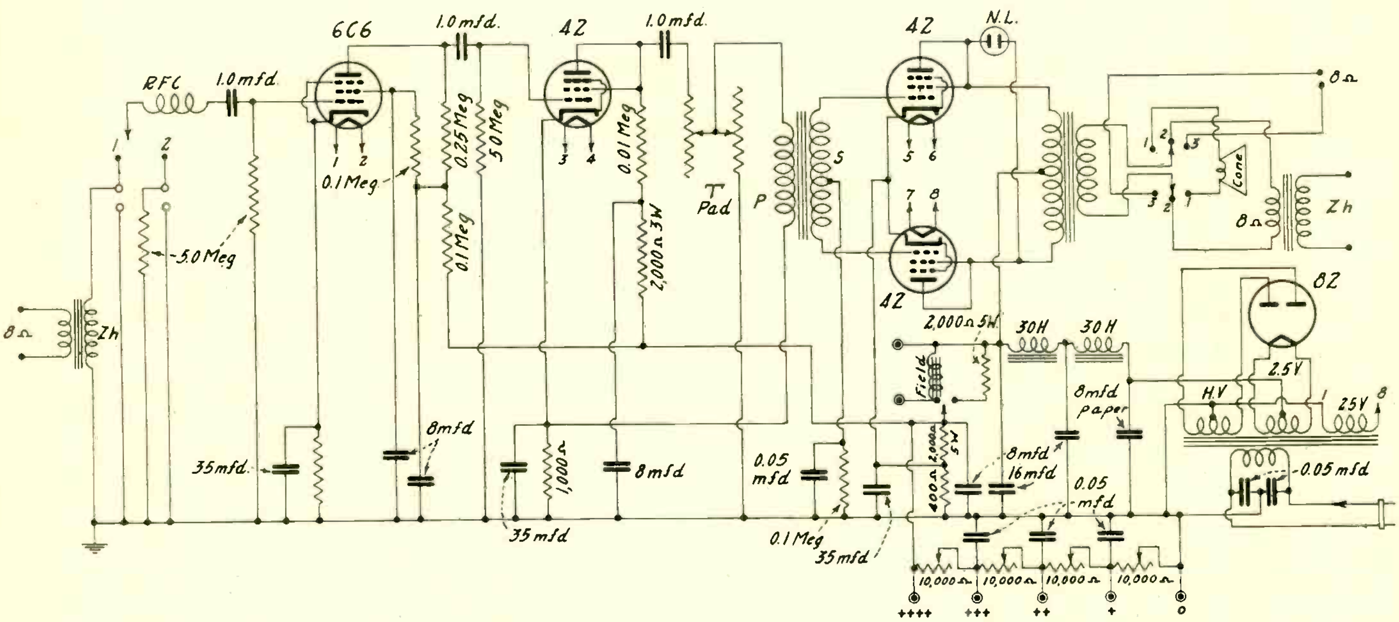
The third coil would be for the antenna stage, and the primary may be wound over the secondary, rather than interwound, and may be made the same way, except that if tests show the first stage contributes nothing, or produces a loss, the number of primary turns, or coupling between primary and secondary, must be increased. There is no use in resorting to theory in this matter. The antenna primary turns have to be increased to bring about satisfactory operating condition.

For the highest band, therefore, with approximately equal secondaries the tracking is tied down near the high frequency end.

A Wide Utility Amplifier

Uses and Connections for 12-Watt PA System Explained

By Rawlinson Beechurst



An amplifier of wide utility. It serves not only the usual purposes of working a speaker, but also a visual indicator of the instantaneous response type, and may be used as a speech amplifier in ham transmitter installations.

AN amplifier such as the one shown may be used for numerous purposes, and has option of input and output methods in conformity with such utility. The output at 5 per cent. distortion is rated at 12 watts, as semi-fixed bias in use on the power tubes.

Some of the inputs to be amplified are:

(1)—Detected component (output) of a radio-frequency tuner.

(2)—Microphone.

(3)—Photo-electric cell.

(4)—Audio-frequency generator, e.g., oscillator.

(5)—Transmission line.

The output uses are:

(1)—Operation of a speaker.

(2)—Operation of a visual indicator of practically instantaneous response.

(3)—Modulation of a transmitter, whereby the name for the present device would be come "speech amplifier," without any circuit changes.

(4)—Transmission line.

Output of a Receiver

Taking up these uses in the order named, the output of a tuner is put into the amplifier in such fashion as to avoid failure of necessary d-c voltage for the tuner's detector plate and also safeguard against short circuit. This means a suitable impedance is put in the plate circuit of the tuner's detector and the output is taken through a stopping condenser connected to position 2, while grounded chasses of tuner and amplifier are common, or if the detector plate circuit impedance is the primary of a transformer, then the secondary is connected to position 2. The use of a transmission line is advisable whenever the receiver and amplifier are separated by a distance greater than 20 feet, when the transformer at tuner's output would have a step-down secondary matching the primary of the amplifier's input tranformer, position 1. The secondary of the set's output transformer and the primary of the amplifier's input transformer should have the same impedance, and the transmission line should be of low impedance. While 8-ohm input and output terminations are shown, the impedance values may be other than that, if equal, and often 500 ohms is the impedance of each terminal winding.

Carbon Microphone

If a microphone is to be used, of the carbon granule type, the impedance will be too high for connection to an 8-ohm primary and too low for connection directly across the grid of the first tube, therefore a microphone transformer would have to be used. This has a primary impedance equal to that of the microphone impedance, a few hundred ohms usually, while the secondary is of high impedance (Zh). Since a carbon microphone would need a small excitation voltage, the connection is made with the series microphone-battery circuit between position 2 and ground, switch thrown accordingly. The stopping condenser is there for isolating from the amplifier bias on the first tube and d-c voltages necessary for microphone or photo-cell.

The left-hand 5 meg. resistor is included only to enable distinction between positions 1 (open) and 2 (closed through high resistance) in trouble shooting.

The better grade of microphones used is not very sensitive, e.g., condenser, velocity (ribbon) and crystal, and require pre-amplifiers now more commonly called microphone amplifiers or if built into the head as with the condenser type, head amplifiers, so that the sound currents, utilized as voltage values, are built up even before input to the main amplifier (the one diagramed). These microphone amplifiers are small affairs, usually having three tubes, of which two are amplifiers and one tube is the rectifier. Then the output of the pre-amplifier is considered just the same as if it were the output of the detector of a tuner as previously discussed.

Many photo cells used to-day, e.g., the selenium cell of the high-sensitivity type, require an exciting voltage, and this may be applied, the series circuit connected across the amplifier input at position 1, where Zh acts as a protective resistance to the cell. The self-generating type cell may be put directly across the input at position 2. The only object of using a cell would be to rectify the modulation of a light beam, and hear the result in the output, or perform some mechanical work with the speaker armature as relay. In general the caesium type cell is preferable, because the lag is much less, although results can be obtained with selenium cells.

Light as Equivalent Output

Audio-frequency generation may be the output from an audio oscillator or may be any audio frequency changes, such as keying, using a buzzer or a vacuum tube oscillator, for line transmission introduction, when the amplifier becomes the remote receiver.

This is encompassed under the heading of "transmission line," which includes all output uses where heard or seen results are distant from the input.

In all instances the input consists of sound, or at least of variations at an audio frequency, which may include light variations by stoppage and starting at the input, with cell operation. Not in all instances will the output consist of sound, for the equivalent may become light, as when a neon lamp (NL) is caused to go

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Negative Resistance Circuits

The 57 and 6C6 for Straight and Relaxation Oscillations

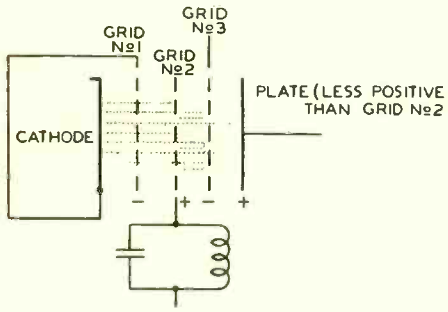


FIG. 1A
Electron paths in negative resistance tube (57 or 6C6).

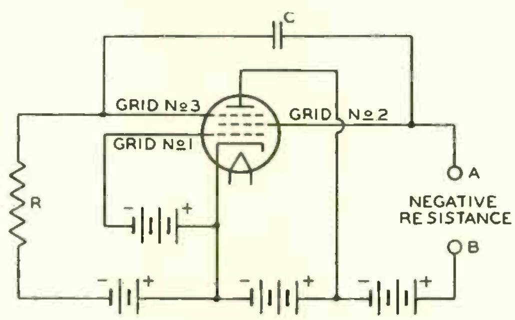


FIG. 1B
Voltage-controlled oscillator, tuned circuit across AB.

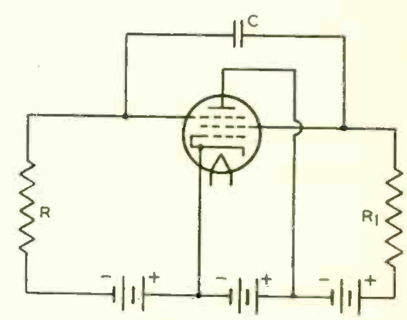


FIG. 1C
Current-controlled relaxation oscillator for small amplitudes.

ONE circuit combination with three-grid tubes in which the connections to all three grids are brought out, produces a simple and reliable negative-resistance device.

In vacuum tubes connected in the usual manner, a rise (change in positive direction) in control-electrode voltage causes a rise in anode current. With a resistive anode load, the anode voltage drops with a rise in anode current; thus, the grid-voltage change and the anode-voltage change are in exact opposition. In order to make oscillations possible, it is necessary to feed back energy from the anode circuit to the control-electrode circuit in such a way as to increase the controlling voltage. Since, with a resistive grid and a resistive plate circuit the voltage changes in the two circuits are in opposition, it is not possible to provide feedback in a simple way. Ordinarily either reactive circuits or magnetic coupling is used in the oscillator arrangement to adjust properly the phase of the voltage feedback from anode to control electrode.

Simplicity Achieved

Both methods require a more complicated oscillator circuit than that required with simple two-terminal negative-resistance devices such as, for example, the dynatron.

If the anode current of a tube could be made to decrease when the control-grid voltage is raised, the grid-voltage change and the plate-voltage change with resistive circuits would no longer be in opposition but would be in the proper relation to produce feedback effects. Such an arrangement would avoid the feedback complications of the ordinary oscillator, since only a large fixed condenser between the control electrode and anode is necessary to transmit anode-voltage fluctuations to the control electrode in proper phase. A tube in which the anode current drops when the control-electrode voltage rises has a grid-plate transconductance opposite in sign to that of the usual tube, and may therefore properly be described as a tube having negative grid-plate transconductance.

If the No. 3 grid (suppressor) of the type 57 or 6C6 is used as a control electrode and is made more negative, some of the electrons will be turned back toward the cathode; the plate current, therefore, decreases. See Fig. 1a. The electrons turned back, however, are attracted by the positive voltage impressed on the No. 2 grid (screen), and pass to it so as to increase its current. If, then, the No. 2 grid be considered as the anode in place of the usual plate, and the No. 3 grid be considered as the control electrode, the arrangement will have negative grid-plate transconductance. When a pentode is used in this fashion, the current which passes to the usual plate is not employed. This is similar to conventional applications where the screen current is not utilized.

Although no mention has been made of the No. 1 grid, this grid does have a valuable function in the tube, because it can be used to control the total amount of cathode current and therefore the magnitude of the effect. In this respect, it is analogous to the function of the No. 1 grid in the Pliodynatron. In addition, it exerts a limiting action on the total current so that the No. 2 grid resistance is increased.

Attenuation Method

A circuit using the 57 in this manner to obtain a negative resistance is shown in Fig. 1b. For simplicity in explaining the operation the No. 1 grid can be connected directly to the cathode. Amplitude of oscillation may be controlled by grid No. 1 voltage. The usual plate is connected to a positive potential. The No. 3 grid is connected to the No. 2 grid through a

(Continued on next page)

Use of Transmission Lines with Amplifier

(Continued from preceding page)

on and off at intervals determined by changes at the input. For instance, if a watch is put in front of the microphone, the neon lamp will go on and out at the rate of ticking, about five pulses a second. If a standard chronometer is used, the neon lamp may be scanned by a stroboscope, then the standard removed and a watch to be adjusted is put at the microphone instead and the lever turned until the second watch keeps time with the first, that is, the stroboscope is watched carefully until the adjustment results in the same reading as with the standard.

Operation of a speaker is the most common use, of course, and for this purpose the output switch is put at a given position, marked 1 in the diagram, to move the armature in the cone. To enable the switch operation in this manner the voice coil leads must be unsoldered from the speaker and connected to the switch tabs, the two switch indexes being connected to the secondary of the speaker's output transformer. This secondary may be any value, but 8 ohms are ascribed, and at position 2 the connection would be made for a transmission line to terminate at the far end at an impedance consisting of a primary equal to Zh and secondary matched to the voice coil of the speaker to be used.

