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The MB-29 A

By Neal Fitzalan

This shows the connections of the MB-29A, a four-tube screen grid receiver designed by the designers of the MB-29 and the MB-30.

The makers of the MB-29 and the MB-30 have designed a four-tube model tuner called the MB-29A. In some respects it is like the MB-29 and in other respects like the MB-30. It is intended for those who want an up-to-date receiver somewhat less sensitive than the MB-30 and considerably less expensive, yet one that is sensitive and selective enough for all ordinary reception.

Fig. 1 gives the circuit diagram of this tuner and radio frequency amplifier. Comparing this diagram with that of the MB-30, published in the June 28th issue, we note that tuning arrangement is the same except that one band pass filter is omitted in the MB-29A. A hand pass filter is placed between the antenna and the first tube, just as in the MB-30. Likewise and untuned radio frequency transformer is placed between the first and the second tubes. Then follow two standard tuned radio frequency stages.

In the MB-30 there are six tuned circuits, tuned by two triple condensers. In the MB-29A there are four tuned circuits, tuned by one quadruple condenser. Compactness is achieved by the use of this condenser.

Equal Design of Transformers

The design of the couplers in the MB-29A is the same as that of the couplers in the MB-30 previously described. Therefore the characteristics of the circuit will be the same except so far as they are modified by the omitted band pass filter and the extra stage of screen grid amplification.

The sensitivity curve, which is shown in Fig. 2, has the same general shape as that of the MB-30 and shows the highest sensitivity at 1,000 kc with only a small decrease in the sensitivity toward the ends of the broadcast band. At 1,000 kc the sensitivity is 4 microvolts per meter and at 500 kc and 1,500 kc it is 8 microvolts per meter. This is really a very small difference when compared with the characteristics of many other receivers.

It will be recalled that the maximum sensitivity of the MB-30 was about one-fourth microvolt per meter, so that the omitted tube accounted for an amplification of 16. The slightly lower sensitivity of the four-tube circuit is not of serious importance because the noise level is greater than 2 microvolts per meter.

List of Parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
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<tbody>
<tr>
<td>C1, C2, C3, C4</td>
<td>One four-gang tuning condenser.</td>
</tr>
<tr>
<td>C5, C9</td>
<td>Two 0.5 mfd. by-pass condensers.</td>
</tr>
<tr>
<td>C6, C12</td>
<td>Two 1 mfd. by-pass condensers.</td>
</tr>
<tr>
<td>C7, C10</td>
<td>Two 0.1 mfd. by-pass condensers.</td>
</tr>
<tr>
<td>C8</td>
<td>One 0.05 mfd. by-pass condenser.</td>
</tr>
<tr>
<td>C11</td>
<td>One 0.006 mfd. fixed condenser.</td>
</tr>
<tr>
<td>C13, C14</td>
<td>Two 0.0025 mfd. by-pass condensers.</td>
</tr>
<tr>
<td>R1, R2</td>
<td>Two 20,000 ohm resistors.</td>
</tr>
<tr>
<td>R3</td>
<td>One 150 ohm resistor.</td>
</tr>
<tr>
<td>Ch1, Ch2, Ch3, Ch4, Ch5</td>
<td>Five special National radio frequency choke coils.</td>
</tr>
<tr>
<td>T1</td>
<td>One special National input transformer with shield.</td>
</tr>
<tr>
<td>L1</td>
<td>One special National inductance coil with shield.</td>
</tr>
<tr>
<td>T2</td>
<td>One National untuned radio frequency transformer with shield.</td>
</tr>
<tr>
<td>T3, T4</td>
<td>Two standard National radio frequency transformers with shields.</td>
</tr>
<tr>
<td>P1</td>
<td>One non-inductive National potentiometer.</td>
</tr>
<tr>
<td>P2</td>
<td>One 50,000 ohm potentiometer.</td>
</tr>
<tr>
<td>Four UY sockets.</td>
<td></td>
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<tr>
<td>One National drum dial with dial light.</td>
<td></td>
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<tr>
<td>Five binding posts.</td>
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<tr>
<td>One battery lead cable.</td>
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<tr>
<td>Four tube shields.</td>
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<tr>
<td>One National MB-29A chassis.</td>
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most of the time and a sensitivity of 4 microvolts per meter is about all that can be utilized to advantage except under the most favorable conditions. Of course, there are times when and places where a sensitivity of one-fourth microvolt per meter can be utilized. Those who wish to be prepared for such reception have to be more circumspect in the choice of their equipment, while those who care little for extreme distance reception may choose the smaller set for steady service.

The Selectivity Curves

The selectivity of the four-tube circuit is shown in Fig. 3, in which curves are given for the 600 kc and 1,300 kc carriers. There is a greater difference between the curves for the high and low carriers in the four-tube circuit than in the other. This is to be expected since in one there is only one band pass filter while in the other there are two. This difference between the curves is largely near the carrier frequency, which also should be expected. The curves in Fig. 3 represent a highly satisfactory selectivity in a four tube receiver. It should be remembered that in a receiver having a maximum sensitivity of four microvolts per meter not nearly as high selectivity is required as in one having a sensitivity of one-fourth microvolt per meter.

A receiver having three screen grid tubes is not nearly so difficult to stabilize as one having four such tubes, mainly because of the difference in the amplification. Hence it is not necessary to take extreme precautions against oscillation, and a few filter parts may be saved. For example, a common radio frequency choke, which is usually used for the screens of the first two tubes, and also a common by-pass condenser for the two. Thus one choke and one condenser are saved. This could not have been done safely with the five tube circuit.

In the plate circuit of the first tube in the MB-29A the choke and the condenser are omitted, and again parts are saved. Of course, this saving would be not improper if the circuit would become unstable when the filter is omitted, but the fact is it remains stable and thus the saving is real.

Common Bias Resistor

Another place where consolidation of parts has been done is in the grid bias arrangement. In the five-tube circuit each tube has a separate bias resistor and a condenser across it. In the four-tube circuit the three amplifier tubes have a common bias resistor and a common condenser. Since this resistor, R2, serves three tubes and the current in it will be three times as great as for the single tube, the resistance is made only 150 ohms. This low resistance calls for a rather large by-pass to effect a given reduction of the impedance and therefore the value of C8 is one microfarad. This capacity across 150 ohms is more effective than .01 mfd. across 350 ohms. The resistance used in the cathode lead of each tube in the five tube circuit, but if it is also assumed that it should be more effective there is more feed back that must be reduced.

The volume is controlled, as customary for this type of circuit, by adjusting the screen voltage on the amplifier tubes. A 50,000 ohm potentiometer P2 is used for the purpose, which controls the screen voltage of all the amplifier tubes. A voltage of 67 volts is applied across the potentiometer, permitting a variation between this value and zero. The voltage applied on the plate is 135 volts.

As in the five-tube circuit, a non-inductive potentiometer P1 is connected across the 2.5 volt filament supply, and the center tap is grounded to minimize hum. A single 2.5 volt filament winding supplies the heater current to all the tubes and also supplies the current to the pilot light on the tuning control drum. The AC leads, of course, are twisted to minimize hum pick-up.

Thorough Shielding

Every tuning coil or transformer is inclosed in a large aluminum shield. Inclosed in the shields also are by-pass condensers and chokes which are associated with given tubes. There are two shield cans for the band pass filter, one condenser L1 and L2 or the other L1. Thus there is no inductive coupling between the two tuned coils in the filter and no other capacity coupling than that supplied by the coupling condenser C8. Therefore the band width is just what it is intended to be, which is not always the case in band pass filters where there is stray coupling in addition to the intended coupling.

In addition to the shielding around the coils and transformers there is a shield around the tuning condenser gang. There is also a shield around each of the four tubes. Thus the circuit is well shielded and well protected distributed pick-up. The input to the coil in the circuit, and every signal that enters must run the gamut of the entire tuner. The circuit is also well shielded and filtered against feed back, making it stable throughout the tuning range.

The Output Circuit

The tuner may be connected in front of either a transformer or resistance coupled circuit. Only one output terminal is given in the circuit and since two must be used in an explanation it is necessary. The unmarked output terminal to the right of Ch5 should go to the plate terminal of an audio transformer. The B terminal of that transformer should then be connected to the 67 volt terminal of the B supply, or to a greater output capacity is desired, to the 135 volt terminal.

If the coupling between the detector and the audio amplifier is by resistance, the unmarked output terminal should go to the upper side of the coupling, the one next to the stopping condenser. The other end of the plate coupling resistor should go to the 135 volt terminal of the B supply, or to an even higher voltage. No satisfactory results will be obtained unless a high voltage is applied when the coupling is by resistance.

Recipes for Cooking

Home-Made Coils

Radio enthusiasts who prefer to wind their own coils can save themselves a lot of grief.

Summer weather near the ocean or larger lakes usually means that the atmosphere is heavily moisture-laden, and whether you use silk, cotton or enameled covered wire the danger of moisture imbibition, or even surface moisture, is always real.

If you are winding a new coil on cardboard tubing first warm the tubing well and then dip the tubing in a bath of liquid colloid. Avoid beeswax and paraffin.

When the form is dry wind on the wire and when you're finished, slightly warm the coil and paint it lightly with a coat of colloid to hold the wires in place.

Even lacquer tubing should be warmed in the oven to avoid scaling in surface moisture when the coil is finally finished.

Moisture tends to short-circuit coils turns and in the case of cardboard dielectric this effect becomes a large condenser for the time being, also a fairly good conductor. If weak acids are present in the texture of the material.

It is understood that these precautions apply to radio frequency transformers.
Wave Band Coverage

By Herman Bernard

THE capability of tuning in the entire broadcast band of wavelengths or frequencies depends on the capacity and the inductance. In modest circuits, where no shielding is necessary, it is usually possible to use as small a maximum capacity as 5,000 mfd. for the tuning condenser. A suitable coil may be wound that will bring in the lowest wavelength and also the highest. These are the only two reference points that need be considered in testing for coverage.

However, every broadcast circuit may offer an obstacle. The use of a screen grid tube, with a tuned primary and a high inductance secondary, immediately suggests the presence of much distributed capacity. This may be sufficient to defeat full coverage. At all hazards the use of .0005 mfd. is risky, unless under actual test it has been found to be sufficient. The minimum capacity of a .0005 mfd. tuning condenser is likely to be no less than that of a .0005 mfd. model. Assume this minimum to be .0005 mfd. (50 micro-microfarads). The capacity ratio of the .0005 mfd. model is 1-to-7, while that of the .0005 mfd. model is 1-to-10.

Where Skill Alone Conquers

As for the coils for identical circuits, the distributed capacity difference between the two will be negligible. You can cover the wave band without a doubt with the larger capacity condenser, and even if the condenser is actually a little short of the rated .0005 mfd., as many of them are. But if the .0005 mfd. model is shorted the danger of missing out at one end of the broadcast spectrum is great, because only with skill in design can coverage of the wave band be accomplished with full .0005 mfd. Such is the real situation, although not fully realized by many who build or use radio receivers. One fact that sticks out is that any persons not able to tell whether a receiver covers the full band, because no station at one extreme is receivable, or no station at either extreme.

For instance, in New York City, in some locations, 1,400 kc is the highest frequency easily brought in, while 570 kc is the lowest. Although 1,400 kc is only 100 kc removed from the highest frequency, still there are ten channels in this place while there are two in lower frequencies than 570 kc, a total of twelve channels without response.

The usual method is to draw a curve, showing frequency or wavelength plotted against dial settings, and follow that to see whether the undetermined extremity is likely to be receivable.

Deceptive Guesswork

But this is theoretical. The curve may not follow its contour or slope, but may have an erratic feature. At the highest frequencies one may not be able to tell whether a receiver covers the full band, because no station at one extreme is receivable, or no station at either extreme.

For instance, in New York City, in some locations, 1,400 kc is the highest frequency easily brought in, while 570 kc is the lowest. Although 1,400 kc is only 100 kc removed from the highest frequency, still there are ten channels in this place while there are two in lower frequencies than 570 kc, a total of twelve channels without response.

The usual method is to draw a curve, showing frequency or wavelength plotted against dial settings, and follow that to see whether the undetermined extremity is likely to be receivable.

A Disguise for a Fault

If there is missing out on "lights" the number of channels always can be reduced, as if to make not so bad a showing, by making sure to tune in the highest frequency, since small capacity variations represent great frequency change at this end, while such is not true at the low end. Yet the margin you might want to hear particularly might be at the low frequency end. Nevertheless, no makeshift is a solution. The performance is not improved at all.

