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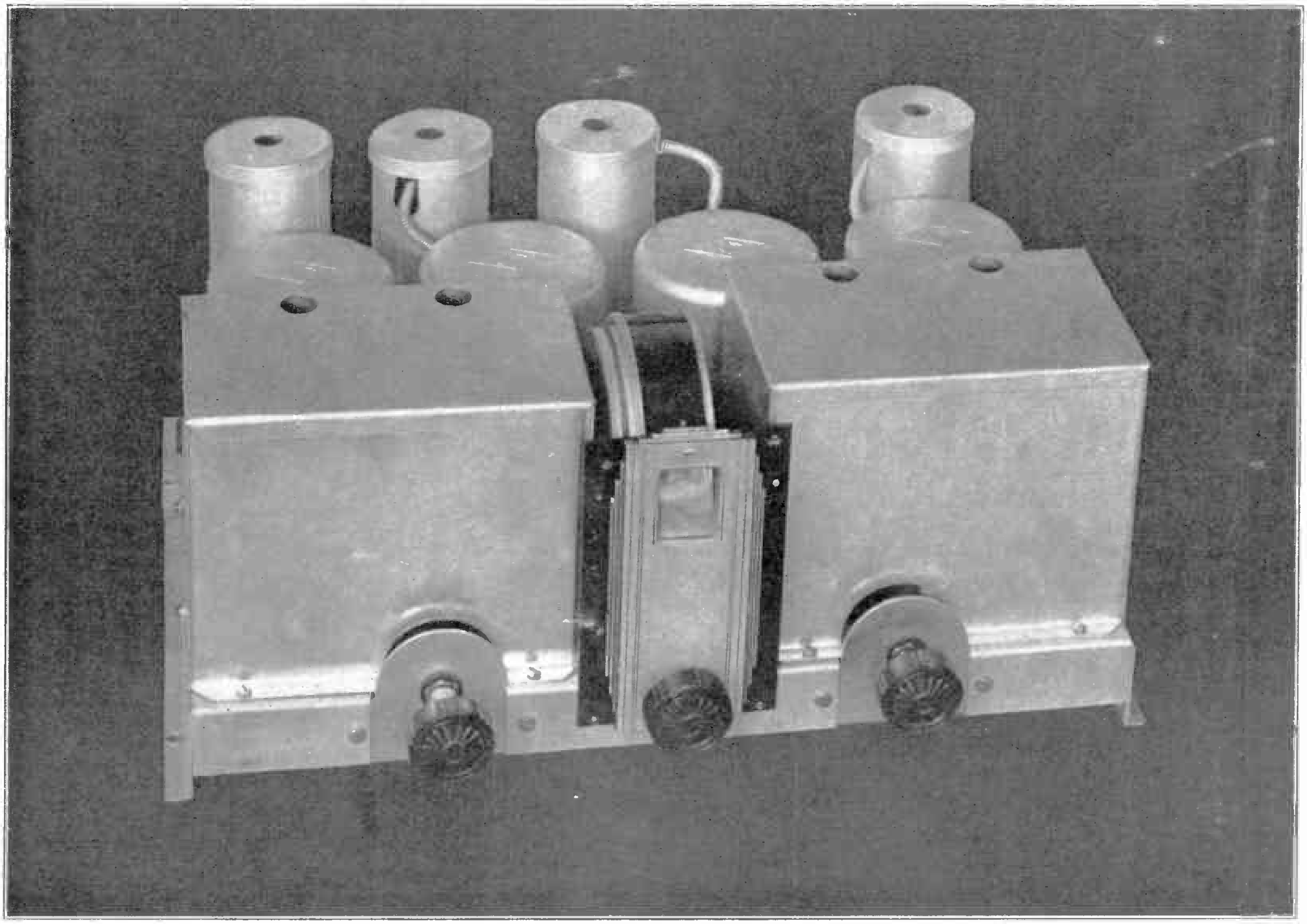
NEW MB-29A SCREEN GRID TUNER!