The second position of the switch takes care of the condition just described, as the low impedance is in the primary and the high impedance (Zh) in the secondary. Position 3 takes care of a low impedance output, direct from secondary, to a low impedance line to an impedance equal to the aforementioned secondary's.

Besides being an amplifier of considerable utility for amplification purposes, and providing for excitation of a speaker field, where ohmage differences are not of as great importance as in most other circuits, and besides supplying a substitute resistance if no speaker field is to be excited, this device allows for d-c potentials for powering an external circuit, e.g., tuner. Rheostats of 10,000 ohms are adjusted until the desired voltages are attained. These voltages ascend in the order of the plus signs at lower right in the diagram.

The values of the parts are imprinted on the diagram, except for the T pad. This should be wire-wound, and while 5,000 ohms is "top" in catalogues generally, 25,000 ohms would be better, and the 0.01 meg. 5 watt resistor may be raised to 0.025 meg. (25,000 ohms) in the 42 driver plate circuit.

The very high capacity bypass capacities are electrolytic condensers of low voltage rating. The 8 mfd. condensers are electrolytics, while the 16 mfd. condenser may consist of two electrolytics in parallel, the voltage rating of the electrolytics being 500 volts d.c. An exception exists in the condenser next to the rectifier, which may be of 4 to 8 mfd., but should be of the paper type, of 600 volts r.m.s. rating.

(*Continued from preceding page*)

large condenser, C. A suitable negative bias is applied to the No. 3 grid through the high-resistance grid leak, R. The negative resistance is exhibited between terminals A and B. The operation of the circuit is as follows:

Rapid Voltages Apply

An instantaneous rise in voltage across the terminals AB is transmitted by the condenser C to the No. 3 grid, which has its potential increased, thereby decreasing the No. 2 grid current. Since the No. 3 grid is biased negatively and draws no current, the total current in whatever circuit is connected to AB is determined only by the No. 2 grid current. It is, therefore, evident that the instantaneous rise in voltage across AB is accompanied by a drop in current. This is the characteristic of a negative resistance.

From the explanation it is seen that the negative resistance occurs only for variations in voltage which are rapid since, otherwise, the condenser C does not transmit the variations. A static characteristic taken on the arrangement shows no negative resistance, although the negative resistance is present for alternating voltages. As either the condenser C or the grid leak R is made larger in value, the lowest frequency to which the circuit behaves as a negative resistance is made less. The condenser C and the grid leak R must be chosen in the same way as the coupling condenser and leak in a resistance-coupled amplifier, i. e., the condenser reactance must be small compared to the grid-leak resistance, to transmit satisfactorily the lowest frequency to be used.

Value of Negative Resistance

The value of the negative resistance produced may be calculated as follows: When the instantaneous voltage on the No. 2 grid rises a small amount $\triangle E$, a rise in current $\triangle E/r_{g2}$ would be expected where r_{g2} is the No. 2 grid resistance. At the same time, however, the condenser to the No. 3 grid permits its voltage to rise an amount $\triangle E$: this tends to lower the No. 2 grid current by an amount $s_{m3-2}\triangle E$. The effective resistance of the combination is represented by the change in voltage divided by the total change in current and is therefore given by:

Resistance $= \triangle E/\triangle I = \triangle E/\ (\triangle E/r_{g2} - s_{m3-2}\triangle E) = 1/\ (1/r_{g2} - s_{m3-2})$

In the 57 and 6C6 tubes, $1/r_{g2}$ is much smaller than s_{m3-2} under best operating conditions to produce negative resistance. The negative resistance produced is, therefore, approximately the reciprocal of the negative transconductance between the No. 3 and the No. 2 grid. The lowest negative resistance is thus found at the point having highest negative transconductance.

Operating Conditions

Suitable operating conditions for a tube may be found by choosing a value for No. 1 grid voltage (E_{c1}), No. 2 grid voltage (E_{c2}), and plate voltage (E_b) to give a reasonable cathode current and then by varying No. 3 grid voltage (E_{c3}) to find the point of maximum transconductance to the No. 2 grid. This value of E_{c3} may then be used as the bias value.

Typical operating conditions for the two types of tubes are:

	Type 57	*Type 6C6*
Heater Volts (E_f).......	2.5	6.3
No. 1 Grid Volts (E_{c1})...	0	0
No. 2 Grid Volts (E_{c2})...	100	100
No. 3 Grid Volts (E_{c3})...	—10	—10
Plate Volts (E_b).........	22.5	22.5
No. 2 Grid Milliamperes (I_{c2})*	4	4.1
Plate Milliamperes (I_b)*..	2.9	2.4
No. 3 Grid to No. 2 Grid Transconductance — micromhos (s_{m3-2})	—320	—280
Negative Resistance Produced — ohms*.........	3400	4000

*Approximate.

In addition to the operating conditions for the values given, the 57 and 6C6 may be operated over a wide range of voltages. For example, increasing E_{c1} in the negative direction reduces the cathode current and increases the negative resistance. If E_b is increased, E_{c3} must be increased in the negative direction by approximately the same ratio in order to continue to operate at the center point of the negative-resistance characteristic. No improvement in operating characteristics is obtained by raising E_b. An increase in E_{c2}, though not advised from the point of view of tube life, will cause an increase in s_{m3-2} and hence a decrease in the negative resistance.

The complete negative-resistance performance of a three-grid tube may be predicted from No. 2 grid characteristic curves obtainable from the tube manufacturers.

Case of Tuned Circuit

In order to utilize the negative-resistance circuit for the production of oscillations it is simply necessary to connect a parallel tuned circuit to the terminals AB of Fig. 1b. Variation of the No. 1 grid voltage provides a simple and convenient method of controlling the strength of oscillation. This is illustrated by the curve of Fig. 3. It should be pointed out that the advantages of simplicity, stability and good waveform obtainable with the dynatron are all present in the negative-transconductance method. In addition, *the negative resistance produced does not depend on secondary emission* so that a degree of uniformity and reliability not ordinarily found in dynatrons is present. The negative resistance produced is lower than that of most tubes used as dynatrons when the same cathode current is permitted. This is an advantage, since the lower negative resistance permits oscillation with a higher-loss tuned circuit. At the same time, the total shunt capacitance of the tube, feedback condenser and leak may be made almost as small as that of most commercial tubes used as Dynatrons.

To give practical data on the advantages of the 57 and 6C6 tubes over the dynatron method of obtaining negative resistance and to compare results with similar data taken on the 57 and 6C6 in the negative-transconductance circuit, measurements were taken on some type 24-A tubes used as dynatrons. The results are presented briefly in the following analysis. The data were taken on 24-A tubes of present production having carbonized plates. The voltage conditions were adjusted to obtain approximately the same cathode current as that of the 57 and 6C6 tubes.

	Type 57	*Type 6C6*	*Type 24-A (dynatron-operated)*
Mean Negative Resistance ...	3400 ohms	3900 ohms	59000 ohms
Average Deviation from Mean...	8%	3%	44%
Maximum Deviation from Mean.	23%	15%	87%

Figure of Merit

Although the 24-A tubes tested were extremely poor as dynatrons because of the use of carbonized plates, it is believed that the variations between tubes as measured by the percentage deviations from the mean are typical. Thus, the use of a more suitable plate material might lower the negative resistance to an average of 20,000 ohms or so, but the variations between tubes expressed in percentage would probably remain nearly the same for tubes chosen at random.

In most applications a figure of merit for a negative-resistance device of the class in which the dynatron and the negative-transconductance method fall is given by 1/CR where C is the total effective shunt capacitance, and R the negative resistance. On this basis, the 24-A's which have an effective capacitance of approximately 10 mmfd. would have a figure of merit of 1.7. If it is assumed that more suitable plate material could be used, this figure might be increased to 5. In the 57 or 6C6 circuit, the tube contributes about 12 mmfd. to the shunt capacitance and the external coupling condenser and leak may be caused to contribute as little as 6 mmfd. The figure of merit is then approximately 15 or three times as great as the best figure given for the dynatron.

Transit Time

Electron transit-time effects limit the upper frequency at which the 57 or 6C6 will oscillate to approximately 20 megacycles. This limitation makes it impracticable to use these tubes as oscillators in all-wave receivers or at frequencies much above 15 megacycles. The negative-transconductance tube can, however, be used to advantage as a two-terminal oscillator in receivers, measuring devices, or other equipment in which the frequencies involved are lower than 15 megacycles. No tickler coils or taps are required for this type of oscillator. This is a feature which greatly simplifies the switching problem for apparatus employing more than a single frequency band, since but one switching terminal need be considered for each band; the other terminal can be connected permanently in the circuit.

Voltage Controlled

Figure 1b shows how the 57 or 6C6 can be connected for use in a voltage-controlled negative-resistance oscillator in conjunction with a tuned circuit. This arrangement will produce sinusoidal oscillations. Figure 1c illustrates a relaxation-oscillation circuit using the 57 or 6C6 in a current-controlled circuit. For operation at small amplitudes, the oscillations are approximately sinusoidal.

Engineer Broadcasts From Bobsled

Skimming over the ice on the Mt. Van Hoevenberg bobsled run at Lake Placid, N. Y., at a speed which at times reached 70 miles an hour, Eugene S. Darlington, a General Electric engineer, carrying a small portable radio transmitter, broadcast a running description of the sensations experienced in this mile and a half dash. It required less than two minutes to make the trip. The broadcast was carried over WGY and W2XAD, Schenectady, N. Y. A second man was at the wheel and a third at the brake.

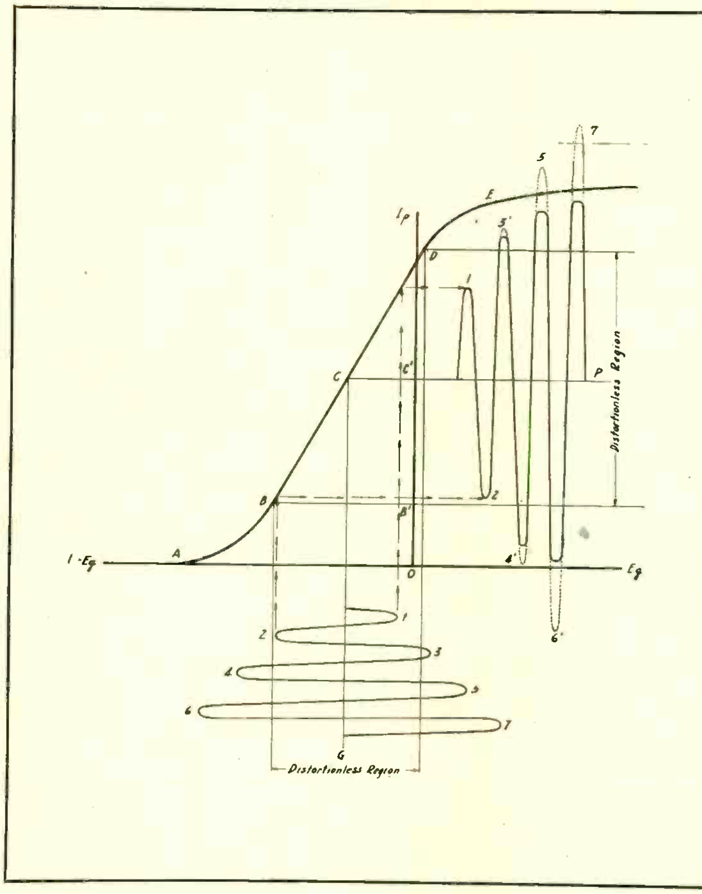
Firmly strapped to Darlington's back was the small short-wave transmitter, a 25-pound "pack set," atop of which was a five-foot antenna more or less resembling a fishpole. Fastened to his chest was a special microphone having a mouthpiece extension similar to that used by a telephone operator.

Amplifier Overloading Tests

How to Determine Whether Audio Channel is Faithful

By Malcom P. Chute

The operation of an audio amplifier tube should occur only along the straight portion of the grid voltage-plate current characteristic curve. Operation beyond this limit causes the generation of harmonics which results from the flattening out of the peaks. The dotted curves indicate the degree to which the peaks have been flattened out. It is this peak destruction that manifests itself as distortion in the loudspeaker output.



THE high fidelity rage is upon us and it behooves us all to investigate our equipment for this quality. But, before this can be done, it is necessary that we understand what is meant by high fidelity. Then we shall treat one aspect of its attainment.

The recently introduced manufactured high fidelity receivers reproduce evenly all audio frequencies between about 30 and 7500 cycles per second. This, then, can be our basis for high fidelity.

If we are to listen to the radio set that is ordinarily in use these days and also notice the quality of the occasional public address system installed in the doorway of an "enterprising" storekeeper, it will be obvious that a piece of audio apparatus has an overload point. It would therefore seem most ethical on the part of the manufacturers of this equipment to indicate the limits to which the controls may be turned before distortive influences are induced from overloading. In this connection let us consider the theoretical aspects of overloading.

Characteristic of Tube

For this purpose, let us refer to the first sketch. Here is shown what is known as the plate current-grid voltage characteristic of a vacuum tube such as is used in an audio amplifier. The curved line A-B-C-D-E represents the static conditions of the operation of such a tube for a given condition of filament and plate voltages. On this graph, grid voltages are plotted along the line marked E_g while plate currents are scaled along the line marked I_p. All plate currents are positive while the grid voltage may be either positive or negative depending on whether it is to the right or the left of the I_p-O line.