The question may be raised academically why it is necessary at all to tune in the entire spectrum. One might say, "Cut out the high frequency end, as only small stations of small or no interest are tuned at long range.

It is true that the Federal Radio Commission has adopted the policy of placing large numbers of stations on some high frequencies. But you have only seven stations, thirty-six on 1,420 kc and forty-two on 1,370 kc, while there are fifty-two on 1,310 kc. The Commission’s judgment may be assumed to be that these stations are not as important as stations given better positions, greater power and more time on the air, yet such comparison is national, as all decisions of the Commission should be.

The local stations fill a local need. They do not require clear channels and high power to reach their localities, the only territories they are deemed worthy of serving.

Local News As An Example

If you will consider the situation of local news versus world news in your newspaper or magazine, you will find that sometimes there is but little mention of the localities that serve their localities are perhaps closer to the hearts of those who listen to them than are the large stations that undoubtedly put on better programs.

Again, the need of press and wave coverage is that any receiver should be so engineered and constructed that it will serve the purpose for which a receiver is intended, and that is, to hear in the broadcast stations within the sensitivity range.

Since it is quite practical to have the dial represent all the frequencies assigned to broadcasting, what can be the reason for omitting so much less than this accomplishment that be hailed as worthy? The designer or manufacturer should not take it for granted that any possessor of the receiver will be dissatisfied in any proportion of broadcast frequencies, and if he gives the owner all those frequencies, as the owner deserves, then the requirement is fully and honestly met and not dodged.

Good receivers nearly always cover the full band. The reason is that the same degree of care that attaches to the ensemble attaches to each component, and one of the first considerations in connection with the tuner becomes the assurance of full wave coverage.

In outfits together sold at a price, failure to cover the full band is almost the rule. The missing channels are usually at the highest frequency end. And the reason usually is that the shields have been made too small for the capacity of condenser used.

Whenever shielding is resorted to, as must be done in very sensitive receivers, and in all screen grid receivers that have more than one screen grid radio frequency amplifying stage, the shield, if too close to the coil, will decrease the inductance severely. No addition of tuning is to have the coverage of the broadcast spectrum, because if the high frequency end is slightlyed, and you remove turns, the low frequency end will be slighted, and this is more substitution of one evil for another.

Where .0005 Mfd. Is Hopeless

The absorption effect of the shield, if the shield is too small, is so great that the inductance may decrease as much as 25 per cent, with a greater self-capacity increase. Hence a distinction exists between shielded and unshielded circuits, and the fact becomes quite apparent that the use of several .0005 mfd. condensers in circuits with undersized shields makes it utterly impossible to tune in the whole wave band.

.0005 mfd. capacity is to be used in the shield must be so generous in size that there is substantially no difference in dial settings of the high frequency broadcast stations whether the shield is on or off. This would mean about a 5-inch-square shield. The full-frequency condition can be effected, but in highly compact shielded circuits using .0005 mfd. capacity it can’t be. Where .0005 mfd. and shields are used the circuit can not be compact and still cover the wave band.

Indeed, the same situation that existed between .0005 mfd. capacity and wave band coverage without shields exists with .0005 mfd. capacity when small shields are used. In this sense a shield of 3-inch diameter, enclosing a coil wound on 3/4 inch diameter, is considered a small shield. With .0005 mfd. and carryin coil design these proportions cannot support full-wave coverage, but the tuning condenser must be full .0005 mfd. in fact.

Reduction of Cross Modulation

What IS the reason for double tuning in radio frequency amplifiers, that is, why do stations come in at two points dial? Is there any relationship between this phenomenon and cross talk between two stations when the selectivity of the set is high enough to separate the stations?—O. S. E.

Double tuning and cross modulation of the type referred to are due in most instances to detection in the first tube. If the first tube is not all that, there is some sort of unbalanced wave form, and if the signal intensity is limited before the first tube, the trouble may be avoided. It is also important to prevent the signal from entering the circuit anywhere except by the antenna ground circuit. If the signal gets in anywhere else all of it is not forced through the entire tuner and cross talk is likely to develop. To minimize cross modulation, increase the plate voltage and negative bias of the first RF tube.

www.americanradiohistory.com
The pick-up work satisfactorily, but the
connections which are essential of
connected across the primary
for high selectivity
is
interference.

It is more practical to use tuned radio frequency amplification,
that is, to put amplifier tubes between the tuned transformers.
If a multi-stage tuned radio frequency amplifier be placed
before the modulator, complications arise, and for that reason
it seems best to use only one radio frequency amplifier and two
tuners before the modulator, the second of the tuners being
placed in the grid circuit of that tube. Consequently the radio
frequency tuned circuit in Fig. 1 consists of a transformer T1, tuned
with C1 and C1a and a transformer T2 tuned with C2 and C2a.

**Limiting Input**

It is highly important not to overload the modulator tube,
for if this is done, the advantage gained by the tuning in the radio
frequency level is partly lost. For this reason the input to the
radio frequency is controlled by a 30,000 ohm potentiometer Pl
connected across the primary of the first transformer T1. One
side of this potentiometer is grounded and the slider is con-
ected to the antenna. By moving the slider from one extreme
of the resistance to the other the input voltage can be varied
from nothing to the maximum picked up by the antenna.
In order that this volume control should be effective it is
essential that no signal enter the circuit by any other route
than by way of the antenna, and this condition is satisfied by
shielding and filtering.

The type of modulator selected for this receiver is that in
which the local oscillations are impressed on the screen circuit
of the tube. Hence the pickup coil on T3 is connected in series
with the screen lead. If it is desired to introduce the oscilla-
tions in the grid circuit, it is only necessary to transfer the
pickup coil to the lead from the cap of the modulator tube,
connecting it in series. Nothing else need be transferred or
changed, except that the terminals left open by the removal of
the pickup coil are joined together. Both these methods of
pickup work satisfactorily, but the one illustrated is somewhat
simpler constructively.

The oscillator selected is of the tuned grid type. This was
chosen because it permits grounding the rotor plates of the
tuning condenser, thus eliminating body capacity, and it also
permits the use of one section of a triple condenser for the oscillator.

**The Intermediate Amplifier**

The intermediate amplifier contains two screen grid tubes and
two tuners, and the intermediate frequency is adjusted
approximately 50 kc. This frequency is higher than the
frequencies previously suggested and it was chosen because it
enables the use of smaller coils and it also reduces image inter-
ference. The high selectivity in the radio frequency level and
the high intermediate frequency reduce image interference to a
negligible amount.

The first intermediate frequency transformer has a tuned
primary and untuned secondary, whereas the other two trans-
formers have tuned secondaries. Tuning the primary of the
first intermediate transformer is done to provide a large by-
pass condenser in the plate circuit of the modulator tube, thus
increasing the detecting efficiency, and at the same time to
place a high impedance load on the tube.

The detector is of the grid bias type, and the required bias
is obtained from the drop in an adjustable resistor R6 in the
grid circuit. The detection is aided by a by-pass condenser C7 in the plate circuit. The choke Ch7 and condenser C8 are
used for stopping currents of intermediate frequency from
passing into the amplifier. The assumption is that the coupling
between the detector and the first audio amplifier is resistive.
The load impedance, with the exception of the modulator and
detector tubes, there is a similar radio frequency choke coil.
These choke coils are not critical in value as any inductance

---

*[Within the last several months theoretical discussion of Superheterodynes has been published in these columns. The following article deals with constructional features.—Editor]*

**FIG. 1**

THE CIRCUIT OF A SIX-TUBE SUPERHETERODYNE TUNER EMPLOYING SCREEN GRID TUBES. THE THREE TUNING CONDENSERS ARE GANGED AND THE INTERMEDIATE FREQUENCY IS 50 KC.
for a Superheterodyne

Anderson

Editor

from 1 to 125 millihenries is suitable. Standard chokes of 30, 65, 85 and 125 millihenries are on the market. A good choke of approximately one millihenry can be made by winding 200 turns No. 10 stranded wire on a 1.25 inch bakelite tubing. This is easily made at small expense and it is quite effective. A by-pass condenser of at least .01 mfd. must be provided for each coil. For without the condenser the choke serves no useful purpose. All these condensers, six in all, are connected to ground on one side. As in the case of the grid bias, by-pass condensers of relatively low values should be regarded as the minimum rather than the optimum. The larger they are, the better, and larger values are recommended when the chokes have as low inductance as one millihenry.

The Output Filter

The output filter consisting of choke coil C7 and condensers C7 and C8 is more critical than the other filters because it must be designed so that it prevents the intermediate frequency currents from passing on to the amplifier and at the same time so that the high audio notes are not unduly suppressed. The minimum value for either of the two equal condensers should be .00025 mfd. and the maximum value for the choke should be one millihenry. This assumes that the intermediate frequency is not much lower than 50 kc. The maximum value should be 5 millihenries for the choke and .0005 mfd. for the condensers. The design for the one millihenry choke previously given is suitable for this choke also, especially if C7 and C8 are .0005 mfd. condensers.

Design of RF Transformers

The radio frequency transformer T1 and T2 may be any standard transformers designed for screen grid tubes and the broadcast range, but it is recommended that they be wound for .005 mfd. tuning condensers because smaller condensers, as a rule, do not give the entire band of different dimensions and wire sizes are available for those who prefer to purchase them, and the following design may be used by those who prefer to construct their own. This design assumes that the maximum capacity in each circuit is 550 mfd., one-tenth of which is in the trimmer condenser and in distributed capacity. It also assumes that the tuner just reaches 550 kc.

The coil is wound on a 1.75 inch bakelite tubing with 60 turns of No. 28 double silk covered wire, with the turns as close as the inductance will permit. Due to the fact that the condenser used may be somewhat less than 500 mfd., it is well to put on a few more turns to insure sufficient inductance. If it should prove that the coil is too large, it is a simple matter to remove turns until the value falls about 25 on the dial.

Since high selectivity is more important in this tuner than high sensitivity, the primaries of these coils should be smaller than for a grid coil tubing and this reduces the inductance. This makes it practical to wind each primary on the same form as the secondary and at one end of it. Use 15 turns for the primary of T4 and 24 turns for that of T2. No separation between the two windings of T2 should be used, but a separation of about one-fourth inch can be used between the windings of T1.

If the two radio frequency condensers C1 and C2 are ganged, and they should be, it is necessary not only to adjust the trimmer condensers but also the inductances of the secondaries, and this can only be done after the coils have been surrounded by the shielding that is to be used. The inductance values will depend not only on the turns and the size of the forms but also on the position and amount of shielding. The two tuning circuits cannot be made to "track" exactly by adjusting the trimmer condensers alone. However, if the coils are made as nearly equal as possible, and if they are not crowded by shielding, very little inductance adjustment is needed. The inductance of either coil may be varied by changing the number of turns or by separating the turns at one end, depending on the amount of inductance change needed.

Design of IF Transformers

Perhaps the simplest way of getting suitable intermediate frequency transformers is to take standard RF transformers wound for screen grid tubes and .0005 mfd. condensers and then use a larger condenser across them. A coil that has been wound for a .0005 mfd. condenser to reach the 550 kc limit of the broadcast band will require .00042 mfd. to reach 500 kc. To tune the coil a fixed condenser of .00035 mfd. and a trimmer of 100 mfd. can be used. The trimmer will provide ample margin, since the difference between .00035 and .00042 is 74 mmfd.

In the case of T4 it is the primary which should be wound for .0005 mfd. The secondary of this transformer should have at least as many turns as the primary. Suitable coils intended for tuning the prs or are available.

Now it may be that the builder of this circuit may prefer to wind his own transformers, which he may do by winding 86 turns of No. 28 double silk covered wire on bakelite tubing 1.75 inches in diameter. This winding assumes that the tuning capacity consists of a fixed condenser of .00035 mfd. and a trimmer set to .0005 mfd. That is, it assumes that the coil tunes to 500 kc when the total capacity is .0004 mfd. If the maximum capacity of the trimmer is 100 mfd there will be considerable margin for taking up differences or for adjusting the frequency to a little above or below 500 kc.

The Untuned Windings

It is recommended that the untuned windings of these coils be put on forms which fit snugly either inside or outside the tuned winding form. There is no need of using different wire for these windings, but if finer wire is available it is all right to use it. Wire as fine as No. 36 is all right and heavy enough to handle easily.

Assuming that the untuned winding in each case is put on a form having an outside diameter of .5 inches, which fits inside the other form, the secondary of T4 should have 100 turns. Close coupling may be used to advantage in this coil and therefore the secondary winding should be centered axially with respect to the other winding. This can best be done by cutting the two pieces of tubing to the same length and then centering both windings.