A band pass filter circuit in a four-circuit tuner marks the MB-29A, the improved version of the MB-29 of last season

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The MB-29 A

By Neal Fitzalan

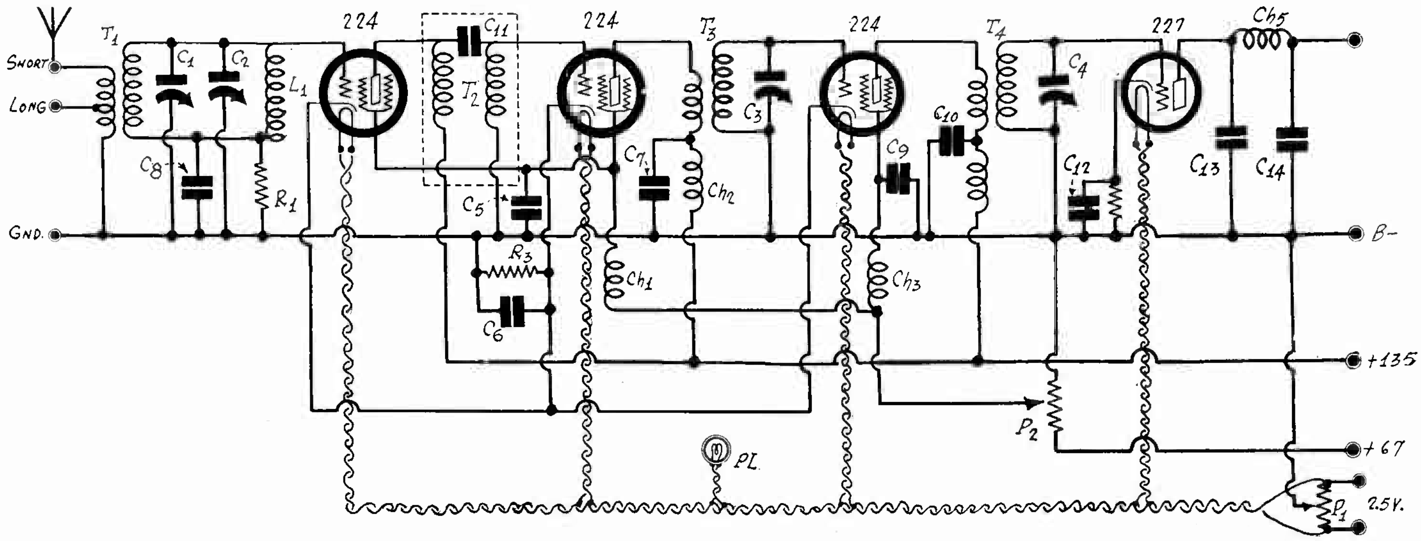

FIG. 1
THIS SHOWS THE CONNECTIONS OF THE MB-29A, A FOUR-TUBE SCREEN GRID RECEIVER DESIGNED BY THE DESIGNERS OF THE MB-29 AND THE MB-30.

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 band 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 550 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

C1, C2, C3, C4—One four-gang tuning condenser.
C5, C9—Two 0.5 mfd. by-pass condensers.
C6, C12—Two 1 mfd. by-pass condensers.
C7, C10—Two 0.1 mfd. by-pass condensers.
C8—One .05 mfd. by-pass condenser.
C11—One .006 mfd. fixed condenser.
C13, C14—Two .00025 mfd. by-pass condensers.
R1, R2—Two 20,000 ohm resistors.
R3—One 150 ohm resistor.
Ch1, Ch2, Ch3, Ch4, Ch5—Five special National radio frequency choke coils.
T1—One special National input transformer with shield.
L1—One special National inductance coil with shield.
T2—One National untuned radio frequency transformer with shield.
T3, T4—Two standard National radio frequency transformers with shields.
P1—One non-inductive National potentiometer.
P2—One 50,000 ohm potentiometer.
Four UY sockets.
One National drum dial with dial light.
Five binding posts.
One battery lead cable.
Four tube shields.
One National MB-29A chassis.

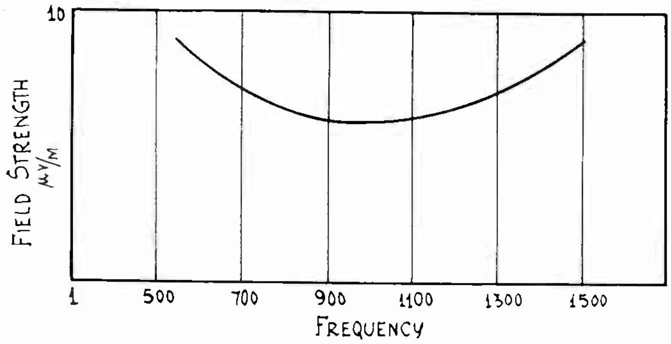

FIG. 2
THE SENSITIVITY CURVE OF THE MB-29A, SHOWING HIGHEST SENSITIVITY AT 1,000 KC AND ONLY SLIGHTLY LOWER SENSITIVITY AT THE EXTREME FREQUENCIES IN THE BROADCAST RANGE.