A test for a particular vacuum tube operated with certain fixed filament and plate voltages reveals that the curved line indicated represents the operation characteristics of the tube. Thus, when a grid voltage represented by the horizontal distance of the point B from the I_p line is impressed upon the tube, only the plate current designated by OB' can exist. Following this through for all points on the curve, plate current conditions may be definitely ascertained from any given grid voltage. Thus if the alternating signal voltage applied to the tube grid is drawn along the line CG and then projected to the right at right angles the associated plate current can be plotted thereon to scale along CP, as shown.

It can be seen that this procedure is accomplished by means of projecting each individual value of grid voltage along the CP line. Thus, point 1 on the grid curve is projected upwards until it strikes the characteristic curve whence it continues to the right at right angles until it reaches point 1'. Similarly, point 2 on the grid curve becomes 2' on the plate curent curve until all the points are plotted to give that smooth curve shown.

Straight Portion

It will be noticed that the characteristic curve contains a straight line portion and curves at both ends. While the grid voltage varies along this linear portion, it will be seen that the plate curent is an exact reproduction of the grid voltage in amplified form. However, when the grid voltage exceeds the limits, B-D, the plate current change is no longer exactly similar to the grid voltage change but becomes flat-topped due to the curvature of the characteristic. This is shown by the dotted lines on the peaks that are distorted. Incidentally, the grid voltage has been assumed gradually to increase in amplitude as shown in order to display the distortion influences that work when the volume control's position causes the application of an excessive grid voltage. The dotted continuation of the peaks reveals the extent to which the original wave shape has been altered. It is obvious from this discussion that if the grid voltage oversteps the bounds of the linear portion of the characteristic, distortion will result. Where is that distortion point on a particular amplifier and how could it be measured? An attempt to answer that question will be found below.

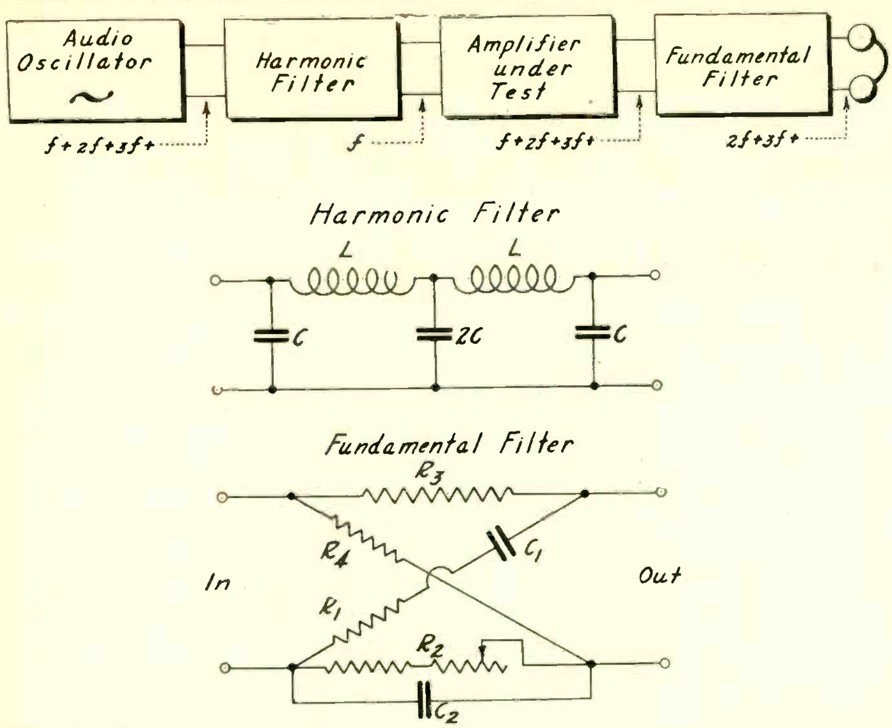
The most obvious way to measure this condition is to feed an amplifier with a pure sinusoidal wave of any desirable audio frequency, say 1000 cycles. Then gradually increase the volume control of the amplifier to the point where one hears harmonics of the 1000 cycle note in addition, having been generated by the curvature of the characteristic. The point where these harmonics begin to appear represents the beginning of the distortion point. If this point does not appear upon the usable portion of the volume control, it reveals that the amplifier has been correctly designed and that distortion does not occur at any setting of the control. On the other hand, should the harmonics make their appearance soon after the volume control leaves the minimum position then we have a bad case of distortionitis.

Audio Oscillator

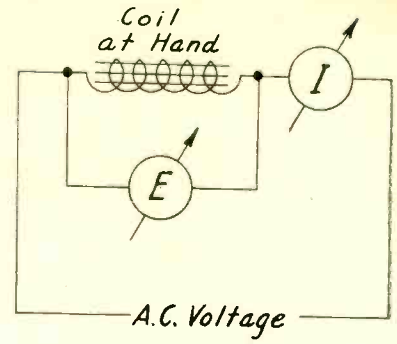
Reference to the second sketch will show how the apparatus is connected together for this test. First, we start off with an audio oscillator. This may be of the type described in RADIO WORLD, issue of February 9, 1935, on page 11, or may be of the type with one fixed frequency as by means of a turning fork. In any case, however, these oscillators do not provide us with a pure audio oscillation. They are full of other frequencies of harmonic relationship. Therefore, in order to render the wave pure, we feed the oscillator output into a filter that does not allow any frequency other than the fundamental frequency to pass. In other words, the output of the filter will be a pure sinusoidal wave of the fundamental frequency. This is then suitable for introduction into the amplifier being tested.

The output of the amplifier is then fed to another filter that suppresses the fundamental frequency though simultaneously passing the harmonic frequencies. Thus, if the output of the amplifier is a pure tone—just what was introduced into it by the first filter—then nothing will be heard in the head phones. However, should the amplifier have generated harmonics within itself, then audible tones would be heard in the phones. The procedure, then, is to vary the volume control of the amplifier in suitable steps until the point is reached where something is heard in the headphones.

Should a more sensitive means of indicator be desired, a volume indicator or out-



The block diagram shows the arrangement of the apparatus for measuring the overload characteristics of an amplifier. The following two diagrams show the kind of filters that are used.



$$Z = \frac{E}{I} = \sqrt{R^2 + X^2}$$

$$X = 2\pi f L$$

$$L = \frac{X}{2\pi f}$$

To measure the inductance of a coil, simply connect it to a source of a-c potential and measure the current and voltage on the coil. The formulas do the rest.

put meter may be substituted for the headphones. In this case, the volume control of the amplifier should be varied to the point where a reading just shows itself upon the meter. Thus, can the overload point on any audio amplifier be ascertained. This is a direct measure of one aspect of the fidelity to be expected from such an amplifier.

The second and third sketches in this diagram concerning the apparatus used shows the constituents of the first and second filters respectively. The first is a low pass filter and its design is indicated in one of the tables. The L's are two inductances of equal value just as the C's are two condensers of equal value, while 2C is twice the value of C. The second filter is generally known as the Wien bridge and has the faculty of being a fairly good band-stop filter in addition to its normal bridge functions. The constants of this filter are also indicated in one of the tables.

Using Coils You Have

A study of these two tables reveals that each component is readily made or procured on the market with the exception perhaps of the inductances. It is not convenient for us to make these units of our own design since inductance charts and tables do not extend to such ranges. If we refer to various texts on high inductance, it is found that the formulas involved are quite ponderous if not complicated, and very approximate at that. So we are reduced to a matter of hit or miss.

First, it would be wiser to cast about our stock of miscellaneous chokes and transformers and measure their inductance. Should their size be unsuitable, they may be trimmed to the correct magnitude by taking off or adding on turns or varying the air gap in the case of a choke. This involves measuring apparatus that is quite simple to assemble.

As can be seen from the last diagram in this article, all the apparatus that is necessary is an alternating current voltmeter and ammeter. The coil is then fed with an alternating potential and the current through it read in the meter "I" and the voltage drop across it read in the meter "E". From these two readings we can compute the coils impedance (Z), as shown in the diagram by merely dividing the voltmeter reading by the ammeter reading.

Now, the impedance is equal to the square root of the sum of the squares of the coil's resistance and reactance. The coil's resistance is measurable in the same way that its impedance is ascertained except that a d-c potential is utilized in the same hook-up as above with d-c instruments.

The quotient of the d-c voltmeter reading and the d-c ammeter reading then will give the coil's resistance. Now that we know the impedance and the resistance of the coil, the reactance of it is readily ascertained from:

$$X = \sqrt{Z^2 - R^2}$$

When we have determined the reactance of the coil from this computation we can compute its inductance from the formula:

$$X = 2\pi f L$$
$$L = X/2\pi f$$

since we know the frequency of the alternating current that was applied to the initial a-c measurement. In this fashion, can we go about the steps to procure the necessary inductance for the filter in this apparatus.

This method may seem rather crude, but the reader is advised that it is the simplest expedient in an otherwise difficult situation.

Constants for Low Pass Harmonic Filter (500 Ohm Impedance)

Frequency (c.p.s.)	*L (henries)*	*C (Mfd.)*	*2C (Mfd.)*
50	3.18	6.36	12.72
100	1.59	3.18	6.36
200	0.795	1.59	3.18
400	0.3975	0.795	1.59
600	0.265	0.53	1.06
800	0.19875	0.3975	0.795
1000	0.159	0.318	0.636
1500	0.106	0.212	0.424
2000	0.0795	0.159	0.318
3000	0.053	0.106	0.212
4000	0.03975	0.0795	0.159
5000	0.0318	0.0636	0.1272
6000	0.0265	0.053	0.106
7000	0.0227	0.0454	0.0908
8000	0.019875	0.03975	0.0795
9000	0.01767	0.03533	0.07067
10000	0.0159	0.0318	0.0636
12000	0.01325	0.0265	0.053
14000	0.01135	0.0227	0.0454
16000	0.009995	0.01985	0.0397
18000	0.00884	0.01765	0.0353
20000	0.00795	0.0159	0.0318

Constants for Fundamental (Band Stop) Filter

$R_1 = 100$ *ohms.*
$R_3 = R_4 = 1{,}000$ *ohms.*
$C_1 = 1.0$ *mfd.*

Frequency (c.p.s.)	R_2 *(ohms)*	C_2 *(mfd.)*
50	101,500	0.999
100	25,400	0.996
200	6,425	0.984
300	2,912	0.962
400	1,681	0.941
500	1,112	0.910
600	803	0.875
700	616	0.838
800	495	0.798
900	412	0.756
1000	353	0.717
1500	212	0.527
2000	163	0.386
3000	128.1	0.219
4000	115,2	0.138
5000	110.12	0.091
6000	107.028	0.065
7000	105.163	0.049
8000	103.953	0.038
9000	103.123	0.0303
10000	102.53	0.0247
12000	101.76	0.0174
14000	101.29	0.0127
16000	101.072	0.0106
18000	100.78	0.0077
20000	100.633	0.0063

Movement of Figures

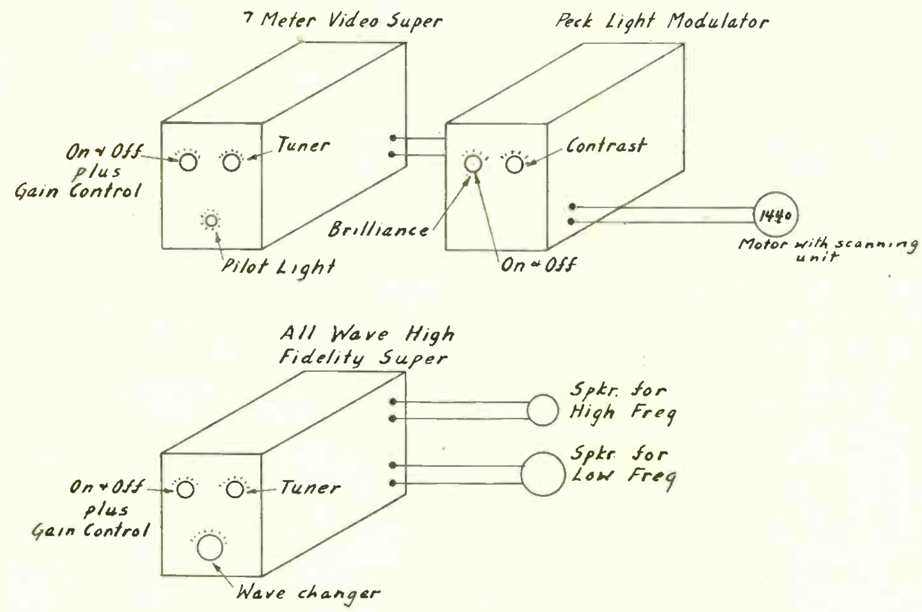
WHAT DOES a moving Lissajous figure denote and how can the movement be stopped?—F. G.