If No. 28 double silk wire is used for both windings the length of the secondary of T4 will be 1.02 inches long. Therefore the tubing should be cut about 2.25 inches long to provide room at the ends for terminals and mounting lugs. The secondary forms for T5 and T6 should have the same length.

Adjusting the Tuning

Not so many turns will be needed for the primaries of T5 and T6 and the best coupling is not necessarily that obtained when centering the windings axially. Therefore these primaries should be wound on shorter tubing, .5 inches in diameter, so that the coupling may be varied by sliding the form in or out without protruding outside of the other form. To provide as much variation as possible for a given length of primary form, the winding should be put near one end so that it may be turned end for end. The primary winding should always be nearer the grounded end of the secondary, unless it is found that centering gives best performance. Forty turns will be about correct for both AC and DC screen grid tubes. The number of turns is not at all critical when the primary is mounted so that it may be moved in or out. Neither is the optimum coupling critical and therefore it makes little difference whether the primary winding is an eighth of an inch too far in or out.

AN AUXILIARY OSCILLATOR GENERATING A MODULATED INTERMEDIATE FREQUENCY WHICH MAY BE USED AS AN AID IN ADJUSTING THE INTERMEDIATE FREQUENCY TUNER.
The Construction and
By Manning

THOSE novices who desire to build a spark coil all by themselves will find in the following a description of a “spark” or Rhumkorff coil that is nearly ideal for experimenters’ design because the desired spark length at the secondary terminals is a function of the condition of your pocketbook. And I can say this without any reservation within the usual spark voltage range that most novices will have to wind up.

The wire size is so proportioned that a spark of from 3/4 inch to 1 inch may be obtained using the same sizes of primary and secondary insulated conductor, respectively.

Wound spark coils by hand many times, and therefore assume that the novice will elect to use the same method, so a little preparatory work is advisable.

The primary coil core is enclosed in a fibre or bakelite tubing which is 7 inches long and is threaded at each end with a 3/8 inch pitch thread for a distance of 1/4 inches. The inside diameter of this tube may be from 3/8 inch to 3/4 inch, the 3/4 inch being preferable.

Windings Are Mechanical Aids

The coil form ends are made of 3/4 inch to 5/8 inch bakelite and are 5 inches square and are centrally drilled and inside threaded to screw tightly on to the primary core insulating tubing.

Obtain about 1 1/2 lbs. of No. 22 gauge soft iron wire and cut it into 7-inch lengths and have same ready for insertion into the primary winding when the coil is wound.

The problem now is to provide some mechanical means to rotate the coil form in order to wind it. The following hints will prove helpful:

Most experimenters have a vise, and a hand-operated drill that will take drill sizes up to 3/4 inch.

To mount the coil form ready for winding, mount the breast drill so that it is horizontal and obtain a 3/4 inch stud 9 inches long, two flat washers, and nuts to fit the stud.

Clamp the stud centrally in the core tubing and distribute its length so that 3/4 inch or so projects from it near the end you expect to clamp in the drill chuck. The other end of the stud will project more than twice this distance. Provide a temporary “pilow” bearing by means of mounting a stout piece of hardwood drilled so that it acts as a steady rest for the free end of the rotating stud.

As the necessary winding tension is supplied by the operator no extra tension device is required.

Two outlet holes are provided for the primary coil leads—and are located within the confines of the primary winding space which is 5/8-inch radially outward from the primary core insulating tube.

One hole is drilled in the end piece near the tube and the other just above it (about a 3/8 inch separation).

Special Precautions Necessary

The secondary coil winding lead holes require some special precaution, thought, and of prime importance is the fact that the top outlet posts must be very carefully insulated. Proceed as follows for the bottom secondary lead hole.

Drill straight down from the center of the top flat of the square bakelite end piece a distance of 1/4 inches using an extension drill (size No. 30) and at a point 1/4 inches below the top of the end piece where the secondary coil lead enters the hole, drill a hole to meet this one at right angles.

Next in order is the preparation of the layer insulation.

The secondary layer insulation width is 6 inches, the width of the secondary wire coil layers being not more than 5/4 inches, thus providing at least a 3/4-inch clearance at each end of the secondary winding for insulation purposes.

The primary winding occupies the entire length of the winding space of 6 inches and requires only four layers, 0.04 inch per layer (total:0.16 inch) insulating covering. Black or yellow empire cloth covering used for separation is finally secured in place by a small quantity of melted wax.

256 Turns Minimum on Primary

The primary winding consists of at least 256 turns of No. 18 single cotton covered enamelled wire. If the gauge size runs smaller than No. 18 you may have room for extra turns, in which case you merely fill in the space.

The secondary is wound with double silk covered enamelled wire and the size to be about 5/8 inch per layer, and you likewise remember to preserve the spacing previously referred to when winding these layers.

The secondary layer insulation can be ordinary good quality condenser tissue, that is, beeswax impregnated, but I prefer to use regulation fish paper and the thickness is .005 inch.

The secondary coil is then a layer-insulated affair and the paper insulation lap joints should be so made and placed so that the external appearance of the coil is substantially uniform. Locating all the laps at the same place will make the job look better.

The secondary coil’s bottom lead that passes through the bakelite end piece is to be sheathed in india rubber tubing that may be obtained from a mechanical rubber goods supply house.

For a 3/4 inch or 5/8 inch spark (15,000 to 20,000 volts at the secondary) 1 lb. of No. 34 double silk enameled covered wire is sufficient. The complete winding space for the secondary will take 21/2 lbs. of wire.

That is sufficient No. 34, 0.5 E. to wind up to 3/4 inch of the flat stock at each end pieces and will provide a spark of at least 1 inch when the coil is operated by four dry cells (6 volts).

Impregnate in Beeswax

You can obtain a longer spark without damaging the secondary if you raise the applied DC voltage to 8 volts, but this is about the safe limit.

It is advised that after the primary coil tubing is filled with the straight pieces of iron wire that comprise the core (and these wires are to be jammed in tight), that the constructor impregnate the finished coil in boiling beeswax until all the air bubbles cease, then allow the whole outfit to cool, cutting the excess cold wax away from the coil package.

It is suggested that the builder provide a neat hardwood coil box with a recess underneath for the vibrator shunt condenser.

The box should be so made that the secondary leads emerge from the coil through insulating rubber tubing and these leads should go to stout binding posts that are mounted on hard rubber strips.

These posts should be at least 4 inches apart. You can make up spark balls as pictured in Fig. 2 to form a discharge gap.

The vibrator pictured is of the “hammer” variety, but if you obtain an old ignition coil vibrator and supply it with new sparking points it will serve perfectly.

The writer made up a good vibrator, similar to the one pictured, with some left-over parts. The vibrator tongue was an old steel knife and the hammer a piece of circular soft iron round stock held in place by a countersunk rivet.

Fig. 2 shows the schematic diagram. A larger condenser than the one shown will be necessary if you use more than 4 volts applied DC.

If you want to get a very intense red spark at a given sparking potential merely stiffen the vibrator.

If you have an electrolytic interrupter handy this coil will develop tremendous “kick.” Its uses for the experimenter are legion. Among these are operation of small X-ray tubes and whole strings of Geissler lights.

Coil Is Basis of Successful Experiments

With appropriate additional apparatus Hertzian and cathode ray experiments may be performed easily. Tesla coil and other high-tension experiments of both this and the past decade may be undertaken.

The basis of all successful high tension electrical demonstrations is a good coil.

A table of air dielectric breakdown voltages may be obtained from the literature on the subject and the experimenter can thus calibrate the coil output secondary voltage.
Use of a Spark Coil

Manwaring

If the novice will provide himself with spark balls (two of each) made of zinc, the characteristic color will be found to be bright blue. Copper balls will produce a greenish tinge, iron a pronounced red and aluminum and brass have their characteristic color but it must always be borne in mind that these colors are modified by the presence of atmospheric oxygen. One way of studying the vapors of metals is to enclose the electrodes in a glass envelope and pump out as much air as possible, i.e., examine their spark spectrums at very low atmospheric pressure.

Not Suitable for Ignition

I have delved into the possibilities of the use of a spark coil to show the novice and experimentalist that it is really worth while to build your own coil, and I might add here that a builder also quite easily can construct a high-tension transformer to supply 20,000 volts with the primary operating at 110 volts AC. High-tension transformers are of course very much more bulky than spark coils of a given voltage output, because of the comparatively low frequency of the power supply as compared to the frequency of the mechanical interrupter. Also the secondary voltage depends in a large measure upon the rapidity with which the primary current is started and stopped.

This coil is a duplicate of one which I used for high-tension experiments and I found it highly useful in that capacity. I don't recommend this coil for ignition purposes, however, as its construction and wiring arrangement do not lend themselves to this class of work very readily.

DATA ON RF CHOKE OF 1 MILLIHENRY

I wish to construct a number of small radio frequency chokes having an inductance about one millihenry. These coils I wish to wind on one-inch bakelite tube using No. 36 enamelled wire. Kindly tell me the number of turns that I should use—E. H. E.

You will need about 300 turns of this size wire, closely wound, making a coil one and two-thirds inches long.

RULE FOR FREQUENCY WAVELENGTH CONVERSION

WILL YOU give a simple rule for converting meters to frequency and vice-versa?—R. C. T.

Divide 300,000 by the wavelength in meters and you get the frequency in kilocycles. Divide 300,000 by the frequency in kilocycles and you get the wavelength in meters. The formula is \( W = 300,000 \), in which \( W \) is the wavelength in meters and \( F \) is the frequency in kilocycles. The number 300,000 is the velocity of the radio wave in kilometers per second. The product of the wavelength and the frequency always gives the velocity of any wave.
Moving-Coil

By John C.

MAGNETIC braking action involves only one direct force, which is the resultant of the interaction of two fluxes. Magnetic rectifiers, however, necessarily involve the interaction of two or more forces because there is usually a vibrating mechanical system to be coordinated with an electrical or magnetic one, in order that the contact for completing the pulsating DC circuit may be made at the right time and for a sufficient duration to permit current to flow.

We have a great many forms in which the phenomenon of resonance may be observed and these include sound, water, mechanical (principally reeds and springs) electrical (involving currents of near or similar frequencies), light (which is electrical in nature) and also that division of resonance phenomenon demonstration that includes magnetism.

Fig. 1 shows a very simple arrangement in which the resonant period of a mechanical system is influenced by a medium not in actual contact with it, that is not in physical contact at any rate. The apparatus involved is both simple and complex—that is, so that at the low frequencies we can limit the current to safe values.

We begin with a low frequency and at this point should include a series ammeter in the exciting circuit. Let us start at 20 cycles or so and keep the current at five-tenths ampere.

The ball magnet is slightly affected and seems to execute a regular series of excursions of lesser and greater magnitude than occurs at the greatest amplitude and the frequency is found to be 40 cycles. To test this we now displace the ball magnet with our hand and find that it vibrates up and down at this frequency, independently of the exciting source.

This immediately proves that the relation between the natural rate of vertical vibration of the ball and the rate of recurrence of the magnetic pulses was similar and this similarity of events is called resonance. The previous elementary discussion is all right as far as it goes but we need to know something more about the influence of mutual electromagnetic fields.

Fig. 2 shows two parallel wire circuits and if the circuits can be imagined for convenience under a condition where current is flowing in each circuit (disregard resistance, battery and meter) and the flux due to current in the left-hand wire tends to oppose the building up of flux in the right-hand wire, it will not be difficult further to imagine that if the left-hand conductor is in a fixed position and the right-hand one is mounted on a spring support that it will move away from the left-hand wire as far as possible.

Fig. 1 now begins to assume some significance. If the ball magnet now be removed and a wire solenoid substituted and separate means provided for its excitation, resonance effects can be much more easily observed because the interacting fluxes are now both alternating in character (and it is likewise assumed that the two independent sources of AC are similar in wave form).

Nothing Happens, and Why

It will be convenient to adjust the physical and mechanical status of the suspended coil so that its period of vibration is the same as before, namely 40 cycles, and if I now excite the stationary coil at that frequency with the suspended coil circuit "open," well, nothing happens. Why not? Because the system depends for its mechanical motion upon the interaction of two flux sources and as yet there is only one.

Referring to Fig. 2 again for a moment we see that the right-hand circuit is complete and also it manifests a current flow. Since the meter deflection shows this to be the case there can be no doubt about it.

So also in the case of our "all-AC" resonator, the suspended coil circuit must be closed, and so we close this coil circuit by merely short-circuiting the coil and of course the coil begins to vibrate.