Whenever either of the frequencies of the voltages applied to the plates of a cathode ray oscillograph tube varies, the Lissajous figure that forms on the screen will move. If the variation is very slow, the movement of the figure will be slow while rapid variation will produce an equally rapid movement of the figure. Last week's Fig. 9b illustrated approximately, the effect of a movement in the figure. Although the frequency still is the same as that of Fig. 9a, the frequencies drifted slightly from the conditions shown in the first figure to those shown in the second figure when they settled down to constancy again. Obviously in order to avert movement of the Lissajous figure, the frequencies of the voltages under consideration must remain constant.

An Advanced T

Wide Band I.F. Used in Set Suit

By J. Lawren



Functional block diagram of the television receiver.

WITH the sounding of the keynote, "Television in 1935," a discussion of some of the latest thoughts in receiver design is quite pertinent.

A-C, D-C, A-V-C Octode Stirs "Father of Radio"

BY LEE DE FOREST

To allow German set designers to become acquainted with their new binodes, r-f pentodes, hexodes and octodes (the septode seems to be strangely missing) no other new types of tubes can be brought out in Germany for one year—a sort of electronic moritorium has been governmentally ordered.

In addition to all our own triodes, pentodes and tetrodes which set designers here in America have to contend with, our German friends have to deal with duo-diodes for a.c. and d.c.; a mixing hexode for r-f, i-f and d-c operation; an octode for a.c. and an output pentode for d.c. operation.

Also a mixing (variable mu) hexode, (an exponential hexode, no less); the output of this hexode is lead through a band-pass filter to the diode electrodes in the diode-tetrode binode, or duo-diode tube.

Then there is the "fading-mixing" hexode; while, to cap the climax, the combination of the fading and mixing hexode having the properties of an r-f pentode is the a-c, d-c, a-v-c octode.

Imagine a tube with 6 grids and 10 terminals in a set selling at $9.95!

There is no question that television signals will be broadcast on waves below ten meters. It is the most logical place to put the many, many small stations that will be needed to service the large areas of our country. This trend to the short waves opens up vast possibilities in design and construction of receivers.

To begin with, coils and condensers are so small that the midget of today will look like a console tomorrow. New tubes have already been placed on the market that are known as "acorns" and an engineer responsible for their development said that the only thing that was holding back smaller sets was the size of knobs for tuning condensers.

Some Novel Ideas

A problem that will present itself as soon as receivers reach the home will be pilot lights. We certainly know how all lighting for exit signs in theatres is carefully subdued so as not to distract attention and we shall have the same trouble in a television receiver. It is necessary to have light in a dimly lit room to tune in a dial so in the Peck Television Corporation of Canada's receivers some novel ideas have been incorporated to insure as much brilliance as possible in tuning with a mininum of glare to the looker in.

In Fig. 1 is a block diagram of the component electrical parts of a television receiving system. Because we must have a sight and a sound channel we must have two receivers. It is not at all improbable that the present sound broadcasting structure will be kept for some time after the advent of television so as to insure reception of the sound that goes with the picture an all wave receivers of the high-fidelity type has been selected for Montreal lookers-in.

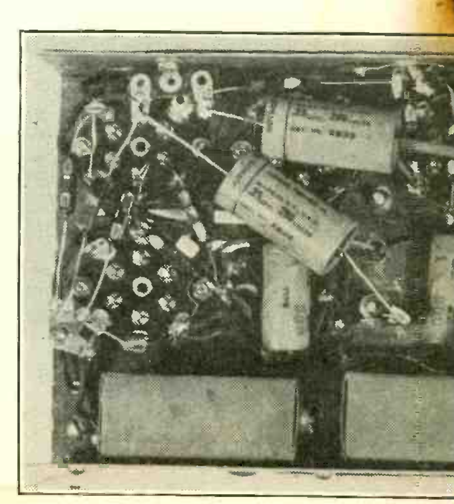
Midget Set

When we stop to think that it is necessary to have in one cabinet two receivers of good gain, a light modulator and an optical system, with as large a screen as possible, we find out that small receivers must be made smaller and with this in mind a super-heterodyne of the midget type was selected as the best television receiver for size. Because of the great difference in voltage requirements and because of the ease of operation and servicing it was decided to make each unit with a separate power pack.

In our seven meter super-heterodyne the requirements are met very nicely by a small a-c, d-c unit. As the modulator unit needs but fourteen volts of signal to drive it, the output of the push-pull 6D6's is more than adequate. No attempt has been made to make the set smaller than a regular midget but if a glance or two is made at the spare room on the chassis it will be seen that much smaller receivers can be made.

Stray Capacity

The stray capacity problem is present to any great extent only in our detector output and in the special push-pull developing buffer stage. A simple corrective network in the light modulating unit allows us to proceed with only good judgment as our caution. The stray capacity problem has been greatly overrated by many engineers. The RF gain that is needed for our intermedial amplifier is not as great as in our present sound receivers. This statement you will probably at first take issue with, but when you are reminded that without

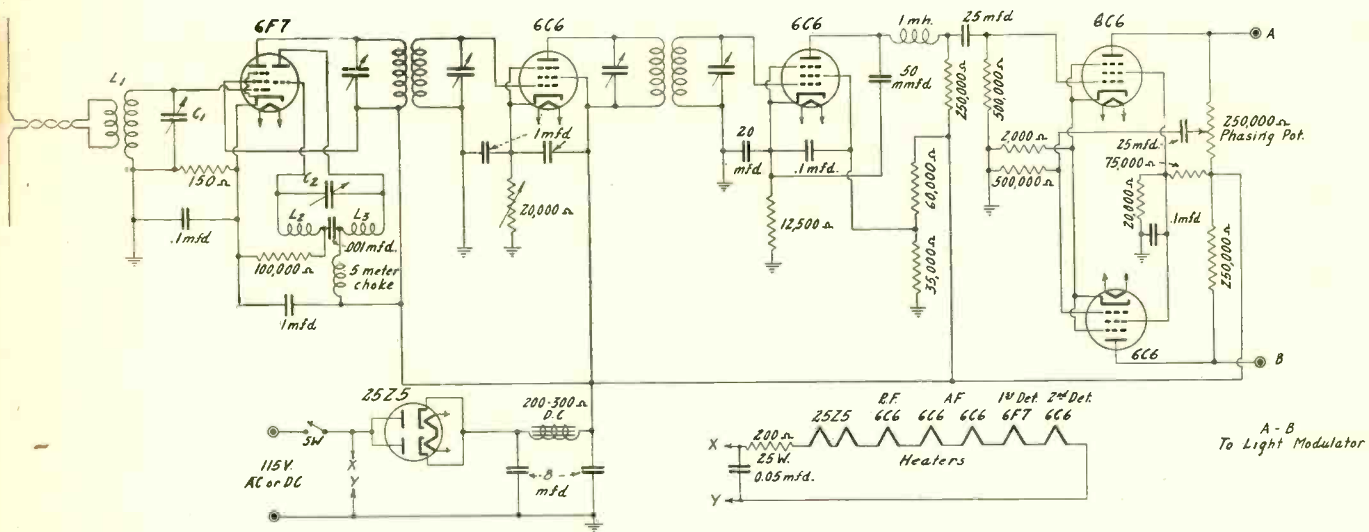


A view of the bottom side

elevision Super

able Also for Amateur Purposes

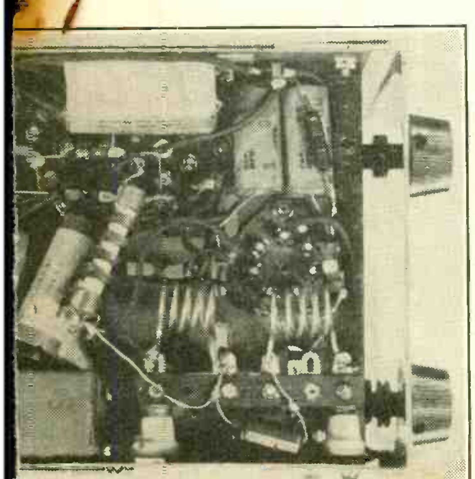
ice Cassell



The circuit diagram with constants.

much trouble it is possible to construct short-wave antennas on the roof of the average apartment that have a pick-up ability many, many times that of the best antennas that decorate our house tops for broadcast reception. The day of the built-in antenna will be a thing of the past because there is room enough for a good directive antenna on every roof and the landlord will construct it and then run twisted cable right past your apartment door so that you will have ample signal to begin with.

It is not hard to see in the near future selectivity as the great problem of the engineer in television receiver design, even though we have a vast space to put the thousands of transmitters necessary to service the lookers-in. In qualifying this prediction we only have to look upon the fact that because at the present time seven meter signals are only expected to go to the horizon, as engineering technique is advanced a great many receivers will pick up the transmitter in the next zone and we shall have monkey chatter and heterodyne squeals as in our present broadcast structure.



of the completed receiver.

Not Hard at All

When seven meter circuits are first thought of we think of all the things that might make them ineffective but after trying several we find that they are no harder than the 200 meter circuits that the amateurs were forced to use at the advent of sound broadcasting.

And so we see packed into a small space a midget seven meter superheterodyne that is no more fussy than any of its well-known brothers doing service in our homes on sound broadcast wavelengths. A word of caution could be said though to constructors of the tiny sets on short waves. Don't use the chassis as a means to return ground connections. Make sure that all ground circuits are in copper wire returned to a single point of the chassis. This is good practice at any wavelength but is of importance on the micro waves. Grid and plate leads to local oscillators should be kept short as they have a choking effect if made long. By a little thought given to the layout these simple rules can well be taken care of.

In Fig. 2 a complete diagram with value of resistors, coils and condensers, is given. This receiver can be used at the present with a pair of telephones at points A—B to listen to the over eight hundred different amateur radio-telephones on five meters.

It is well to get the technique of handling these short waves as before the end of the year even in New York there will be pictures and we all want to know how to receive them.

Amelia Earhart Flight Aided by Radio Aboard

The recent flight of Amelia Earhart from Honolulu to this country amply showed the utility of carrying radio equipment. By means of the equipment in the plane, the aviatrix was able to take bearings in addition to being able to maintain communication regarding progress of the flight.

The equipment was capable of a transmitting range of 200 miles under the most adverse conditions and though consisting of a power generator, a transmitter with four 50 watt tubes, and a receiver for the beacon frequencies, weighed in total only 80 pounds.

This transmitter consisted of a 5-watt tube for a crystal oscillator, a 5-watt frequency doubler, and three paralleled 50-watters in the power amplifier stage. This final stage was then modulated by the remaining 50-watt tube as modulator. The total weight of this equipment was thirty pounds. The receiving apparatus used six tubes and was operative on the frequency band between 210 and 500 kilocycles, where most of the aviation traffic takes place. The weight of this equipment was only 17 pounds. Thus, the radio industry has progressed to the point where it can provide a reliable communication outfit that is quite light in weight, which is an important factor in aviation adaptations.

England's Television Start

Based on Hope of 240 Lines, 25 Pictures and Bright Cathode Ray System

THAT England decided to go ahead with television in the expectation soon of using the high definition type as developed in the United States with cathode ray oscilloscope tubes, is obvious from the official copy of the report of the Government committee that recommended England make a start as sooon as possible. The report of the Television Committee was presented by the Postmaster General to Parliament and recommends the establishment of a high-frequency television station in London under the auspices of the British Broadcasting Corporation, alternately using two systems, those of John Logie Baird and Marconi-E.M.I. Television Company, Ltd. This is stated to be only "a start," and in the beginning low definition television will be used, as that is all England has as yet, but only with the object of attaining high definition as soon as possible.

Moreover, as experience and technique are gained in the operation of this station, it is recommended that other stations be opened, and so that television coverage will be supplied to the island.

The committee favored making a start with the one transmitter at a cost estimated at £180,000 for equipment and a year's operation, without any extra license fee being inflicted on set owners.

What the Report Says

Extracts from the report follow:

As far back as the autumn of 1929 the B.B.C. gave the Baird Company facilities for experimental transmissions of television from a broadcasting station. During the next two or three years a large number of experimental transmissions were carried out by the Baird Company independently, as well as in liaison with the B.B.C.

Improvements were gradually made in the system, and in August, 1932, the Corporation arranged with Baird Television Limited for public experimental transmissions from their London Station (Brookmans Park) of television on a wavelength of 261 meters, and of the accompanying sound on a wavelength of 398 meters from the Midland Regional transmitter (Daventry). The Corporation agreed to provide special programme material and also staff for operating the television apparatus, which was installed in Broadcasting House by the Baird Company on a loan basis. These transmissions, the experimental nature of which was emphasized in a notice issued to the Press, have continued up to the present time, although their frequency has been reduced since 31st March, 1934, to two half-hour periods a week which are extended to three-quarters of an hour when circumstances permit.

In the case of these transmissions the size of the elements (elementary areas) composing the picture is such as to admit of transmission being effected in a series of thirty lines per picture and each picture is repeated 12½ times per second.

Admittedly Coarse

Any picture built up with a structure of the order of thirty lines are, however, comparatively coarse in texture. Little detail can be given, and generally speaking the pictures are only fitted for the presentation of "close-ups"—e.g., the head and shoulders of a speaker—and the quality of reproduction leaves much to be desired. Moreover, any frequency of the order of 12½ pictures per second gives rise to a large amount of "flicker."

Whilst low definition television has been the path along which the infant steps of the art have naturally tended and, while this form of television doubtless still affords scientific interest to wireless experimenters, and may even possess some entertainment value for a limited number of others, we are satisfied that a service of this type would fail to secure the sustained interest of the public generally. We do not, therefore, favour the adoption of any low definition system of television for a regular public service. We refer later to the question of the temporary continuance of the present low definition transmissions pending the institution of a public television service of a more satisfactory type.

With a view to extending the application of television to a wider field and thereby increasing its utility and entertainment value, much attention has been given in recent years to the problem of obtaining better definition and reduced "flicker" in the received pictures.

The degree of definition it is essential to obtain is necessarily a matter of opinion, but the evidence received and our own observations lead us to the conclusion that it should not be less than 240 lines per picture, with a minimum picture frequency of 25 per second. The standard which has been used extensively for experimental work is 180 lines, but we should prefer the figure of 240 and we do not exclude the possible use of an even higher order of definition and a frequency of 50 pictures per second.

To attain such degrees of definition and picture frequency, very high modulation frequencies are required, which in practice can only be handled by radio transmitters working on ultra-short waves the effective range of which is much more restricted than the range of the medium waves used for ordinary sound broadcasting.

The Tube System

For the reception of high definition pictures the cathode ray tube is now usually employed. The cathode ray tube receiver involves no moving parts, and the picture is presented as a fluorescence at the end of the tube. A stream of electrons (particles of negative electricity) is projected along the tube, and impinges on a coating of fluorescent material at the end of the tube, the impact of the electrons on the fluorescent material causing illumination. The amount of illumination can be controlled by varying the flow of electrons, and the point of impact can be changed by deflecting the jet by means of electric or magnetic forces. The jet is modulated or controlled in amount by the received signal, and suitable electrical circuits are provided to move the point of impact in exact synchronism with the transmitter.

The size of the picture produced naturally depends upon the size of the cathode ray tube. At present the most usual size gives a picture of about 8 in. by 6 in., although good results have been seen with larger tubes. The apparent size can, of course, be increased by viewing the tube through a suitable fixed magnifying device, though with a corresponding loss of definition. Experimental work is proceeding with a view to the projection of pictures on a screen of much larger dimensions, but this is still in an early stage of development.

We are informed that the price to the public of a receiving set capable of producing a picture of about the first-mentioned size, with the accompanying sound, would probably at first be considerable, and various estimates have been given ranging from £50 to £80; but it is reasonable to assume that, if and when receivers were made on a larger scale under competitive conditions, this price would be substantially reduced.

Impressed with Quality

Most of the high definition television systems follow in broad outline the methods of transmission and reception referred to above, with some variations in technique. We are impressed with the quality of the results obtained by certain of these systems, and whilst much undoubtedly remains to be done in order to render the results satisfactory in all respects, we feel that a standard has now been reached which justifies the first steps being taken towards the early establishment of a public television servcie of the high definition type in this country.

As regards the existing low definition broadcasts, these no doubt possess, as we have said, a certain value to those interested in television as an art, and possibly, but to a very minor extent, to those interested in it only as an entertainment. We feel that it would be undesirable to deprive these "pioneer lookers" of their present facilities until at least a proportion of them have the opportunity of receivin ga high definition service. On the other hand, the maintenance of these low definition broadcasts involves not only some expense, but also possibly considerable practical difficulties. We can only, therefore, recommend—

(1) that the existing low definition broadcasts be maintained, if practicable, for the present; and

(2) that the selection of the moment for their discontinuance be left for consideration by the Advisory Committee with the observation that, if practicable, so to maintain these broadcasts, they might reasonably be discontinued as soon as the first station of a high definition service is working.

Scope of Television

In our opinion there will be little, if any, scope for television broadcasts unaccompained by sound. Television is, however, a natural adjunct to sound broadcasting and its use will make it possible for the eye as well as the ear of the listener to be reached. Associated with sound it will greatly enhance the interest of certain of the existing types of broadcast and will also render practicable the production of other types in which interest is more dependent upon sight than upon sound.

We are of the opinion that there are two factors which for a number of years will tend to prevent a television service being made use of to the same extent as present day sound broadcasting—

(1) The difficulties of wireless communication on ultra-short wavelengths, particularly in hilly districts, may seriously limit the extent to which the country can be effectively covered.

(2) Some time is likely to elapse before the price of an efficient television receiver

will be comparable with that of the average type of receiver now in use for sound broadcasting.

Nevertheless, the time may come when a sound broadcasting service entirely unaccompanied by television will be almost as rare as the silent cinema films is today. We think, however, that in general sound will always be the more important factor in broadcasting. Consequently the promotion of television must not be allowed to prevent the continued development of sound broadcasting.

No doubt the evolution of television will gradually demonstrate the possibility of its application for many purposes other than those of entertainment and illustrative information.

Ultra-Short Waves

As previously mentioned, the transmission of high definition television is practicable only with ultra-short waves, and a wide band of frequencies is necessary. Fortunately, there should be no difficulty, at present at all events, in assigning suitable wavelengths in the spectrum—between 3 and 10 meters—for public television in this country, although in allocating such wavelengths regard must, of course, be paid to the claims of other services. The recent experimental work has been conducted upon wavelengths around 7 meters.

Technically, it is desirable that the transmitting stations should be situated at elevated points, and that the masts should be as high as practicable, consistent with any restrictions which may be deemed necessary by the Government. The mast at present in use in Berlin is about 430 feet high, and the question of employing masts of greater height is under discussion in Germany. Quality of reception varies, of course, with the location of the receiving station and the nature of its surroundings. It may be observed that reception of these ultra-short waves does not seem to be materially affected by atmospherics. The most frequent sources of interference appear at present to arise from some types of electro-therapeutic apparatus, and from the ignition systems of motor cars; but we understand that it is possible to prevent or reduce certain types of such interference by simple remedial devices.

Short Range

Present experience both here and abroad seems to indicate that these ultra-short waves cannot be relied upon to be effective for a broadcast service much beyond what is commonly called "optical range." Generally speaking, it is at present assumed that the area capable of being effectively covered by ultra-short wave stations of about 10 kilowatts capacity will not exceed a radius of approximately 25 miles over moderately undulating country. In more hilly districts this may be considerably reduced, and indeed in certain areas an entirely reliable service may be impracticable. It is clear, therefore, that unless and until the effective range be increased, a large number of transmitting stations would be required to provide a service covering most of the country, though we think that with 10 stations, probably at least 50 per cent. of the population could be covered from suitable locations.

Service Men's Sessions Increased by RCA

RCA announced the inauguration of a new series of meetings for servicemen to begin at once and extend until more than 150 towns and cities have been covered. The new meetings, one in each city, will be concerned with antenna systems. RCA technical experts wil trace the history and development of antenna beginning with Hertz's experiments down to the present-day systems, including an analysis and demonstration of the double-doublet type.

Brighter Screen Sought for Cathode Ray Tube

Though Nipkow's discovery, made during the nineteenth century, of his celebrated disc with spirally disposed holes proved to be the really first practical television system and also even though adaptations of his system are still quite generally used, RCA Victor, Philo T. Farnsworth, Baron Manfred von Ardenne and others are concentrating on electrical systems.

Since the cathode ray tubes that are used for oscillograph purposes transform electrical energy into light energy, it is possible, to a limited extent, to adapt these versatile instruments to the purposes of television, which likewise requires a means of transforming electrical energy into light energy, although the present available tubes are not sold for television purposes.

The cathode ray tube evolved from a great many experiments and development stages. Its modern form is quite an improvement over the rather crude forms of other days. It has evolved into a number of different types with screen diameters that range from 3 inches to 9 inches and which are of the hot cathode, high-vacuum type. The different types permit of either electrostatic or electromagnetic deflection of the beam.

The control elements of the cathode ray tube have at various times been called an electron gun and consist of the cathode, control electrode, accelerating electrode and focusing electrode. These elements serve to generate and control the electron beam which is sprayed past the deflection plates or coils on its way to the fluorescent screen that converts the electronic bombardment into light.

This conversion ability of the screen is due to its composition—a mixture of zinc silicate and calcium tunstate. The spot of light on the screen that results from this beam can be regulated as to size and intensity by a suitable choice of voltages on the various electrodes of the electron gun. Since deflection of the beam is what creates a pattern on the screen and since this objective is attained by the a-c voltages on the deflecting plates or coils, the outputs of our television amplifier and scanning amplifier are fed to these respective electrodes to produce the image upon the screen. In the diagram there is illustrated the manner in which three different types of modern commercially produced cathode ray tubes may be connected to form television images and the possible maximum size of picture that is associated with the various screen diameters is clearly shown.

It has been postulated by medical authorities that green is more restful on the eye than red. Yet, some persons insist upon black and white pictures.

A little consideration of both these defects reveals that the difficulty lies in the screen rather than in the tube itself. And so it would seem that deeper research is necessary in the matter of substances that are suitable for screens. The present zinc silicate-calcium tungstate screen could most likely be replaced by some other material or combination of materials which would produce black and white.

It might therefore be boiled down to the bald fact that cathode ray television awaits the cathode ray tube that is especially designed for television purposes with an tensely bright screen rather than trying to adapt present cathode ray oscillograph tubes to such purposes.

6.3 Push-Pull Output Triodes in One Envelope

National Union Radio Corporation announces a new tube, the 6E6, a heater-cathode type of tube combining two low-mu output triodes in one bulb. It is intended for use in the output stage of automobile radio receivers or a-c operated radio receivers. The triode units have separate external terminals for all electrodes except the cathodes and heaters, thus permitting the triode units to be operated either in parallel, or push-pull.

The 6E6, although primarily designed for push-pull service, may be used in single tube service without the second harmonic distortion exceeding 5 per cent. In the case of parallel operation of the triode, the proper load resistance is one-fourth of the plate-to-plate value given under "Characteristics."

It is preferable that grid voltage be obtained from a self-biasing resistor in the cathode circuit. For 250 volt operation, this resistor should be 770 ohms, while for 180 volt operation, it should be 870 ohms. For parallel tube operation, the resistor should either be heavily by-passed, or a suitable filter network be installed to prevent excessive degeneration at the lower frequencies. Transformer or impedance coupling to the grid circuit is recommended. Where a grid resistor is used with any type of input coupling, the resistance should not exceed 0.5 megohm per grid where self-bias is used. With fixed bias, the resistance should not exceed 100,000 ohms.

The base pins of the 6E6 fit the medium seven contact socket (0.855 inch pin-circle diameter) which may be installed to operate the tube in any position. Sufficient ventilation should be provided to permit of free air circulation around the tube to prevent overheating.

Characteristics

Heater Voltage (A.C. or D.C.)	6.3 Volts
Heater Current	0.6 Amperes
Bulb	ST-14
Base	Medium 7-pin
Maximum Overall Height	4-11/16"
Maximum Diameter	1-13/16"

Typical Operation

Plate Voltage	180	250	Max. Volts
Grid Voltage	—20	—27.5	Volts
Plate Current	11.5	18	M.A. per Plate
Mutual Conductance	1400	1700	Micromhos per Triode
Amplification Factor	6.0	6.0	
Plate Resistance	4300	3500	Ohms per Plate
Load Resistance	15000	14000	Ohms plate to Plate
Undistorted Power Output	0.75	1.6	Watts per Pair of Triodes

Relay Optical Systems

And Other Experiments with Light-Sensitive Cells

By Samuel Wein

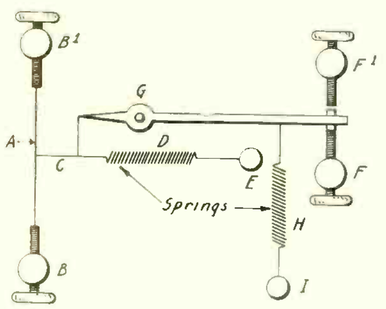


FIG. 11

[Herewith is the second and concluding instalment on a series of fifteen experiments with photo cells and relays. The first instalment was published last week, issue of February 23d.—EDITOR.]

EXPERIMENT 9
Hot Wire Relay

This form of relay was derived from the Lord Kelvin radio frequency meter. This consists of a .005 silver wire (A) 2½" long between two adjustable posts B and B', the wire C is in this case No. 34 copper. D is a spring. E is the tension screw, F and F' contact screws, G armature, H copper wire, and I is for adjustment. See Fig. 11.

When wire becomes heated it expands, allowing D to take up the slack. When pressure is released on D it is increased on H which pulls the armature against F.

This relay must always be critically adjusted.

EXPERIMENT 10
Concerning the Light Source

The experiments about to be described can be carried out at a distance between the cell and the light source, which depends directly on the intensity of the light source used and the proper adjustment of the relay. In other words, if the relay is properly adjusted and the light source is sufficiently intense, the distance between cell and the light source may be many yards.