This resonance vibration is really a repulsion effect.

Since our system is now working it might be well to see what effect is produced if I vary the exciting frequency.

The demonstration apparatus is simple and the experimenter may easily build it, but the source of variable frequency is not easily constructed, though by no means unattainable. A 3-inch outside diameter bakelite tubing is provided with an inside hollow core preferably of soft iron wires cut in straight lengths and a 2¾-inch O.D. tubing is placed inside the larger one and the space in between is filled up with the soft iron wire lengths to form a uniform and symmetrical hollow laminated core.

The winding placed around the 3-inch O.D. tubing is composed of 200 to 240 turns of No. 18 double cotton covered wire, and terminals are brought out to B and B'.

Types of AC Source

The variable frequency AC source could be a big oscillator of the impulse frequency type but a reversing commutator with a large contact area is practically as good. The commutator is driven by a variable speed motor and the source of power is 110 volt DC. A big condenser shunted around the commutator will help.

To avoid forced vibrations let us include a variable resistor.

www.americanradiohistory.com
Resonance

Williams

All this discussion has some bearing on radio receiver circuits but the time is not yet ripe to enter this phase of the subject. Let us now suppose that it is desirable to obtain certain selected frequencies of vibration of the moving coil and I apply to the terminals of the moving coil the other independent AC source that I have in reserve. And I now apply 40 cycles to each coil and the result is an arrangement of nothing for the moving coil slightly in excess of what we had previously. But if I could measure the mechanical force available in the second case, I would find it much that they nullify each other. The resultant motion will be as before—namely zero. But if I now raise the applied frequency impressed on the movable coil, the resultant mechanical frequency will be 2 cycles because it represents the difference between the periodicity of the two applied emfs and if one of the systems is subjected to continually increasing excitation frequency (the difference frequency will increase until when 40 cycles is reached the amplitude of vibration of the movable coil will again be a maximum). This is a combination of forced and free vibrations in which the effect of resonance may be seen the form of a maximum or a minimum amplitude of free vibrations. It is now 80 cycles the next maximum of the free vibrations. It will be realized now that with the previously described free vibrating condition this phenomenon would never have occurred. This next highest vibration point of 80 cycles is what is termed a second harmonic frequency and although it was a property of the moving coil system in the earlier experiment I could not bring it out without altering the elasticity of the previous arrangement—a thing which I did not wish to do because it would have altered the natural period of vibration.

Now that I have shown briefly the possibilities of controlling or otherwise deviating the period of vibration of a moving system by means of magnetic fluxes of an alternating character it will be of interest to ponder the results obtained if I mix more than two frequencies in the aforesaid manner. And since much depends upon what sort of final result is desired I suppose that it is up to me to indicate what the next step shall be.

Introduction of Third Frequency

Fundamentally the effect of a third frequency can best be shown by the use of another coil and another separate source of AC emf. So I will assume that these necessities are at hand. But before proceeding I want to remind you that in case 2 or 3 phase alternators had automatically suggested themselves as AC sources for these experiments that the idea is erroneous as these systems involve no harmonic voltages, and consequently are unsuitable for resonance experiments of this character. Sinusoidal generators are usually employed.

Fig. 3 shows the schematic arrangement of an extension of the idea involved in Fig. 2 and it will be realized that 2 other possibilities are the inclusion of a second coil as a series element of this system, and also the use of two moving systems of similar periodicity separately mounted but capable of being coupled either mechanically, magnetically or electrically. Hence similarity matters a little and I am going to label the three coils in this diagram A, B, and C. The moving coil, B, the original exciting coil, and C the added stationary exciting coil, that is wound over the top of B as shown.

I am sure that you see the full ramifications at the writing. Now let us see what happens if we apply 40 cycles to the two coils A and C, two of the original sources so far.

The result may be that the two cycles will be equal and in phase. The result may be that the two cycles will be equal and in phase. The result may be that the two cycles will be equal and in phase. But if B is a 40 cycle coil and C is a 2 cycle coil, then the difference frequency was reflected by the resultant movement of the small coil of 2 cycles. So that the third frequency's effect upon the resultant of the other two will depend upon its phase relationship to them, that is, on the direction in which this third current is flowing at any given instant of time relative to one or the other exciting currents individually or collectively, and also its value measured in terms of the values of the other two.

But to simplify matters let us assume that this "collective" frequency is in cycles then if we apply a 2 cycle coil so that it adds to the collective frequency, the resultant frequency's effect will be increased amplitude at the same frequency—but if the third frequency is added so that it nullifies the "collective" frequency the vibrating coil will be stationary.

Energy Wasted in Heat

If I apply a 40 cycle emf to the fixed and stationary coils so that a positive pulse or wave passes through both coils, and the fluxes due to both coils are in opposite directions, the resultant moving coil motion is zero. It will be realized that if the cycle difference allows us to continue to study the negative pulse paths through the system the resultant movement will be the same, insomuch as mechanical motion of the moving coil is countereffect just as when the coils were connected in the circuit. This represents wasted energy of course. Let us now see what happens if we apply 40 cycles to the two coils in the system so far. In which the effect of resonance may be seen the form of a maximum or a minimum amplitude of free vibrations. It will be realized now that with the previously described free vibrating condition this phenomenon would never have occurred.

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Study of Flux Reactions

From this it will be realized that this apparatus is really nothing more than a device for studying alternating magnetic flux reactions—this is true but in addition analogies to effects present in radio receivers are made very like and very much more readily grasped by the novice than by merely listening while some one else talks.

In all of the foregoing the excitations of the movable coil are analogous to the resultant operative flux effective in the tuning or radio frequency coils in your radio receiver. The exciting flux in the first instance really represented the incoming signal current, the applied current in the moving coil being variously the induced back emf, or coil turns connected so as to oppose or neutralize each other, etc.

Alternating magnetic fluxes play by far the largest effect in the operation of the radio set—and mostly all other electrical effects that help or hinder reception are subservient to them—of the great importance of correctly designed radio frequency coils in a set.

The presence of magnetic resonance effects is one of the stumbling blocks of radio set coil design or evolution, and it is because of this that my readers are not always as good as their designers think they are—which is only another way of saying that a coil that is correct for a given circuit or under a certain group of operative conditions is not at all apt to fit in well elsewhere, despite popular opinion to the contrary.

The novice must study a great many electrical and also purely "radio set" phenomena before sufficient experience may be gained that entitle his or her opinions to the serious regard of more experienced people.

This all is especially true where short wave receiver assembly is involved.
The power of broadcast stations is continually being increased. Broadcast engineers maintain that increased power is the only way of improving service and overcoming natural and man-made static. Some listeners welcome the increased power transmitted. Certain members of the Federal Radio Commission and other officials contend that increased power is a menace to good radio service. They maintain that a high power station blankets large areas and makes it impossible for listeners in these areas to choose their programs, since no matter where they set their tuning dials the high power station will come through and overwhelm the signals from less powerful stations.

Advantages of High Power

That high power is advantageous is recognized by radio engineers throughout the world. In Italy a 100-kilowatt station is being planned or constructed. In Russia several of stations are being planned and other stations of the order of 30 kilowatts have been in service there for some time. In Lahti, Finland, there is a high power station giving good service, in face of disturbances incident to the aurora borealis in high latitudes. In Motala, Sweden, there is another high power station which has justified its existence to the point that other high power stations are now being planned or constructed. The German stations are being boosted in power, although only comparatively short distances are to be covered. There is no other way of improving the signal to noise ratio but to increase power. This is recognized by all who have any technical knowledge of the subject. There is one major drawback to high receiving stations. The high power stations have been in operation for some time and it is known that the people living close to the high power stations cannot receive any other stations without interference from the powerful station.

Confession of Obsolescence

Those who use their own receivers as proof that high power stations will blanket other stations by saying that high power stations give anyone who can get the receiving set on the air and on all settings of the tuning control merely tell the world that they are placing a pile of junk on the air. Receivers by themselves, when set on high, are usually hand set to the foolish recipients as a convenience on the part of the station, and it is expected that they will not be used for experimental purposes only between 1 a.m. and 6 a.m. The German stations have been placed in service, and strange to say, their characteristics are used as arguments against high power by those who have the greatest opportunity to improve their stations by the use of high power. There is, of course, a limit to the amount of power that can be hurled into the air by stations without causing interference since there is a limit to the selectivity that can be used practically, and the power of all receiving stations must be increased just as the service area is increased, but the service area is increased faster than the blanketing area. If the high power station is well located in sparsely populated places a few will be affected by the blanketing while hundreds of thousands will be benefited.

Study of Antennas

Even so, a limit must be placed on the amount of power, but that limit has not yet been approached. A power of 50 kilowatts has not created enough blanketing to justify a reduction, especially in view of the vastly improved service such stations have been rendered in the past. For experimental purposes even higher power should receive the encouragement by both officials and the public. Engineers believe that they can design and construct transmitting antennas so that the blanketing area will be reduced without sacrificing the service farther away from the stations. The idea is to construct the antennas so that the energy is radiated largely upward rather than along the ground, allowing a small spray, so to speak, to fall over the area immediately around the station. If that succeeds, receivers close to the high power stations will not be blanketed and, indeed, may not receive the station as well as receivers located from 5 to 15 miles away. Certainly, high power should be permitted for the purpose of working out this desirable condition. The problem cannot be solved on paper but must be solved or tested experimentally. It can only be solved on paper to the extent of determining whether or not experiments are likely to lead to a successful conclusion. Apparently there is a strong probability that suitable antennas will be worked out, for research organizations are already willing to spend huge amounts of money to test the suggestion.
It is conceded that the higher the power of a broadcast station, the better the service at a distance from that station. Signals will come in with less noise mixed with the programs. Satisfactory signals can be received from that station with less expensive receivers, and since the majority of the listeners can afford only the less expensive receivers it would seem that high power is desirable. This, at least, is the argument in foreign countries for increasing the power of stations.

But European conditions are not American conditions. In Europe, where the above argument is valid, listeners are satisfied with one or two programs. In this country nobody is satisfied with less and programs are built on a thousand different channels. The most modern receivers are modern must not be living in the millennium. Today, in the year 1930, there are no such receivers, and there will not be at least for ten years. The most modern receivers in the year 1929 are those of 50-kw. for the 1930 receivers have not yet been offered to the public. Among the very best of the 1929 receivers there is one that will perform that stupendous task set forth in the preceding paragraph. Moreover, if there were one which even approached such performance, that receiver would not be one of the best, but it would be the worst receiver. Indeed, it would not even be a broadcast receiver, for it would tune out all which constituted the program.

Even when we are using the best modern receiver we have station interference, and plenty of it. True, we may be able to receive a station 1,000 miles away without offensive interference from a station of equal power located ten miles away, but if we are one mile from the local the situation is quite different. The signals are so close that advertisements will be unattended. High power stations, as those of 50 kw., have not yet been designed to cope with the high signal strengths laid down by the high power stations, and those that are intended primarily for high quality local reception. They are not as sensitive as the high power stations, and those of 1,000 kw. are not included in the group. In the year 1930 there are not one that will perform that stupendous task set forth in the preceding paragraph. Moreover, if there were one which even approached such performance, that receiver would not be one of the best, but it would be the worst receiver. Indeed, it would not even be a broadcast receiver, for it would tune out all which constituted the program.

Modern Selectivity

We hear so much about modern receivers of high selectivity, receivers so selective that if they are placed in the shadow of the antenna of a 200-kilowatt station they are capable of selectivity. Some even promise to reduce the slight interference from the giant near by, even when there is only a 10 kc separation between the carriers of the two stations. Listen to advertising! Should we permit these advertisements to be living in the millennium? Today, in the year 1930, there are no such receivers, and there will not be at least for ten years. The same modern receivers in the year 1929 are those of 50 kw. for the 1930 receivers have not yet been offered to the public. Among the very best of the 1929 receivers there is one that will perform that stupendous task set forth in the preceding paragraph. Moreover, if there were one which even approached such performance, that receiver would not be one of the best, but it would be the worst receiver. Indeed, it would not even be a broadcast receiver, for it would tune out all which constituted the program.

The Shout of Modern

The truth about the modern selective receiver is only a war cry of those who want to saturate the air throughout the country with their advertising and those who want to sell their latest model. The receiver of 1926 is just as sensitive and just as selective as the set of 1930. The later receiver simply has a few more adjuncts supposed to be improvements. They are improvements on the same nature as the handle or front of a broom. In the year 1930 there are no such receivers, and there will not be at least for ten years. The same modern receivers in the year 1929 are those of 50 kw. for the 1930 receivers have not yet been offered to the public. Among the very best of the 1929 receivers there is one that will perform that stupendous task set forth in the preceding paragraph. Moreover, if there were one which even approached such performance, that receiver would not be one of the best, but it would be the worst receiver. Indeed, it would not even be a broadcast receiver, for it would tune out all which constituted the program.

The Shout of Modern

The shout about the modern selective receiver is only a war cry of those who want to saturate the air throughout the country with their advertising and those who want to sell their latest model. The receiver of 1926 is just as sensitive and just as selective as the set of 1930. The later receiver simply has a few more adjuncts supposed to be improvements. They are improvements on the same nature as the handle or front of a broom. The device is contrived to show that the earlier model is out of date, and not devices to make the performance of one better than that of the other.

There are countless people who have receivers giving good service so long as they are not blanketed by a local high power station. Some people should be educated on how to reach more people should we permit the stations to increase their power so that these thousands of people have no choice of programs, but must listen to advertising! Should we permit these advertisements to be as loud as one other can be heard? Should we permit hundreds of thousands of receivers to be forced out of date, in order to make advertisers pay for the traffic? It may be that in the future high power will be standard and that the receiver of the 1926 or 1927 will not be a receiver of the 1930. The receiver still has the higher power must not come too rapidly, for there are too many receivers in service not suitable for high power. Not all the receivers are of the 1928 or later models. Those who still have the earlier models are not in a position to get new receivers right away. And while they still have the old ones they are entitled to receive programs without an undue amount of interference. It is fortuitous, I think, that some of the Commissioners look out for the interests of these listeners, that they discourage a too rapid increase in the power of stations.

Small Stations Offer Variety

When there are many medium power stations most receivers can select any one of them without interference from any of the others. This, in several of the continental cities, where the stations carry hardly anyone need forego reception rather than to be offended. Out of a large number of stations the probability is high that at least one within the reception range of the receiver will carry a pleasing and entertaining program. When there are high powered stations only a few of them can operate, and if these carry offensive programs, the listener has no choice but to plug his ears or turn the sets off. And it will be admitted that many of the high power stations do carry offensive programs a large part of the time.

Many Quality Receivers

It might be contended that there are not many such receivers in existence and that the many should not be made to suffer for the benefit of the few. The fact is there are more of these receivers than is generally realized. There are countless home-built receivers which have been built for quality reception, distance reception being of no interest whatsoever to the owners. Shall the owners of these sets be compelled to listen outside for programs. When there are many medium power stations most receivers can select any one of them without interference from any of the others. This, in several of the continental cities, where the stations carry hardly anyone need forego reception rather than to be offended. Out of a large number of stations the probability is high that at least one within the reception range of the receiver will carry a pleasing and entertaining program. When there are high powered stations only a few of them can operate, and if these carry offensive programs, the listener has no choice but to plug his ears or turn the sets off. And it will be admitted that many of the high power stations do carry offensive programs a large part of the time.

When the Millennium Comes

When the day arrives and all receivers can be selective enough to exclude all stations not desired, no matter how strong the signals of these stations may be, and when the stuff received by these sets is as good as the high quality sets are now able to bring in, then it is time to change over to super-power stations. But that day is not even in sight, even by the most imaginative inventor. Radio is still in the stage where high quality and selectivity are mutually inconsistent, and that stage will last for a long time to come. Short-wave power stations are the most logical and will give the greatest number of people the best service. If people insist on getting programs from far places there are practical means for doing the same thing by short-wave relay. Of course, such pick-up must be done by the broadcast stations and cannot be left to the individual listener, but that is one of the penalties we must pay for the present lack of technical development, a lack which may not be filled until the millennium comes.

Therefore, with radio transmission and reception being what they are today and what will be their future, we have reason to expect at least for a generation, it is plain that it is in the interest of the majority of radio listeners that broadcasting be done with many medium power stations and that it be done with as little selectivity as possible. There will be a wider choice of programs and there will be less interference from cross talk, and the receivers now in use will serve their normal life of usefulness.
**Radio University**

**THE CIRCUIT DIAGRAM OF A COMPLETE RECEIVER IN WHICH A BAND-PASS FILTER IS USED BETWEEN THE ANTENNA AND THE FIRST TUBE.**

### Band Pass Filter Circuit

WILL you kindly publish a circuit incorporating a band pass filter between the antenna and the first tube? I prefer one in which the two tuned circuits are coupled by a small inductance coil.—N. T. R.

Fig. 832 is a complete receiver having one band pass filter ahead of the first tube. It also has three standard tuners.

* * *

### Action of RF Choke

IF a radio frequency choke coil suppresses the high frequencies how is it that chokes are put in the screen grid and plate leads in many circuits through which signal currents of radio frequency must flow? Does not the choke make the set less sensitive than it would be without it?—D. R. D.

A choke coil would make the set less sensitive if the by-pass condenser always associated with it were not used. The choke prevents the radio frequency currents from flowing to the B supply and the condenser provides a short, low impedance path for them directly to ground or to the cathode.

### Identification of a Pure Tone

HOW is it possible to tell a pure tone from one having harmonics? Is there a simple method, will you please explain it to me?—O. T. K.

Those who have had a lot of experience can usually tell whether or not a tone is pure, but, of course, it is necessary to have an instrument with which to gain this experience. There are electrical methods for determining the harmonic content of tones but they are rather complicated. Perhaps the simplest instrument is a cathode ray oscillograph. This is capable of following practically all frequencies, which means that not only will it show the wave form of high frequency waves, but it will show the exact shape of complex waves of lower frequencies. Oscillographs employing a vibrating mirror are not fast enough for the higher audio frequencies. When a tone is pure the wave form is a sine curve.

* * *

### Coils for .0005 Mfd. Tuning

I have a quantity of No. 28 double silk covered wire and 2-inch bakelite tubing. With this material I wish to make coils for screen grid tubes and .0005 mfd. condensers. Please give the primary and secondary turns required.—B. R. D.

Assuming that the wire winds 60 turns to the inch, you will need 54 turns. This also assumes that the distributed capacity is 25 mfd., so that when all the capacity of the variable condenser is used the total capacity in the circuit is 525 mfd. The primary winding, which is to be connected in the plate circuit of a screen grid tube, might have the same number of turns as the secondary, and it should be put on the same form next to the secondary. A good transformer may be made by putting the primary winding on a piece of tubing which will just slide over or inside the secondary, still using about half as many turns as on the secondary. This tube can be moved in and out to secure the optimum coupling.

In case it is desired to tune the primary this winding should have the same number of turns on the same form as the secondary in the previous case. But the secondary in this case should have at least as many turns as the primary and closely coupled to it. It may be wound on a piece of tubing which either fits inside or outside of the primary. Except in special cases it is better to tune the secondary.

* * *

### Coupling Oscillator and First Detector

WHICH in your opinion is the best method of impressing the local oscillation on the first detector? In many circuits it is impressed by coupling a grid coil to the oscillator in series with the grid circuit of the detector. In other cases it is impressed similarly in the screen grid circuit. I have also seen Superhetrodynes in which the oscillation is impressed on the plate circuit of the detector.—F. L. T.

For equal coupling between the first detector and the oscillator there is almost no difference among the several ways. The difficulty is to get just the right amount of coupling. Putting the pick-up coil in the grid circuit of the modulator tube, or first detector, has always been regarded as one of the best ways. Putting the pick-up coil in the screen circuit has not been so popular largely because Superhetrodynes have not been so popular since the screen grid tubes became available. Possibly, these methods, or slight variations of them, are the best.

* * *

### Shielding Sensitive Receivers

IS it REALLY necessary to shield all the parts separately in a multi-tube receiver? For example, is it necessary to put the tubes in separate shields, and the tuning condensers, and the tuning coils? Or is it sufficient to separate the stages by means of shields?—T. E. S.

It depends somewhat on the layout of the receiver and on its sensitivity. As a rule, it should be sufficient to separate the stages by means of shields. But in adopting this method it is necessary to remember that every part and lead in the plate circuit of any tube should be shielded from every part or lead in the grid circuit. It frequently happens that even when the tubes, condensers and coils are separately shielded, grid leads are exposed to plate leads in such a manner that the shielding effect is partly lost.

### The Three Types of Detector

UNDER what conditions do you recommend power detection? I have noted that some of your hook-ups you have recommended power detection, in others grid bias detection, and in still others grid leak and condenser. What is the basis on which you decide which type is best?—O. J. N.

Power detection (high negative bias) is used when there is a great deal of radio frequency amplification and when it is desired to use only one stage of audio. Grid bias (medium negative bias) detection is used when there is much radio frequency amplification and when two or more stages of audio amplification are used. Grid leak and condenser detection is used when there is not so much radio frequency amplification and when there are two or more audio stages. There are no hard and fast lines of demarkation, and it is largely a matter of judgment when the radio frequency amplification is sufficient to support power detection.

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*Fig. 832.*
Leakage in Resistance Audio

I HAVE a resistance-amplifier coupled which has given splendid service for about two years, but lately it has begun to misbehave. When I first turn it on it plays all right for a minute or more, but then gradually dies down so that nothing comes through. This trouble is worse some days than others and at certain times the set plays just as well as ever. I can't say exactly what the trouble is. Please suggest the cause and remedy.—W. H. K.

This question comes up often and complete explanations have been given many times. But since the trouble occurs so frequently it is well to repeat the explanation. The trouble is due to leakage from the positively charged plate to the control grid. The leakage may be over the insulation of the socket or it may be due to leakage of the stopping condenser or the resistance mounting. It may even be due to leakage inside the tube. Dust and moisture on the insulators may be responsible. Since the trouble varies from day to day it may be that moisture is the main cause of the trouble in your case. First remove all dust on the insulators on the sockets, resistors and control the volume more thoroughly. Because the dust may be carbon or may contain material which becomes a conductor when it absorbs moisture. If this does not help try new stopping condensers. It may be that one has sprung a leak. Still another remedy is to lower the grid leak resistance. A lower value grid resistance will permit the positive charge to leak off and allow the grid to maintain the proper negative potential. If the leakage is very great this is not a good remedy and the leak must be found and stopped.

When Volume Is Automatic at AF

I HAVE noticed that in all commercial sets incorporating automatic volume control the radio frequency voltage impressed on the detector is controlled. Why would it not work better if the audio frequency voltage on the grid of the last audio tube were taken to operate the volume control tube? This is much greater than the radio frequency voltage and could control the volume more thoroughly. Using the audio frequency voltage would only control the modulation, not the volume. That is, when a fortissimo passage constituted the signal the intensity of this would be reduced, and when a pianissimo passage constituted the signal this would be strengthened. The whole thing would be very monotonous as far as modulation is concerned. With a radio frequency voltage controlled the modulation remains the same as it is at the transmitting station and the fortissimo and pianissimo passages retain their relative strength.

Wind of Sound Puts Out Candle

R ECENTLY you referred to the intense wind that accompanied certain tones and stated that this wind may be stronger than any hurricane. I have also heard that a candle can be put out by means of intense sounds. Is the candle put out by this wind to which you referred? I wish to experiment with this and would appreciate to know what frequency should be used.—E. T. S.

Yes, that is the wind which puts out the candle. The higher the frequency and the louder the sound the more intense is the wind. But as the frequency increases the wavelength of the sound becomes smaller compared with the size of the flame and therefore the heat around the wick is not carried away so fast and the wick is not carried away to the extent that the light is not put out. It is well to try frequencies such that the dimensions of the flame are about half wavelength. The wavelength in feet is obtained by dividing 1,000 by the frequency. A 10,000 cycle frequency would have half a wavelength of 0.06 inches.

Modulator Plate Filtration

I S IT PRACTICAL in a Superheterodyne to suppress the radio frequency currents in the plate circuit of the modulator by means of a parallel tuned circuit in the plate lead? If so, is this more effective than the usual by-pass condenser? To what frequency should the parallel circuit be adjusted, assuming that this method is practical?—P. E. A.

It is not practical. The only frequency to which it could be tuned is the intermediate frequency, and if it is tuned to that it is in series with the set. But such a filter can be used to advantage in the second detector. Here, too, it should be tuned to the intermediate frequency. Even when this is used there should be a condenser across the line next to the tube in order to suppress harmonics of the intermediate frequency.

Double Tuning's Effect

W HEN THE primary and secondary windings of a radio frequency transformer are tuned exactly to the same frequency is the tuning peak not much sharper than when only one is tuned? I ask this question because this seems reasonable to me yet I have heard that such a tuner gives two peaks. If it does I cannot see how it happens.—B. N. S.