One may use either direct or reflected

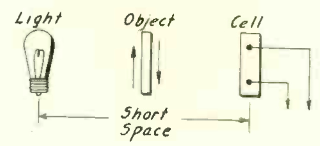


FIG. 12

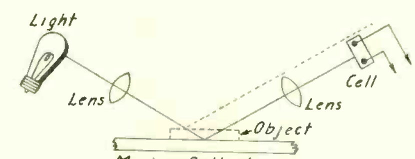


FIG. 13

light, but it must be remembered that every time the light is reflected, a portion of the light intensity is reduced and so a more intense light beam is required at the outset to off-set this loss of light, and the relay must be adjusted for this loss of light.

In Fig. 12 we see the opaque or translucent object intercepts the light source falling on the cell.

In Fig. 13 we see the light source concentrated as by means of a lens onto the moving object, and the light reflected from the object is again picked up by means of another lens and the light now falls on the cell.

These two diagrams should give one an elementary idea as to the essentials necessary for light falling on a cell to get the best and most consistent results.

EXPERIMENT 11
Light Projection

The distance over which the cell and relay can be successfully worked depends upon the length of the optical system used. In Fig. 14 is seen diagrammatically how an ideal optical system functions, designed primarily to function with the "AM" cell. It must be remembered that a beam or ray of light originating from the light source does not travel parallel but continues to spread and so little effect would be produced on the cell. To offset this an optical system will cause a greater light change over the surface of the cell, and so give rise to a greater electrical or photo potential.

Here see the 32 candle power lamp fed from the secondary of a transformer. If d.c. is the source of e.m.f. intended to supply the current to the lamp, then a suitable resistance is interposed in the current source.

If the source of illumination is small the effective distance over which the light can affect the cell is small, and conversely if the light source is increased so can the distance between the cell and the illuminant be increased. In this connection it may be interesting to note that Prof. Alexander G. Bell spoke over a beam of light a distance of several hundred feet as early as 1884, and this feat was duplicated years later by Dr. Case between the Woolworth Building in New York City and Auburn, N. Y.

The optical system is one commonly used in throwing a beam of light over a given distance, with the exception of the mirror for throwing the beam of light at any angle. Of course here we can use a second and third mirror to throw the beam at other angles, not shown in the diagram.

The light filter is made of a colored piece of glass or gelatine to pass only those portions of the light source as affect the cell and not yet visible to the naked eye. This then makes it possible to affect the cell by so called "invisible light."

EXPERIMENT 12
Biasing Out the Dark Current

Many experimenters find it useful to bias out the dark current, which is sometimes sufficiently large to interfere with the proper functioning of the relay. By biasing out this dark current we merely inject a potential in the circuit which opposes the potential that is objectional to the proper functioning of the unit or meter in the circuit under experiment.

In Fig. 15 we see just such a circuit, using batteries in both the cell circuit and in the biasing means as well.

In Fig. 16 we see the cell circuit uses the 110 volt line circuit, and the biasing means uses a battery in its circuit.

In Fig. 17 we see the completed unit as seen in Fig. 16, the entire unit being housed in a wooden case.

EXPERIMENT 13
D-C Type Unit

In Fig. 18 we see a complete unit using the circuit seen in Fig. 19. The relay

(*Continued on next page*)

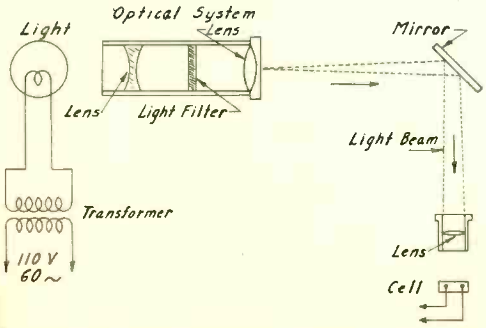


FIG. 14

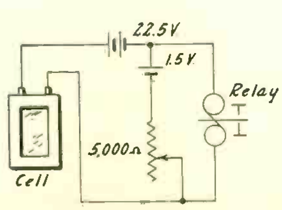


FIG. 15

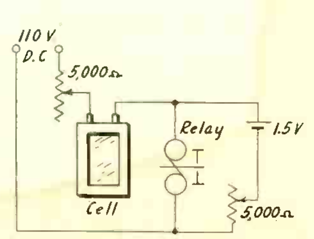


FIG. 16

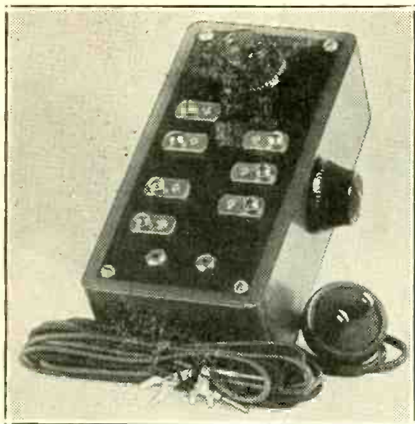


FIG. 17

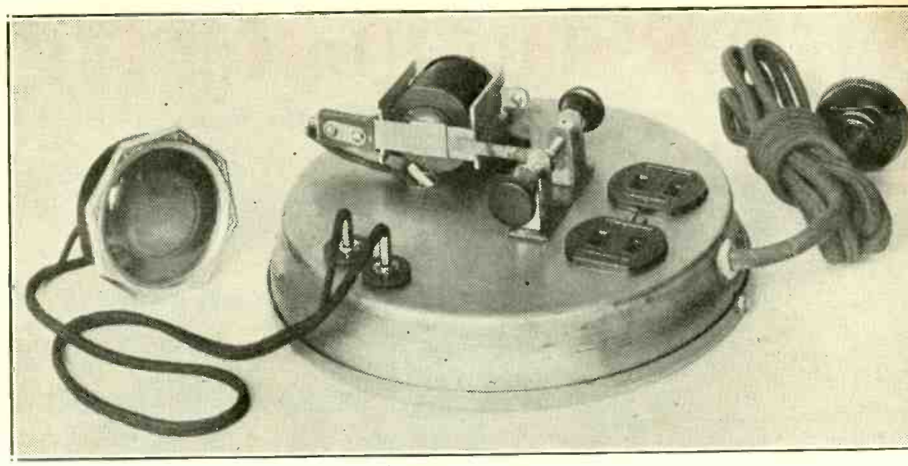


FIG. 18

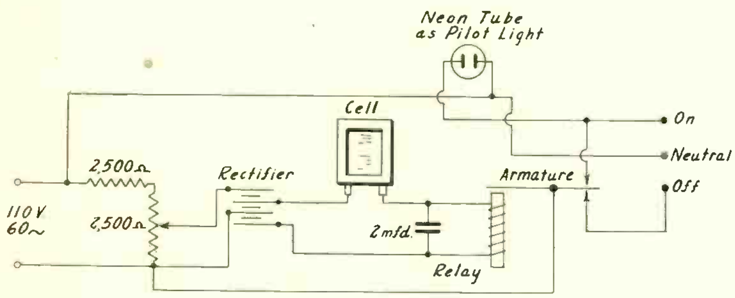


FIG. 19

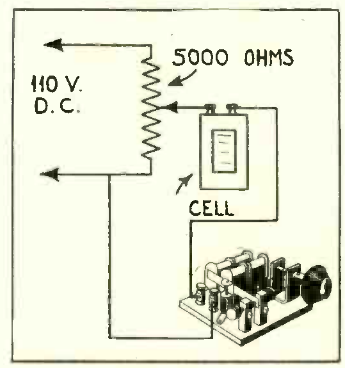


FIG. 20

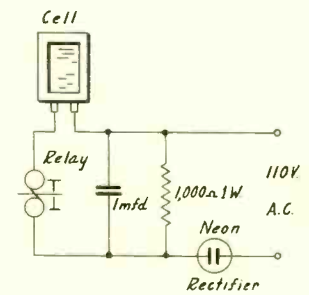


FIG. 21

(*Continued from preceding page*)
coil has a resistance of 1,000 ohms. This outfit makes a neat appearing model. The cell proper in this unit was placed in a hexagonal shaped case.

EXPERIMENT 14
Using Meter Rectifier in the Cell Circuit

In Fig. 20 we see a complete unit using a d-c type relay operating from a rectified a-c source, the current reduced through proper resistances. The rectifier used is that commonly applied to meter purposes. All of the constants of the various parts in this unit are readily seen in the drawing. The use of this rectifier makes an inexpensive and simple unit, particularly if the experimenter has on hand a d-c type of relay and is desirous of using a-c in the circuit.

EXPERIMENT 15
Gaseous Rectifier Use

In Fig. 21 we see a circuit using a neon type of gas conduction rectifier with the AM type of cell.

A diode type of tube (filament and plate) may be used with equal results in the place of the foregoing type tube, if the gaseous type of tube is not available.

Radio University

Pipe Antenna

I INTEND ERECTING an antenna for transmission purposes. One of these vertical copper gutter pipe antennas has been recommended to me. I've wondered whether this antenna can be improved upon by changing its circular cross section to the cross section of a six pointed star. Would the improvement warrant the effort?—H. K. M.

Though the efficiency of an antenna for transmission purposes is improved by reducing its r-f resistance (what you are doing by increasing the surface area), the expense of forming a pole of this sort is not commensurate with the results. Also the soldered joints that are introduced by this action may even make such an antenna less efficient than a cylindrical gutter pipe. It would therefore seem that the cylindrical gutter pipe is preferable. If you desire to try something that has not been utilized much you might try to cover your antenna pipe with a multitude of sharp points all over its surface, putting that principle of physics into practice that states that a point will radiate better than a curved surface.

* * *

Transmission Line Quandary

WHY DOES THE characteristic or surge impedance of a transmission line remain constant regardless of its length?—J. M. B.

The very definition of surge impedance explains this seeming impossibility. The surge impedance of a line is defined as being that impedance of a line that is infinitely long but spaced the same amount and of the same wire size as the line under consideration in the particular instance. Thus, if a finite portion of this infinitely long line is removed, the line will still be infinitely long from the very definition of infinity. It can be seen from this that the impedance of this infinitely long line will accordingly be the same. Let us represent this impedance as Z_0. Now, suppose we reconsider the finite length of line that we have just removed. If we connect across the output of this finite line, a load whose impedance is equal to the surge impedance or the impedance of the infinite line, we have a finite line that will display the characteristics of an infinitely long line since the output load's impedance is the same as the impedance of the infinite line. Of course, the finite line does not know that it is feeding a finite load rather than an infinite line and so conditions exist just as if there was an infinitely long line. Therefore we can summarize this by saying that whenever a finite length of transmission line is terminated in its surge impedance, its length is of no concern.

* * *

Antenna Insulation

SHOULD A PIPE antenna be insulated from its supporting pole?—H. K. M.

Yes, the antenna should be insulated from all objects except the feeders in order that it may be electrically as far from ground potential as possible. This has been handily accomplished by mounting the lower end of the vertical pipe over the mouth of a closed milk bottle (closed so that rain will not accumulate). If the diameter of your pipe is bigger or smaller than the diameter of the milk bottle, any other suitable glass bottle could be utilized that will separate the bottom of the antenna pipe from its supporting pole.

* * *

Reducing Resistor

WHAT SIZE SERIES RESISTOR is necessary to reduce the 6.3 volts available from a filament transformer to feed two tubes requiring a potential of 2.5 volts?—O.W.

From the meager information you furnish the question cannot be answered. The 6 volt tubes require a much smaller current than do the 2.5 volt variety and so a 6-volt transformer might be unable to handle the larger current. For two 1-ampere 2.5 volt tubes the resistor should be 1¾ ohms.

* * *

Wave Band Switches

PLEASE RECOMMEND a good make of wave band switch.—R. A. P.

A good wave band switch should possess a small capacity between banks so that the effect of one bank upon the other is negligible. Switches made by Oak, Yaxley, Soreng-Mangold and Central Radio Corporation are highly satisfactory, and no doubt others make switches in the same category.

THE TREND OF THE TRADE

Conducted by
Herbert E. Hayden
Trade Editor

Radio Tax in 1934 Yielded 35.6% More than in '33

The U. S. Internal Revenue Bureau collections on the 5 per cent. excise tax on radio and phonograph apparatus during December 1934 were $568,117.99, according to official government reports and brought the total of 1934 tax collections to $3,520,855.47. This was an increase of 35.6 per cent. over the total excise tax collections of 1933 which were $2,596,612.29.

As a barometer of radio industry sales, the excise tax collections showed a greater increase during the first six months of 1934. This increase was 54.8 while the increase in the last six months' period of 1934 was 23.1 per cent over the similar period of 1933.

Since institution of the excise tax law June 20, 1932, the radio industry has paid $7,301,977.82, and the 5 per cent. tax promises to be continued by the new Congress. Detailed figures on the 1934 radio excise tax collections follow:

Calendar Year 1934

January	$415,358.83	
February	272,335.09	
March	268,136.45	
April	202.301.98	
May	234,010.60	
June	190,275.47	
Total Six Months		$1,582,418.42
July	$ 92,007.81	
August	229,681.76	
September	305,291.91	
October	280,699.11	
November	462,638.47	
December	568,117.99	
Total Six Months		$1,938,437.05
Total Calendar Year		$3,520.855.47

Car Sets "Automotive" for Tax, Radio for Code

Automotive receiving sets sold by jobbers and dealers are subject to the supplemental code for radio wholesalers, according to an interpretation of NRA Divisional Administrator Brady.