The tuning characteristic of such a tuner has a double hump. There are two tuned circuits coupled together by means of the mutual inductance. This constitutes a band pass filter of the same sort as one made of two tuned circuits coupled together by means of an inductance coil. The closer the inductive coupling between the two tuned circuits the farther apart are the two humps, and the more selective they are. The deeper is the hollow between the two humps. If the two windings of a radio frequency transformer are tuned the selectivity characteristic will not be satisfactory unless the coupling between the two circuits is less than the critical, which is loose coupling indeed.
First Protest Made
On 50 Kw for WOR

Protest against the issue to WOR, of Newark, N. J., of a construction permit for a 30,000-watt transmitter, on the ground that WKBO, Jersey City, which sends out many religious programs, would be blancketed, was made by the Young People’s Division of the Methodist Episcopal Church and Epworth League. A telegram sent to Senator Keenan at Washing-}

The Federal Radio Commission has put over until Fall action on applications for 50,000 watts.

The latest application received, that of WOR, Newark, N. J., concerns the First Zone, in which WEAF, New York City; WGY, Schenectady, N. Y. and WTIC, Hartford, Conn., now use 50,000 watts, while a construction permit for 50,000 watts has been issued to WABC, New York City, which is now using 5,000 watts. WGY operates full-time on the same wave as its 7,500-watt sister station, KGO, Oakland, Calif., so during part of the time both are on the air at the same time, WTIC is on the same frequency as three other but smaller-powered stations and shares time with WBAL, Baltimore.

Three Groups Listed

Since KFI, Los Angeles, has been granted a construction permit at 50,000 watts, the situation is as follows:

Stations now licensed at 50,000 watts: WBAP, Fort Worth, Tex.; WEF, WENR, Chicago; WFAA, Dallas, Tex.; WGY; WLW, Cincinnati; WTAM, Cleveland; WTIC, KDKA, Pittsburgh. Total, nine stations (eight transmitters, as WBAP uses the WFAA transmitter).

Stations possessing construction permits at 50,000 watts, but not yet licensed at that power: WABC, WL; Chicago; WOAI, San Antonio, Tex.; KFI, Los Angeles; KMXO, St. Louis, and KXN, Los Angeles. Total, seven.

Stations that have applied for 50,000-watt construction permits, on which action is pending: WAP, Birmingham, Ala.; WCFI, Chicago, Ill.; WPIM, Indianapolis; WHAM, Rochester, N. Y.; WHO-WOC, Des Moines and Davenport, la.; WOR, Newark, N. J.; WOWO, Fort Wayne, Ind.; WRVA, Richmond, Va.; WSB, Atlanta; WSM, Nashville, Tenn.; WVT, Detroit; KGO, San Francisco; KFW, Scranton, Pa.; Total, fourteen. (WHO-WOC, now synchronized, are rated as one station.)

Problem in First Zone

The Commission has limited the number of cleared channels to twenty, or four to each of the five zones, so that the 50,000-watt broadcasters, plus the construction permit holders and the applicants awaiting action, are nine in excess of the maximum.

In the First Zone, for instance, there are three 50,000-watt transmitters now, whose key is pending: WAP, Birmingham, Ala., and another, WOR, has an application on file. If WEO is granted 50,000 watts, while WGY has the same power, the First and the Fourth Zones might be taxed with only one full cleared channel for each such station, which would open the way to granting 50,000-watt licenses to both WABC and WOR.
Believing that improvement in record-ings and methods of reproduction was par-ticularly needed, the Ten-nessee Com-mission, in its present test by WOR, has gone far in putting records on the air in the afternoon.

There were not standard phonograph records but are specially made for broad-casting, the object being to enable sta-tions to present excellent musicians and voices by playing of phonograph records, as beyond the record's fin-an-cial reach if personal performance before the microphone were required. Such spe-cial records issued by Sound Studios, Inc., Brunswick, Columbia and Stanley, while other plans to enter the field.

So that experiment heard the original artist, and also the records, through the microphone circuit, listening to a loudspeaker in an other than their usual building.

Many Couldn't Tell Difference
Not having been told in which order the demonstrations were to be given, they listened carefully, and enough could not dis-tinguish between the two, or picked the wrong one, to heighten their confidence in the feasibility of using the recordings on the air. Also, the output quality, at the reproducing unit, was measured on an oscillograph, and found to be so excellent that it was felt no complaint could be made reason-ables if records were used, especially during "off hours," for the time being.

There has been much prejudice against the reproduction equipment, be-cause in the early days of broadcasting the air was overladen with this type of "phony" air. Never before have the stations often tried to create the impression that an orchestra was playing in the studio. The "phony" air was credited to many a performance that the Victor Or-chestra had committed to a record. Be-sides, electrical recording was not used in those days. The reproduction unit and tone chamber were different, so the quality, even listening to a phono-graph, was not as good as present.

Western Electric apparatus has been installed at the New York branch studios of WOR, at 1440 Broadway. Four turn-tables are on hand. Two revolved thirty-three minutes a minute, the other pair seventy-eight minutes a minute. They are driven by twin motors. The new records enable the produc-tion of a continuous program, as a mecha-nical means is provided for auto-matically switching from one record on the verge of completion, to the other, that starts where the first one left off. There is a little overlapping when the same thing is being played by both records.

It is said that the needle scratch has been virtually eliminated and that the reproduction equipment has the play-ing of the finest music without attenua-tion of any frequencies due to recording or reproduction or any other cause.

Station Takes Bold Stand
WOR's stand in the matter was taken enthusiastically and marked a bold de-parture, as it is a 5,000-watt station, with a reputation for putting on good pro-grams. It is an executive key station of the Columbia Broadcasting System, under contract, but now is an individual sta-tion, furnishing its own programs exclus-ively, except for the lease of the play-eing of the music with equal right, as the Federal Radio Commission would take care of them. WABC is using 5,000 watts now, but has a construction permit for 50,000 watts, and is awaiting the issue of a license to put the station on that power. When the transmitter would be erected on a 50,000-watt capacity basis. The construction permit specifies WABC must move to an approved site before getting a 50,000-watt license.

No Records for NBC or CBS
In contrast with WOR's attitude on playing even special records, the Colum-bia Broadcasting System, with WABC in New York, and the National Broadcasting Company, with WEAF and WJZ in its key stations, state that they do not play special records in broadcasting. In fact, the NBC even asserts that when a continuity calls for the playing of an orchestra, or sometimes happens in a sketch, the orchestra present in the studio or some singer or inst-rumentalist takes over, imitates a phono-graph rendition aided by appropriate sound effects!
Records for the Air

RECENTLY great progress has been made in electrical recording and reproduction, so that special records for broadcasting are near enough to perfection to justify the purpose for which they were intended.

Many stations, even some using 5,000 watts, find it extremely difficult to fill the air with programs during the day, especially during the evening hours. While some stations may clamor for more time on the air, it may be only because they do not think that they can not make use of the time already allotted! Stations that put fine programs on the air will have little trouble. The public need not feel now that it is being cheated. That feeling was justified in the early days of broadcasting when standard phonograph records were played mechanically, and an unforgivable output of records was introduced into the wave. Feeding a fine record into a microphone and a loudspeaker, until the wave was audible, the wave was received on sets that themselves produced indifferent results. This mitigated the acoustical offensive somewhat, on the general good ear not offended, but the public was not to be heard to complain against each other. But the moral offense was without mitigation.

The phonograph records were played and played, and all the while unashingly announced as rendering the best orchestras.

Even to-day, it will surprise chronic chain listeners to learn the use of phonograph records. The sale of records for 75 cents, is frequent at small stations, some of which stations even have "sponsored programs," consisting of nothing but these cheap records, with complimentary remarks about the advertiser and his product made before each and every record is played. It is so enormously expensive to supply first-class talent that one has to temper any tendency toward criticism of our grade broadcasting with the thought that perhaps poor taste is less to do with than has the state of the finances. Small local stations have a small service area, attract only local concerns as advertisers, get little for what they give, and have a hard struggle. Then along comes an improved method of recording and reproduction, whereby it is difficult to tell the difference between the record of the performing original and the one put on the air. In connection with this recording of the performer originally. Besides, no standard records can be used, but special records of the performer himself, and the whole system so united that by automatic switching from one record to another any precision can be given, easily a full hour! If this is not a Godsend to the small station struggling to offer a better program, but handicapped financially, what is?

When we come to the larger stations the aspect is different. The desperation is absent, and the air is now more interesting. The evening hours are filled with fine programs. The desire for excellence is there. There is an attempt to be different. The people want their choice. They are demanding more. They are beginning to listen to the stations and to judge them on their worth. They want to hear something worth while. This is what the stations are trying to give.

Special radio records, as evening offerings. In the evening this station, situated in Newark, N. J., and maintained on behalf of its owner, puts on excellent programs. There are times during the day, however, when its output is not as good. The station has its problems. Despite its 50,000 watts, it is not doubt pressed hard for first-class offerings during some part of each day. Is it better to offer something of a different nature, because it is being sung or played, or must it be better to offer the recording of a superior and original program?

Great stations no doubt will not seize upon the recorded program. The pride of preservation of original in person runs high, and it is creditable that the National Broadcasting Company and the Columbia Broadcasting System feel this pride. They do not trust too implicitly on the powers they possess both by Federal grant and by their own natural ability to use phonograph records to their great advantage. This mitigated the difficulties of broadcasting, and even some of the first-class stations are beginning to use phonograph records at their key stations, or at any stations they control.

The programs that may be found in the recorded program is not now theirs. The small stations are the ones mostly concerned, even some 5,000-watt stations using clear channels having an air monopoly.

Starting as "fillers" the recorded programs may rise to such importance that instead of the high-priced talent, the phonograph may take the place of the high-priced talent, the phonograph may and now that, instead of the air being monopolized by the station, it may be as monopolized by the station, it may be monopolized by the station.

As a matter of fact many stations now use phonograph records for the evening offerings, and in some cases for the entire day. The idea is catching on, and the results are encouraging.

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WASHINGTON

Answers to the Federal Government's suit for alleged conspiracy in restraint of trade and monopoly, were filed by Radio Corporation of America, Westinghouse Electric and Manufacturing Company, and other defendants, in which they deny any violation of law. It is admitted a patent pool was formed and that among the primary defendants interlocking stock ownership existed, and also that by licensing was established, but there was no illegal intent or effect in any of these acts.

Main Question Relates to Legality

From the answers it is apparent that the main defense is in disputing the law of whether, the acts complained of are illegal. Some disputes are forecast as to matters of fact, including whether the pool and all that go with it were authorized by law. Also, the answers indicate that the acts of the pool were the acts of the pool itself, and not of the separate companies.

In reference to the time prior to 1919 the RCA answer states in part:

"Radio Corporation contracts, upon information and belief, that no one of the primary defendants (except Radio Corporation, which did not exist), then owned or otherwise controlled large numbers of patents and patent rights relating to various features of radio, many of which were useful, or otherwise productive, use and sale of radio apparatus in combination with inventions of the other primary defendants. Such inventions were owned by each company or owned by others not subject to the patents of others necessary or useful for producing a satisfactory and efficient system of radio communication, and that the patent conflicts were such as to render the establishment of an effective radio system or substantial progress in the field of radio communication impossible, and that the result of establishing such system or substantial progress in that field would be that no one of the primary defendants alone could use the same, and that the result of establishing such system or substantial progress in that field would be that no one of the primary defendants alone could use the same, but that the result of establishing such system or substantial progress in that field would be that no one of the primary defendants alone could use the same.

Many Patents Held

Regarding the patents the RCA answer sets forth:

"Radio Corporation admits, upon information and belief, that other defendants separately own and control many patents relating to various features of radio apparatus, excluding more than 4,000 patents in the aggregate. It avers that these patents relate to an art which has gone through an intense and very active development in recent years, a large number of such developments being due to the co-operative inventive work of the research and engineering departments of these primary defendants. In such development it was inevitable that many of the inventions for which patents were obtained would, as they did, prove to be of no practical or commercial value; that many others would become superseded by later inventions, and have become obsolete; and that that the public interest, as well as the public interest, as well as the public interest, as well as the public interest, as well as the public interest, as well as the public interest, as well as the public interest, as well as the public interest, as well as the public interest, as well as the public interest, as well as the public interest.

"That the development which has been conducted by these primary defendants has created and is creating a large industry in the field is in large measure to the fact that the cross-license agreements, referred to in the petition, have made possible and required the exchange of technical information between these defendants so that, by concerted effort, results have been secured that would otherwise have been impossible.