The ruling does not apply to manufacturers selling automotive sets, as such manufacturers are subject to the electrical code. Although the Internal Revenue Bureau in administering the radio excise tax law has ruled, for taxation purposes, that automobile sets are automotive accessories, for NRA code purposes they are ruled to be radio rather than automotive products, at least when sold by distributors and dealers.

Electrical-Radio Show in N. Y., Sept. 18 to 28

Joseph Bernhart, long associated with Madison Square Garden as booking manager, will be the show manager of the 1935 National Electrical and Radio Exposition, to be held at Grand Central Palace, September 18th to 28th, inclusive. The exposition will be sponsored by the Electrical Association of New York, Inc.

ASSIGNMENT BY EGERT

WIRELESS EGERT ENGINEERING, INC., at 179 Varick St., dealer in electrical instruments, has assigned to Charles Glogower of 223 East 4th St., Brooklyn, New York City.

100,000 Questionnaires Mailed to Rural Owners In Quiz on Reception

A test of radio reception in rural and remote sections of the country is being made by the Federal Communications Commission in co-operation with the National Association of Broadcasters. It has sent 100,000 postcard questionnaires to farmers and others in sections selected to test the efficiency of broadcasting on the forty clear channels from coast-to-coast and the necessity for maintenance of clear channel broadcasting. The postcards bear three questions:

1. Do you own a radio set? If so, what is its make, model number, number of tubes, when purchased, and is it now in good operating condition?
2. Name your four favorite radio stations by call letters in the order of your preference.
3. What is your postoffice address?

An engineering survey has been begun by the Commission and the NAB involving an expenditure of about $60,000, largely borne by the broadcasters.

Literature Wanted

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

D. E. Smith, 370 Cypress Ave., Bronx, N. Y.
W. F. Nichols, Jr., 4209 N. Central Pk Ave., Chicago, Ill.
Charles M. Clark, 61 South St., Union City, Pa.
South Highland Radio and Supply Co., 1314 S. Edith St., Albuquerque, New Mexico.
Lawrence L. Goth, 644 S. 2nd St., San Jose, Calif.
Fred Ebeling, 1514 Upson Ave., El Paso, Tex.
Valentin Kleynen, 37, Rue Clementine Straat, Antwerpen-Anvers.
William C. Fleming, 2631½ Walton Way, Augusta, Ga.
O. V. Murphy, 239 Chestnut St., Newcomerstown, Ohio.
Fred Pranschke, 110 E. Walnut St., Denison, Iowa.
B. G. Radin, 27 Clairmount, Detroit, Mich.
Norman W. Smith, Smith Radio Service, Box 273, Jamestown, N. Y.
A. A. Stoll, c/o Carters Clothes, 4th & Ludlow Sts., Dayton, Ohio.
R. C. Travis, 408 N. Dean, Bay City, Mich.
David S. Tall, c/o Wm. Lang, 4512 So. K St., Tacoma, Wash.
Frank Turner, 3 Waterloo St., Halifax, N. S.
Preston Willis, Box 922, Jenkins, Ky.
Carl F. Weber, 1423 Harvard, Apt. 9, Washington, D.C.
Geo. S. Brooker, 632 2nd St., Douglas, Ariz.
S. T. Stueland, 2147 Market St., La Crosse, Wis.
Paul Wallace, Radio Service, Montrose, Colo.
Ben Michaels, 146 Fuller St., Somerset, Pa.
Clyde W. Sealock, 1851 Lobdell Crt., Los Angeles, Calif.
Julius F. Baron, 2706 Maple St., Detroit, Mich.
E. Allen, 585 Buena Vista Ave., San Francisco, Calif.
Lyle Allen, 5241 S. Kenneth Ave., Chicago, Ill.
J. W. Anderson, 506 N. Webster St., Saginaw, W. S., Mich.
J. Baird, 103 Richmond Road, Westboro, Ont., Canada.
W. H. M. Bartlett, c-o Winnipeg Hyrdo Electric System, Winnipeg, Man., Canada.
Robert R. Burke, White Oak Hotel, Greensboro, N. C.
Fred Borozny, R. F. D., Cumberland Hill, Manville, R. I.
Walter L. Baxter, 602 Robbins Ave., Lawndale, Phila., Pa.
I. C. Lewis, Tulsa, Okla.
A. A. Cooper, 3015 Atlantic Avenue, Atlantic City, N. J.
Edgar Canfield, 2781 Hampshire Road, Cleveland Hts., Ohio.

Goldsmith Heads Industries Board on Interference

Organization by Radio Manufacturers Association of an inter-industry committee on radio interference has been effected. Dr. Alfred N. Goldsmith is chairman of the committee which includes representatives of the U. S. and Canadian government commissions, associated radio and also electrical organizations. Reduction of man-made noises which interfere with radio reception is the objective of the committee.

The first meeting of the committee will be held March 8 at the Hotel New Yorker in New York City. Last November at a general interference conference at Rochester, N. Y., the RMA arranged for the inter-industry committee. the present organization membership of which follows:

Federal Communications Commission
U. S. Bureau of Standards
Canadian Department of Marine
RMA of Canada
National Association of Broadcasters
Society of Automotive Engineers
National Electrical Manufacturers Assn.
American Institute of Electrical Engineers
Institute of Radio Engineers
Radio Wholesalers Association
American Radio Relay League
Institute of Radio Service Men
Radio Club of America
O. H. Caldwell (Member at Large)
R. D. Duncan, Jr. (Guest Member)

In addition the American Standards Association will cooperate with the committee.

Set Makers Invoice Figures Are Doubled

Statistics of sales of radio products for the first six months' period, January 1 to June 30, 1934, compiled from manufacturers' reports filed under the NRA code for the electrical manufacturing industry, record a large increase in sale of radio sets, parts and accessories over the similar six months' period of 1933.

According to the statistics, radio industry sales for the first six months of 1934 totaled $49,407,000 at manufacturers' invoice prices, compared with $31,311,000 during six months ending June 30, 1933. Set sales represented $24,925,000, about double the 1933 period. The statistics did not include reports from a number of radio manufacturers and some radio products were not segregated from similar electrical products, leaving the statistics incomplete but still of some comparative value.

B. W. BULLOCK APPOINTED

B. W. Bullock has been appointed assistant manager of the General Electric publicity department, Schenectady, N. Y. Mr. Bullock also becomes assistant manager of broadcasting for General Electric. Mr. Bullock had been assistant to Chester H. Lang, manager of the General Electric publicity department.

COLLING GETS RCA POST

Ernest S. Colling, for the last two years with the National Broadcasting Company, was transferred to the Radio Corporation of America, RCA Building, Radio City. He is now in the Department of Information of that company, under Frank Mullen.

OVER THE COUNTER

Commenting on the increased dollar volume of receiver sales, Jack Grand, of Sun Radio, 227 Fulton Street, New York City, said: "Increased sales of console models are building up the dollar volume. Better programs have an effect on this sales increase. Also, the wider acoustical band of frequencies covered by the 1935 console sets is attractive to persons who are tone conscious. This does not mean that small sets are not selling. They meet a definite need, but can not reproduce the full depth of tone, due to baffle restrictions."

* * *

Stores fail to render full service if they do not cater to amateurs, in the opinion of Michael Kranz, of Thor Radio Corporation, 167 Greenwich Street, New York City. Mr. Kranz is one of the recognized authorities of retail merchandising. "A store should carry everything from a spool of heavy wire for winding transmitter coils to steel racks and panels for housing complete outfits," he said. "We have them all." By carrying a large and varied stock, Thor has been able to build up a nation-wide amateur business.

* * *

Portable sets are beginning to be shown in retail store windows.

* * *

Blan the Radio Man, 177 Greenwich Street, New York City (in private life Michael Blan), has a window display consisting of a vari-colored disc with numbers on it that revolve clockwise until one puts his hand on the outside of the window pane, over a certain spot, when the direction of disc rotation is reversed. The window shopper's skill in selecting specified numbers may be tested also. The system uses a photo cell and relay.

* * *

Dealers who have been hesitant about carrying high fidelity sets because of the magnitude of the commitment are losing sales, as there is considerable public buying of this type of instrument, when one allows for the price question. At present Philco and Stromberg-Carlson high fidelity sets are offered in stores, each representing a different engineering method of achieving a given result. As one example, Philco uses a single speaker of special acoustical range, while Stromberg-Carlson uses two speakers, the small one, or tweeter, being switched out if desired, for relative bass accentuation, although there is an additional tone control.

* * *

Wide public interest attaches to devices for eliminating interference. Numerous products are on the market, but few of them afford sufficient variety of service to be able to cope with the numerous interference problems, mainly locally generated noise. By disconnecting the antenna one discovers that in nearly every instance the noise disappears, so the solution seems to lie in antenna filters. It is hoped the inter-industry interference conference will do some engineering in this important direction, instead of confining itself exclusively to "co-operation."

* * *

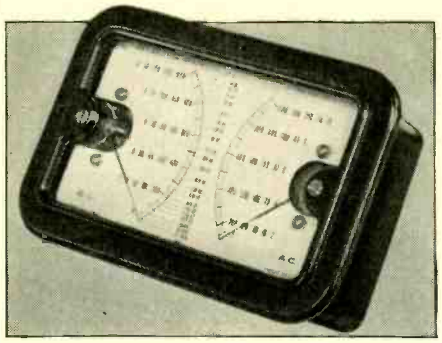
A good market is reported for radio devices selling for less than a dollar that perform a definite service.

HERBERT E. HAYDEN.

MORE BATTERY SETS

Battery sets enjoyed an increased sale during 1934. Sales of battery sets last year aggregated about 300,000, according to the best information available and are regarded as another evidence of increased rural purchasing power.

Triplett Master Meter Foundation in Kit Form



The instruments used in the Triplett Master Meter.

The Triplett Electrical Instrument Co., of Bluffton, Ohio, announced that its No. 1200 Volt-Ohm-Milliammeter is now available in kit form and is designed for use with built-in shop equipment. This announcement will be of interest to service men who desire to build their own instruments, or who want instruments to meet special space and installation requirements.

The 1200 Volt-Ohm-Milliammeter in kit form is identically the same as the Master Model except that it does not have the panel, the adjustable feature on the meter, the batteries or case, but does have index marking. It is furnished complete with all shunts, resistors, condensers, coils, drilling template, blueprints and instructions.

National Union Produces Cathode Ray Oscilloscope

National Union Radio Corporation of New York announced the production of a cathode ray oscillograph for use in the radio service-dealer field.

The features of the new instrument include the use of National Union cathode ray tubes of the high vacuum electron lens focus type with high intensity short persistence screen in either the 3-inch or the 5-inch diameter size. It is designed to permit operation up to 100 megacycles, has linear sweep circuit covering the audio frequency range, controls for rough and fine frequency adjustment, synchronization and sweep amplitude, two single stage amplifiers with a simple switching arrangement enabling one stage to be used on either axis or two stages on one axis, patented calibrated scale so accurate quantitative measurements can be made and a power supply which furnishes all necessary voltages for cathode ray tube, sweep circuit and amplifier.

The new National Union cathode ray oscillograph is made available to the trade on either an outright purchase basis or with the purchase of National Union radio tubes on one of National Union's regular shop equipment contract offers.

Regular Dividend Declared on RCA Preferred "A"

The regular quarterly dividend on the "A" preferred stock of the Radio Corporation of America for the first quarter of the year 1935 was declared by the Board of Directors. The dividend is 1.75 per cent. for the quarter, amounting to 87½ cents a share. It is payable on April 1, 1935, to holders of record of the stock at the close of business on the first day of March, 1935. A dividend covering all the previous arrears on the "A" preferred stock to December 31, 1934, was previously declared.

American Sets Demanded Abroad; Export Rise Seen

By ARTHUR PUDLIN
General Export Manager for Materials Disposition Corp.

After a thorough field survey of the foreign markets on the Eastern Hemisphere, the thing that struck me most was the demand for American made radio products. As a matter of fact, it is admitted by the foreign set manufacturers that the American method of building sets is at least three years in advance of the most modern European radio receiver. Also radio parts as manufactured in this country are accepted as standard in all foreign countries.

ARTHUR PUDLIN

A good many of the European manufacturers who have visited the radio factories in the United States are amazed at the mass production method used in making radio sets. One plant which I visited in England employs 700 persons and turns out 1200 sets a week. With a force of one-half that number, 1200 sets can be produced in a day in this country.

The general public in the foreign countries is not satisfied unless the radio receiver is of American make. The European sets are built as we built them in this country in 1925 and while they are gradually catching on to our idea of making radios, by the time they reach one stage, we are already four or five steps ahead of them—meaning thereby, that they are always behind us by at least three years.

In France, while the quota system is used for customs, it is found that due to the large demand for American radios, the government is a little more liberal than usual in this particular field.

Holland has a tremendous request for parts, the set situation being covered by licenses and controlled by one company, the Philipps Company of that country.

The situation in Germany at the moment is very depressed due to general economic conditions.

In Spain it is very rare that any other than an American set is used.