LITERATURE WANTED

T

HE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank at bottom may be used for a post card or letter will do instead.

RADIO WORLD

141 West 45th St., N. Y. City

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Sean P. Miller, 117 Pine St., St. Paul, Minn.


C. A. Felter, 2233 Calendar Ave., Chicago.

Anthony Weinberg, 2720 South Parkway, Columbus, Pa.

2916 1-6 Ave., Council Bluffs, Iowa.

C. J. Schrock, 100 Eastport, Ltd., Andrew VeVeance, 922 Wager St., Columbus, Ohio.

Floyd Wilkins, Seaside Park, N. J.

Andrew Henry, 134 W. Martin St., Del Rio, Tex.

C. A. Kompore, 152 N. 5th Ave., New Rochelle, N. Y.

J. M. Winer, 5 Columbus Circle, c/o Dynamic Radio Service, New York, N. Y.

Charles Pierce, 435 6th Street, Monongahela, Pa.

Norman Bernstein, 627 Todd St., Phila., Pa.

James Ringle, 1726 Park St., Cedar Rapids, Iowa.

Troy L. Thompson, R. F. D. No. 1, Dry Fork, W. Va.

L. P. Waterman, 2131 Kirby West, Detroit, Mich.

M. P. Kovalcheck, R. F. D. No. 2, Ashby Park, N. J.

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New Incorporations

Breakfast Treat, radio broadcasting—Attys. Harry, Wainwright, Thaxter & Symmes, 72 Wall St., New York, N. Y.

Joseph F. Fillmore, radio equipment—Attys. Louis D. Schwartz, New York, N. Y.


Y. Lenox Radio Stores—Attys. Klein & Klein, 105 Brevard St., Asheville, N. C.

Howard—Attys. N. Herbstman, 50 East 42d St., New York, N. Y.

Pyte Radio Corp., Wilmington, Del.—radio suppliers—Delaware Registration Trust Co.

Generale Radio Corp.—Attys. Tompokcy & Tromvsky, Utica, N. Y.


Radio Film Shooting Device Co.—motion picture apparatus—Attys. F. W. Schoen, 10 East 46th St., New York, N. Y.

MONOPOLY NOW A REAL DANGER, SAYS ROBINSON

COLUMBUS, O.

In a recent speech here before the Institute for education, Fred A. Robinson, Federal Radio Commissioner, and formerly chairman of the Radio Commission, indicated that the monopoly of the air and declared there is no property right, but only a trust, held by a station by virtue of its license.

The remarks came at a time when the Federal Government was suing Radio Corporation of America, Westinghouse Electric and Manufacturing Company, the American Telegraph and Telephone Company and others, charging monopoly and conspiracy in restraint of trade, and also at a time when the question of whether there is a property right attaching to a license to use a wave length is before the United States Supreme Court for settlement.

Commissioner Robinson did not charge specifically that there is a monopoly, but guarded his words. He quoted Herbert Hoover's remarks, made before a House committee in 1925, when Hoover was Secretary of Commerce, warning that a monopoly of the air would be dangerous.

"Monopoly Claimed by Group"

"Notwithstanding this early and prophetic warning," said Commissioner Robinson, "it can not be gainsaid that a monopoly of radio is now insistently claimed by a group, and its power and influence are so subtle and effective as to portend the greatest danger to the fundamentals of American republican government. No greater issue presents itself to the citizenry."

"Accordingly property right in the air," said Commissioner Robinson, "Congress, by salutary law, has stamped radio as the people's own. It is to be enjoyed for the public interest. By congressional mandate it is so licensed. No license can have a property right unless the public is present in the air. It is merely a trust for the public. He holds his license indeed with the promise that his signal to a station is an exchange therefore a general public use."

FOR BETTER OR WORSE

He referred to radio as "the greatest implement of democracy yet given to mankind" and continued: "What a power for good has radio! And yet what a power for ill!"

The Commissioner landed the procession of teaching, and lamented that he had not continued his early start as a teacher, as "a better service could have been rendered by me than has been rendered in all my public career."

Commissioner Robinson is a former Judge from West Virginia.

PORTABLE TRANSmits FROM COURSE

A special portable transmitter was employed recently in the national open golf championship finals from the International course at Minnesota. The transmitter was carried around the course by Ted Heusing, Columbia Broadcasting System announcer.
POOL TO ALLOW MANUFACTURE OF "SUPERHET"

The Superheterodyne patent has been released by the radio patent pool from exclusive use by Radio Corporation of America and Graybar, so that all the licensed set manufacturers may market factory-built Superheterodynes, if they desire. The release took the form of an agreement to existing licensees.

There have never been any licensed Superheterodynes of any kind on the market except those sold by RCA and Graybar, these being the same sets, only bearing different labels.

Most Difficult to Engineer

Screen grid tubes and other developments enabled manufacturers to build highly sensitive and selective tuned radio frequency receivers that had stability of operation, as well as sensitivity, and that are more easily maintained at a high level by Superheterodyne construction, even though other problems exist. The superheterodyne is the most difficult circuit to engineer for quantity factory production, but the patent pool important in the development of the type of its own experience in the solution of such problems, and also has a special experimental department for meeting individual problems of manufacturers pertaining to circuits.

A superheterodyne was originated as a circuit used by the Allies to intercept relatively low-wavelength messages of the Germans, and permit amplification at high wavelengths where stability was more easily attained. Therefore enemy signals could be detected and decoded. With the present growing interest in short-wave reception, it is considered likely that any manufacturers that will care to put a short-wave receiver on the market will be able to the Superheterodyne, but the tuned radio frequency receivers for the 1930-31 season already are in production.

Drift of Popularity

In the early days of broadcasting the regenerative receiver was the most popular, as it accomplished much with few tubes. Then the Neutrodyne was introduced, enabled reception without squelching and without critical tuning adjustment. The advent of the screen grid tube introduced stability, plus increased sensitivity, in tuned radio frequency receivers, and crowd the Neutrodyne out of importance. Meanwhile the Superheterodyne had been featured as a high power receiver at a high price, but in the last few years the prices were reduced, in line with general reduction of prices of sets, and for 1930-31 a screen grid Superheterodyne, the first factory-made set of its kind to appear on the market, will be the same sets, only with different labels. RCA plans to have a lobby display of its receivers in all Radio-180-theatre.  

Models and Prices

Although these screen-grid Superheterodynes will not be released until next month, with official price announcements and following are the model numbers and reprinted prices.

No. 80, price $142.
No. 81, price $171, due to better console.
No. 86, same chassis, with phonograph pickup and motor built into special console, $250.

They Say

DR. LEE DE FOREST, inventor of the vacuum tube: "I believe that the whole broadcasting situation must be revolutionized and rearranged before we can get on a sane basis of broadcasting. At present there are more than 600 broadcasting stations in the United States. I am convinced that were fifty large, high-powered stations located throughout the United States, connected up by chain, and each station having a power of 200 kilowatts, every one in the country would be able to pick up programs of at least ten of this group of stations. Each one of that ten would be sending out all kinds of definite types of programs of the highest kind; the listeners are to be devoted to classical music, symphonic and opera; another would transmit only the lighter types of music. A third station would specialize in dance and jazz music. Each type would be of the highest quality at all times. Thus, by tuning to a particular station, you might be assured of a particular type of program. In addition there might be 100 local transmitters of the tuning for broadcasting local news and programs sponsored by local merchants."

EDWIN K. COHAN, Columbia Broadcasting System: "The progress made in attempting to operate a number of stations simultaneously on a single wave has been so satisfactory that the conservative must assume that the synchronization of a large group of stations, extending, perhaps from coast to coast, will be realized."

JOHN ELWOOD, vice-president, National Broadcasting Company: "When education joins hands with radio it enters the show business with imagination. Education by radio is to reach its highest degree of value it must conform to the practices of the show business. Some one has said that information, in order to be popularly received, must be sugar-coated. We have been discussing the kind of education with chocolate or licorice or peppermint if we are going to reach the people to whom the information should be most welcome. Therefore, therein, must the sugar-coating of entertainment in so far as it is humanly possible to do so."

NEW CORPORATIONS

Temple of Music Store, Lynbrook, N. Y., radio—Artt, B. B. Turken, 105 Court St., Brooklyn, N. Y.
The Ohio Supply Co., Inc., Long Branch, radio supply—L. S. Brownworth, Long Branch, N. J.
The Dale Co., Wilmington, Del., radio tubes, wireless and radio sets—Carl, Trust Co.
Electro-Broadcasters, Corp., radio broadcasting—A. A. Saposker, 211 West 42nd St., New York, N. Y.
No-Radio Stores—Atty., M. Davidoff, 465 Broadway, New York, N. Y.
United Broadcasting System, Inc., Wilmington, Del., general radio network and broadcasting—Corp. Trust Co.

STATIC ABSENT, 1 TO 7 METERS, SAVANT INSISTS

Breslau, Germany.

The frequencies 300,000,000 cycles to 42,000,000 cycles (1 to 7 meters) are exceptionally well suited for clarity of reception, according to Prof. Albert Esch of Jena University, who has been conducting experiments in Germany.

He found that modulation was carried much better on these high frequencies than on the usual broadcast frequencies, and that the attenuation of high audio frequencies due to selectivity was totally absent, giving speech a crispness and intelligibility beyond that ordinarily experienced.

Also, he found that static, both natural and man-made, was virtually eliminated. For these reasons he is championing the development of use of these high frequencies for broadcasting of programs.

Uses Short-Wave Converter

His experiments were made with a converter, consisting of three tubes, which was connected to a broadcast receiver. The incoming high frequencies were tuned in by the converter which, by the superheterodyne process, changed the short waves to the lowest wavelength to which the broadcast receiver could be tuned, which was 176.5 meters (1,700 kc.).

The Professor states that from his experiences he had progressed, the short waves used could be regarded as "immunes from both transmissions and interference."

Also, he believes that for the total advantage, this was said to be due to the high ratio of the carrier frequency to the modulated wave.

The Professor teaches physics at the university, and he has included in his course a discussion of short waves. Students are required to make some experiments on their own account, and are encouraged by the Professor to use the converter type of reception, because of the greater case of static which will be cut off, and the extra expense for short-wave reception is small.

Results Compared Scientifically

It is planned to conduct some experiments with the aid of German stations. At present the Professor is doing some transmitting himself, to afford reception suitable for comparison. He has the audio component measured as to wave form and frequency characteristics at the sending end, and again at the receiving end, so that his superimposed oscillograms will have some standards.

Much interest is being manifested in short waves in Germany, and the rage has seized the imagination of the students.

Pool Plans to License Without $100,000 Minimum

The patent pool is having difficulty collecting royalties from licensed set manufacturers. It is reported that only three sets manufactured to date are in line of payment of royalties. The contract calls for a minimum royalty of $100,000 a year, but the licensees pay more, if 7½ per cent. of the total business done exceeds $100,000. The proposed plan is a straight 7½ per cent., without any guaranteed minimum, since the guaranty is no better than the certainty provided thereby, and in place a deposit would be required to guarantee payments, depending on the prospective scale of business and the credit standing. For AA-I credit of $50,000 or more possibly no deposit would be required.

Atwater Kent and Majestic have paid the largest royalties.
The Bulova Watch Company, states the National Better Business Bureau, Inc., gives the impression it is broadcasting time signals from Bulova at its observatory, whereas executives of the company and of the advertising agency that is issuing the radio signals are based on time given by Western Union clocks.

The Bureau issued a pamphlet entitled "The Bulova Observatory," on the title page of which is this statement: "Investigations show that Bulova Watch Company is broadcasting time signals in broad- casting Bulova time announcements."

The Bulova time signals are familiar to radio dealers, for thousands of them pass from station to station. The company's advertising investigated by the Bureau and findings set forth in the report.

**Lack of Investigation Charged**

The advertising agency is the Biow Company. Milton H. Biow, president, said:

"The entire bulletin shows a thorough lack of investigation on the part of the National Better Business Bureau. After all, it is difficult for them to pass judgments on matters of astronomy, and it is only natural they will let themselves in for situations of this kind when the touch on ethics they know nothing about."

"Bulova stations broadcast time from accurate timepieces that have either been supplied by or verified and accepted by the Bulova Watch Company. Some stations undoubtedly used Western Union time, but that is certainly not all."

"The Bulova Company at no time made any claim, either directly or indirectly, that it broadcasts time taken from its observatory."

**Comparison's Ship's**

The report of the Bureau sets forth that Bureau representatives were permitted access to the observatory, which "consists of a sheet metal roof, 50 feet square, over an Avenue, New York, the dimensions being 5 feet wide, 8 feet long and about 6 feet 2 inches high."

"In the head of the agency," continues the report, "frankly acknowledged that the observatory was created for the purpose of disciplining the client's Fifth Avenue address."

The Bureau representative was informed, according to the report, that a Bulova astronomer carries a chronometer up to the booth from the Bulova offices and sets it where he can see the eleventh floor of the building when astronomical readings are taken, but the report compares this with the method used by ships in taking readings, where two or more permanently fixed chronometers are used, but one would not describe the bridge of a ship's observatory."

**A THOUGHT FOR THE WEEK**

Radio dealers, take heed: "There's nothing good or bad but thinking makes it so," said the Avonian Bard, who wrote for the centuries. Let's think that the radio business is good and then back it up by going after the orders. Don't be impatient. Anything worth doing takes time. Now we'll stop preaching and take some of our own medicine.
Voices travels around world in 1/5 second

Anti-Noise Man
Cows Store Owners

Riding on a train in Brooklyn, Edward F. Brown, director of the Noise Abatement Commission, and a Special Deputy Commissioner, Mr. Brown, heard loudspeakers at several radio stores, and came to the conclusion they were making too much noise. Recently an ordinance was passed making the noisy operation of a loudspeaker a violation of the Sanitary Code.

Mr. Brown got off the train and retraced his steps until he had interviewed the owners of six stores before whose loudspeakers he proceeded to place an equipment of a very high volume. The owners had heard about the new ordinance, and when Mr. Brown questioned them in noise abatement they consented, and he went on his merry way home.

NIELDS NAMED AS U. S. JUDGE

The efforts by Senator Dill, of the State of Washington, and others, to have Hugh M. Morris remain as judge of the Federal District Court in Delaware, have failed. Senator Dill went so far as to ask President Hoover to interfere, after Judge Morris had sent in his resignation. The reason given privately by the Judge for resigning was that he desired to improve his health.

Senator Norris, of Nebraska, had sided with Dill on the desirability of having Judge Morris remain, especially as the Government cases in suit against the radio pool are to try in the Delaware court.

In the Senate there were remarks made by both Dill and Norris about valuable public servants, defenders of the public interests, sometimes not staying in their positions, but choosing "elevated stairs" through the intervention of large corporate interests. They matched the fact that the Morris, through long experience, is familiar with the patent radio cases, and that RCA and the other defendants were about to appear in that court. Senator Norris recalled that Kenesaw Mountain Landis was made baseball commissioner at $50,000 a year while linking an advertisement for Samuel Insull, "who managed all the public utilities in Chicago," and when important litigation affecting First interests was about to come before the court. The Senate Judiciary Committee heard John P. Nields nominated Judge Morris to succeed Judge Dill. The session was executive. Mr. Nields was questioned on whether he had any connection with the defendants in the radio pool suit, and whether he had been attorney for Pierre S. DuPont, a large stockholder in the DuPont Corporation. One of the defendants in the Government suit. It was found he had no connection with his aid, or the pool suit and had not been Mr. DuPont's attorney, so the committee approved him.

Capital Police Get
Radio Station Permit

The Metropolitan Police Department has been granted authority to install a police crime detection and criminal apprehension service by radio, according to an announcement at the Federal Radio Commission.

WASHINGTON

President Hoover signed the Lowel bill, which confines the jurisdiction of the District of Columbia Court of Appeals to cases arising from decisions of the Federal Radio Commission. Unless it shall clearly appear in the findings of the Commission that the questions involved are of a character capable of being finally determined only on review and not only legal questions, but also administrative ones.

The object of the bill is to give greater weight to the administrative acts of the Commission, such as the issue of licenses involving hundreds of hours on the air, and power, because of a higher appreciation of finality attaching to such rulings.

The Commission has felt handicapped because of de minimis act, which in any event of importance that it performed was appealed to the court, and an injunction issued. Although the injunction was temporary, and might be dissolved, meanwhile an entire broadcasting set-up had to be postponed, and the Commission's decisions became regarded as of not much consequence.

Text of the Amendment

The bill amends section 16 of the radio act of 1927, so that the section now reads as follows:

"Provided, however, that the review by the court shall be limited to questions of law and that findings of fact by the Commission, if supported by substantial evidence, shall be conclusive unless it shall clearly appear that the findings of the Commission are arbitrary or capricious. The court's judgment shall be final, subject to review by the Supreme Court of the United States upon writ of certiorari on petition therefor under the provisions of section 21 of said Judicial Code by appointment, by the Commission, or by any interested party intervening in the appeal."

Passed both Houses Unanimously

The amendment is of a clarifying nature, since the administrative authority was assumed by the district court on the basis of original ambiguous phraseology. The present, the station, a rule on questions of fact, in the WGY case, which was argued for the station by Charles Braun Hughes, WGY, Schenectady, N. Y., appealed the Board's decision denying the station full time on 790 ke. and won. The Supreme Court interdicted its second appeal, ruling that the Supreme Court had no jurisdiction, as it passes on questions of law only, not questions of fact. So the decision of the lower court stood as rendered, and administrative matters have been reviewed freely by the lower court without. The bill was passed unanimously by the House and Senate.

Washington

A preliminary test was arranged in cooperation with Philips Radio of Holland, the Australian Broadcasting Corporation of Australia Limited of Australia, operators of 2ME, the powerful short-wave transmitter. Unexpectedly a technical hitch was put to test was successful. Within two hours after the test was instituted, Australia reported that it was getting Schenectady by way of Java and at the request of Schenectady put the signal through completing the circuit of the globe.

Record Played, Too

He described the route his voice was taking, the stations involved and the wavelengths used. As an additional novelty, a phonograph record electrically reproduced was sent via WXAD over the round-the-world circuit and reproduced on its return. The listeners of WGY only received the music was sufficiently clear in parts for listeners to identify it as "I Love You Truly." It was followed by a sign-off of each of the stations involved in the rebroadcast, first PHL, Holland, then PLW, Java, and PLW, ME. Sydney.

The entire "performance" was recorded on phonograph records.
"Seconds"
But Serviceable Tubes Nevertheless at Prices That Seem Incredible

A tube factory that maintains the highest possible standards for a large laboratory customer has tubes for sale that fall just a trifle below the most exacting specifications, but which are excellent tubes nevertheless. They are called "seconds" and they are "seconds," but they are not "thirds." You can get 500 hours excellent use out of these tubes. Remit with order. Generous replacement policy.

12A 52c 225c
UV or UX-195 52c 225c 50c
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234 65c 250c 50c
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50c each enclosed for 4 weeks' subscription for RADIO WORLD. Send socket wrenches free!

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GUARANTEED Neutrons! Tubes!
"Firsts" only—at Bargain Prices!

224 @ $1.20 UX-199 @ $1.20
250 @ $1.20 UVX-199 @ $1.20
210 @ $2.20 195, Navy base,
245 @ $1.20 191, @ $1.20
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30-day free replacement guaranteed!

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NEW DRAKE'S ENCYCLOPEDIA
1,600 Alphabetical Headings from A

battery to Zero Beat; 1,025 Illustrations, 828 Pages, 240 Combinations for Receiver Layouts. Price, $6.00. Radio World, 145 W. 45th St., N. Y. C.

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

Quick Action Classified Ads
Radio World's Speedy Medium for Entering and Sales

10 cents a word — 10 words minimum — Cash with Order

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FOR SALE—Ultradyn and Hi-Q0. F. L. Han
son, Ithaca, N. Y.


NEW NATIONAL THRILL BOX
Cat. ACSW5, National complete parts for 5-tube AC Short Wave Thrill Box; list price, $79.95 net price.

Cat. DC5W5, National complete parts for 5-tube battery operated short wave Thrill Box; list price, $75; net price, $65.00.

Wired by Jackson Laboratories, $1.70 extra. Add letter "W" to catalogue symbols.

AC model uses two UY22, three UY222, with provisions for pentode or RF stages or pentode. Cat. ACSW5 does not include power supply. Use suitable for home, hotel, vol. 160; 600 plate volts; Cat. 5300-AB, list. $34.50; 2000 Ohm, 2500 Ohm for the $2000 tube required. Order 288. Key tube @ $1.25.

Guaranty Radio Goods Co., 143 West 45th Street, New York, N. Y. (Just East of Broadway)


BARGAINS in first-class, highest grade merchandise. B-11, photograph pick-up, theatre type, suitable for home, hotel, vol. 2000; $10. Blue label link pick-up with vol. control and adapter, $5.00. Steel cabinets for HI Compact, $1.00; four lamp .0035s mil. with trimmers built in, $1.95; 1000 mid. Deducer grid condenser, 21 cents, inc. F. Cohen, Room 121, at 143 West 45th Street, N. Y. City.
Balkite Push-Pull Receiver

$44.00

Silver-Plated Coils

Wound with non-inductive wire, plated with cadmium silver, on ground form, these coils afford high efficiency because of their non-inductive resistance to the radio frequencies. The proved in the moulded boxed forms, the coils resist heat and humidity, thus reducing distortion. Their high degree of insulation, and the secondary windings are isolated and ideal for general use.

The radio-frequency transformer may be permanently fastened to the chassis by means of the headless nails for this purpose. It has a rotor-tapped primary, so that it may be used as an antenna coil with half or all the primaries in series, or to interchange coupling, with all the primary in one single grid plate circuit, or half the primary for any other type tube, including penitodes. The three-circuit transformer is for receiving tubes operated in any of the three circuits, if preferred, by using the headless nails. Pair models of RF transformer and three-circuit, but for 0025 mfd only. Order Cat. G-RF-CT.

$2.48

Shielded Lead-in Wire

No 18 solid wire, surrounded by a solid rubber insulation covering, and more that a covering of braided copper mesh wire, which is to be grounded. In addition to the copper wire, this wire is recommended especially for antenna lead-in, to avoid pickup of man-made static, such as from electrical machines. Also used to advantage in the wiring of receivers, as from antenna pole to set or from set to amplifier, for plate leads, or any leads. If long, this method of wiring can be used advantageously to large and including leads. This wire is recommended for use in general use and for all receivers. Order Cat. SH-L.W. List price 3c per ft.; list price per foot 5c

New Multi-Tap Voltage Divider

The resistance values between the twenty taps of the new Multi-Tap Voltage Divider are given above. The total is 17,100 ohms and affords nineteen different voltages.

The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-ended ones, in which the current rating of 100 milliampères is not seriously exceeded and the maximum voltage is not more than 400 volts. Higher voltages may be used at lower power for performance purposes, but not for constant output. The taps are so arranged that every Tap is 10 per cent of the Tap above it.

R-245 Set and Tube Tester

With the R-245 Tube and Set Tester you plug the cable into a selected section of a transformer, putting the resistor tube in the tester, and using the receiver’s power for making these tests. Price $13.00 for 1, 24 or 36 tubes, price reduced by buying a fifth outlet, or five outlets together. Price per outlet, $2.60. Each outlet is provided with a separate socket, either jack. Element or heater voltage (AC or DC), up to 16 volts, or any other AC or DC voltage source, measured independently up to 100 volts, including AC line voltage. Also screen grid voltage and screen grid current may be read following connections specified in the new How’s It Working.

Each outlet may be used independently. The two test leads, one red, the other black, with clip jack terminals, enable quick connections to any for independent use.

Fixed Condensers

High-Voltage Meters

Doubler Micon fixed condensers, type #62, are available at following capacities and prices:

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<th>Capacity</th>
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<tr>
<td>0.001 mfd</td>
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Order Cat. MICON. Price per mfd. List price $0.25 at 25 mfd.

0-300 v., 200 ohms per volt. Cat. F-300 @ $2.50
0-300 v., 300 p.p. Cat. F-300 @ $2.50
0-300 v. DC and AC, choke, quarter pitch leads, 100 ohms per volt. Order Cat. SH-L.W. @ 95c

Double Drum Dial

Excellent for use in any type of receiver, this dial has the advantage of being adjustable for use with any type of millimeter. Useful for all RF checking.

Hammarlund double drum dial, each section individually tunable. Order Cat. H-210. Price $3.00, and $3.00

Shielded RF Choke

An efficient radio choke, for use with all types of RF circuits, for use with all types of RF circuits, for use with all types of RF circuits. Used for RF checking.

In some instances one number is connected to one, use this lead for B-1 or for ground, use this lead for B-2 or for ground. Order Cat. SH-RF CHOK. Price $1.00. List price $2.00. 50c

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