Italy uses roughly 40% American sets throughout the country; Poland 60%; Scandinavian countries about 60%; Belgium 45%; Czechoslovakia and Roumania 30%; India 60%; Persia 20% and Palestine 18%. Throughout all the English colonies there are used about 45% American radio sets.

There should be a tremendous increase in American exports to these countries. The statement made by the Department of Commerce in the report for 1934 shows the tremendous increase over 1933 and there are great possibilities for the year 1935.

Since the British Broadcasting Corporation made an announcement in the latter part of January in reference to television, the people of all Europe are looking forward to advancement in that direction.

ALUMINUM PAPER FOIL

Do you know that aluminum-coated paper is obtainable and may be used effectively for shielding in radio work? Suppose you want to set up a structure, using scissors and cement, something that can be adhered to any surface? The Trade Editor can tell you about that.

Station Sparks

By Alice Remsen

CHASE & SANBORN GET IT

"One Man's Family," that popular radio series of American family life, waited a long time for a sponsor; finally a little known cigarette made use of its extremely large audience, but did not renew the contract; however, Chase & Sanborn realize the tremendous value of this feature, and on April 3rd "One Man's Family" starts broadcasting in the interests of Tender Leaf Tea. At present this feature is being presented as a sustaining program by NBC each Sunday at 10:30 p.m. . . . Babo-o has a new line-up to follow their Surprise Parties, the program is still featuring Mary Small, but there is a new conductor, Bertrand Hirsch, and a mixed group of singers, with, of course, the usual guest artists. The time is still 1:30 p.m. on Sunday, WEAF and network. . . . Ruth Etting has gone daytime; she was heard on one of those International Week-End Revues, recently organized by NBC for the benefit of the listeners over in dear old England. These programs may be heard in this country also, each Saturday at 11:45 a.m., over an NBC—WJZ network. . . . A new series of six programs is now being broadcast over NBC networks via WJZ on Sundays at 10:30 a.m. emanating from large cities throughout the country. Bringing young singers and instrumentalists in elementary high school and glee club orchestras to the microphone, this series will demonstate the work being done in public school music. Among the cities represented are Detroit, New York, Philadelphia, Boston and Cleveland. Presented under the auspices of the Music Educators National Conference, the program will be called, "Music and American Youth." . . .

THAT'S WHAT'S IN A NAME

Don't let anyone tell you there is nothing in a name, is the advice of Andy Love, twenty-three-year-old pilot of NBC's Tune Twisters.

The Tune Twisters are a prep school harmony team graduated to big time radio and vaudeville. Love, Jack Lathrop and Bob Walker started singing together six or seven years ago when they attended the same school near New York. . . .

They thought they were pretty good, but never considered themselves material for radio or vaudeville. When they left school Love started a medical course at Wisconsin University, Lathrop attended a college in New York, and Walker got a job. Two years ago, Love suggested to Lathrop and Walker that they try to commercialize their old prep school trio. . . .

No one seemed much interested in the trio as Andy, Jack and Bob, or any other name they seemed to choose for themselves. Love grew a little discouraged and took a job as soloist with Paul Whiteman's band. . . .

One day Love decided to audition his trio at NBC. He got the audition. An NBC executive was listening—here was a find. . . .

"What do you call yourselves?" he asked Love. "You sure are some tune twisters." . . .

"That's our name, we're the Tune Twisters," Love grinned. . . . And so they are. . . .

CANDID CAMERAGRAPH

FRED ALLEN . . . poker-faced comedian of radio, looks like Gene Tunney, but more bland, insouciant, dour . . . steps to the microphone chewing gum . . . white handkerchief folded in a triangle juts out from a breast pocket . . . does things with his hands; wrings them slowly, deliberately . . . smacks fist of one hand into palm of other . . . folds arms . . . opens double-breasted coat, plunges hands deep into trousers pockets . . . slides thumb and index finger of left hand slowly up and down nose—it's his favorite gesture . . . left hand hangs loosely at his side, chews slowly . . . speaks his "newsflashes" into inverted end of megaphone, to give the canned "talkie" effect . . . when applause cue misses he nifties: "Don't bother with the reception if it slips your mind" . . . wrinkles forehead, arches brows as he reads script . . . his chuckles sound a bit studied . . . sways slightly from side to side . . . never taps feet in time with music . . . during announcements walks over to sound effects man . . . for a glass of water from the silver thermos bottle . . . drinks slowly . . . yanks up socks . . . cast goes to microphone, Allen stands opposite them . . . like a silent director . . . surprises cast by injecting an unsuspected line into script . . . much laughter.

Broadcast over, he hurriedly jams script into a leather zipper folio . . . his actors carry away their scripts, or rip them on stage after show . . . with his wife, Portland Hoffa, he patiently accomodates autograph-seekers . . . a facetious ad-libber . . . and one of the most subtle of all air funsters.

A THOUGHT FOR THE WEEK

WILLIAM A. BRADY, NOTED AMERICAN MANAGER, is all agog over the possibilities of television. He sees television as the "third shift" from the old-time amusement device of the talking cast in the flesh, physical scenery, beautiful or otherwise, and the play that was written instead of merely being something figured out by technicians. We already have had the motion picture, still and noisy, and now along comes television to give the public still another thrill and a new interest for the box office procession—although in this case much of the money taken in at the gate will probably be for radio sets that will please the eye as well as the ear.

Mr. Brady, who surely cannot be said to be a dreamer without any practical experience in figuring out what the public wants, asserts that film producers are the men who will be largely interested, financially and otherwise, in pushing television ahead because they are today the men most interested in making Broadway theatrical productions, and they are so sure that television is going to be around the w.k. corner that they are sure to tie up the television and all mechanical rights of these new plays.

Mr. Brady, still with the enthusiasm that was his several decades ago, says the newest radio development will probably mean the scrapping of several millions of dollars' worth of present-day broadcasting material but that in this instance it will be a great thing for the rebuilding of the American stage, just as the widespread popularity of pictures and radio has been the means of bringing the older stage from the nth degree of interest and success to the nth degree of artistic and financial starvation.

And what's more, Mr. Brady insists all this is going to take place within the next two years.

GOOD OLD CBS

The new Jack Pearl series is carried over seventy-six CBS outlets, in as many cities from coast to coast. There is a new singing star on the radio horizon in this program, Patti Chapin, a youngster from Atlantic City. Miss Chapin started her radio career on Columbia last November as a sustaining artist, but it didn't take her long to achieve that mecca of all sustaining artists—a big commercial. Good luck to you, Patti! . . . A new series of weekly programs known as "Columbia's Concert Hall" is featuring world famous instrumentalists from many fields, with Howard Barlow and a symphony orchestra, each Wednesday at 10:30 p. m. These programs are designed to feature the lighter and more brilliant aspects of fine music, and is a direct result of the radio public's increasing response to symphonic programs and outstanding soloists. . . . John Q. Public has his chance on radio now, through the microphones of WOR, which have been offered to the average man, who is being invited to have his say on whatever subject he desires. This novel series is presented on Sundays at 11:30 a. m. . . . The plan which WOR executives evolved is this: Listeners have been asked to write letters to the station outlining the subject they wish to discuss, whether it is radio programs, styles, legislation, movies, or anything else. Each week about eight letters which seem most interesting are selected and the writers invited to the studios where the actual broadcast is formulated from their letters. About three minutes will be allowed each speaker.

This is everybody's chance to say something about his pet peeve! . . .

STUDIO NEWS

Edward Nell, baritone, looks so much like Herbert Marshall, of the screen, that a group of autograph grabbers stopped him recently and over his protest forced him to sign "Herbert Marshall" in their books. . . . Irving Kaufman has just completed three years of broadcasting for the one sponsor. . . . Tito Guizar is headed for Hollywood where he will make a movie. . . . Beatrice Lillie begins her day at eight o'clock at night and finishes it at 1:30 in the morning. . . . Paul Whiteman took off forty pounds in one night, playing bridge in London (that's supposed to be a joke!) because he didn't take it off—he lost it! . . . Vaughn de Leath wrote and sold her first song when she was eleven years old. . . . Alfred Nilson, WOR engineer, owns a Chinese junk which he calls "Amoy." He sailed it for five years, circled the globe, went about fifty thousand miles.

Insuline Announces New Wound Coils and Forms

Shielded "handle type" plug-in coils, which fit on the front panel of the radio receiver instead of inside the chassis, are now made by the Insuline Corporation of America, 25 Park Place, New York City.

These coils are supplied in sets of four, to cover 16 to 217 meters. Low-loss ribbed bakelite forms are used. Two-winding and three-winding coils are made. Blank forms are also listed.

A threaded coil form made of Insulex, suitable for amateur transmitting purposes, has been brought out by Insuline. The form is 2½ inches in diameter and 5 inches long, and accommodates 26 turns of any size wire up to No. 10 with a spacing between centers of .143 inch. Two rows of holes along the length of the form permit the ends of the winding to be pulled through inside. This new form is especially suited for 20-, 40- and 80-meter oscillator or amplifier tank coils.

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OFFER D—Free with $6.00 subscription, 52 weeks.

COILS

Aerial eliminator. Dispenses with necessity of an aerial erection. Order P-1400. Offer A.
Police thriller short-wave adapter plugs into set for police calls. For '27 detectors only. Order P-1402. Offer B.
Silver-Marshall output transpower, 1 to 1 ratio for single-sided circuit, magnetic speaker. Order P-1403. Offer B.
Silver-Marshall output transformer, push-pull pentode (7,000 ohm load) to 8-ohm secondary. Order P-1403. Offer B.
Kit of three doubly-tuned, aluminum-shielded, 175 kc. i-f transformers. Order P-1408. Offer D.
Set of four 6-prong plug-in oils, 200-15 meters, for use with 0.00014 mfd. Three windings. Order P-1426. Offer C.
Power transformer for 5-tube set (2.5v., 5v., h-v), 60 ma. Order P-1428. Offer C.
Power transformer for 8-tube set (2.5v, 5v., h-v.), 90 ma. Order P-1429. Offer D.

CONDENSERS

Three-gang 0.00014 mfd. tuning condensers for short waves. Order P 1031. Offer C.
Selection of 15 fixed mica moulded condensers, .0001 mfd. to .001 mfd. State capacities and quantities. Order P-1415. Offer B.
Hammarlund Star Midget condenser. 0.00014 mfd. Order P-1417. Offer B.
De-Jur Amsco dual 0.00014 mfd. Order P-1418. Offer C.
Three 100 mmfd. compression type trimmer condensers. Order P-1419. Offer A.
Eight tubular condensers, 600 volts. Capacities, .002, .006, .01, .02. State quantity and capacities, your selection Order P-1420. Offer A.
Three tubular condensers, 600 volts, .01, 0.25 mfd. Your selection. State quantities and capacities. Order P-1421. Offer B.
8 mfd. electrolytic. 500v. d.c. Order P-1422. Offer B.
16 mfd. electrolytic, 500v. d.c. Order P-1423. Offer C.
Two 8 mfd. eletrolytic in one case. Order P-1424. Offer C.
Three-gang 0.00035 mfd. ⅝-inch shaft diam. Order P-1425. Offer B.

RESISTORS

Kit of 12 assorted volume controls (our selection). Order P-1401. Offer A.
Kit of 25 fixed assorted resistors (our selection). Order P-1404. Offer A.
Kit of 50 fixed assorted resistors (our selection). Order P-1404. Offer B.
Volume control portentiometers with a-c switch attached:
5,000 ohms. Order P-1409. Offer B.
10,000 ohms. Order P-1410. Offer B.
20,000 ohms. Order P-1411. Offer B.
50,000 ohms. Order P-1412. Offer B.
500,000 ohms. Order P-1413. Offer B.
Selection of 15 pigtail fixed resistors, ¼ watt. State values and quantities desired. Order P-1414. Offer B.

MISCELLANEOUS

Two 45 tubes. Order P-1405. Offer B.
Two 26 tubes. Order P-1406. Offer B.
Assortment of screws and nuts. Order P-1407. Offer A.
Twelve tube shields and bases. Order P-1416. Offer A.
Set of 12 wafer type sockets, four, six, seven-medium holes. State quantity and holes. Your selection. Order P-1426. Offer B.
Set of 6 three-piece aluminum shields. Order P-1427. Offer A.

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0.0015 mfd... 12c	0.0006 mfd... 13c	0.0003 mfd... 15c
0.0009 mfd... 13c	0.0005 mfd... 15c	0.0002 mfd... 15c

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Bridge Measured

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500 ohms..... 9c	12,000 ohms.. 11c	80,000 ohms.. 11c
700 ohms..... 9c	17,000 ohms.. 11c	.15 meg...... 12c
1,000 ohms.. 10c	20,000 ohms.. 11c	.2 meg....... 12c
2,000 ohms.. 10c	25,000 ohms.. 11c	.5 meg....... 12c
2,500 ohms.. 10c	30,000 ohms.. 11c	.6 meg....... 12c
3,000 ohms.. 10c	35,000 ohms.. 11c	.7 meg....... 12c
3,500 ohms.. 10c	40,000 ohms.. 11c	.8 meg....... 12c
4,000 ohms.. 10c	50,000 ohms.. 11c	1.0 meg...... 13c

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