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 the choice of the more expensive set, 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 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 Ch1 is 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 poor economy 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, R3, serves three tubes and the current in it will be three times as great as for a single tube, the value of 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 C6 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 desirable that it should be more effective there is more feed back that must be reduced.

The volume is controlled, as is 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 plates 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 tuners. There are two shield cans for the band pass filter, one containing T1 and 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 antenna is the only inlet to 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.

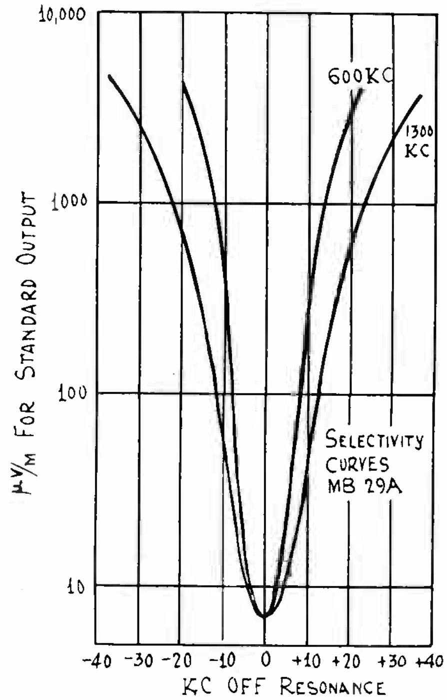

FIG. 3
THE CURVES SHOWING THE SELECTIVITY OF THE MB-29A AT CARRIERS FREQUENCIES OF 600 AND 1,300 KC

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 an explanation 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 if a greater output capability 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 coupler, 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 impregnation, 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 collodion. 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 collodion to hold the wires in place.

Even bakelite tubing should be warmed in the over to avoid sealing in surface moisture when the coil is finally finished.

Moisture tends to short-circuit coil 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 .00035 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, even the unshielded 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 in the coil, and it may be enough to defeat full coverage. At all hazards the use of .00035 mfd. is risky, unless under actual test it has been found to be sufficient. The minimum capacity of a .00035 mfd. tuning condenser is likely to be no less than that of a .0005 mfd. model. Assume this minimum to be .00005 mfd. (50 micro-microfarads). The capacity ratio of the .00035 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 .00035 mfd. model is short even a little bit, 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 .00035 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 many persons are 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 that space, while there are two channels at 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 the contour to see whether the undetermined extreme 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 it is likely to show no change for several divisions, simply because the rotor plates do not immediately engage the stator plates when the dial is turned from zero, but engagement begins effectively at 3 or 4 or higher on the dial.

No matter what value of tuning condenser is used, it is always possible to tune in either the highest frequency or the lowest frequency, but the problem is to tune in both. Reaching either extreme is merely a matter of winding few enough or a large enough number of turns for the inductance across which the condenser is connected.

But what happens at the other extreme? Will you miss out, and if so, by how much?

A Disguise for a Fault

If there is missing out on "highs" 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 stations 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 found there."

It is true that the Federal Radio Commission has adopted the policy of placing large numbers of stations on some high frequencies in the broadcast band. On 1,500 kc there are twenty-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 you will find yourself more interested on many occasions in some scrap of news about your own locality than in the front-page splash about the London Naval Treaty or the Boulder Dam Development. The small stations 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 assuring full 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 bring 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 insisting that something less than this accomplishment be hailed as worthy? The designer or manufacturer should not take it for granted that any possessor of the receiver will be disinterested in any particular 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 thrown together to sell at a price, failure to cover the full band is almost the rule. The missing channels are usually at the high 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 or removal of turns will enable the coverage of the broadcast spectrum, because if the high frequency end is slighted, and you remove turns, the low frequency end will be slighted, and this is mere substitution of one evil for another.

Where .00035 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 .00035 mfd. tuning condensers in circuits with undersized shields makes it utterly impossible to tune in the whole wave band.

If .00035 mfd. capacity is to be used 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 all-frequency condition can be effected, but in highly compact shielded circuits using .00035 mfd. capacity it can not be. Where .00035 mfd. and shields are used the circuit can not be compact and still cover the wave band.

Indeed, the same situation that existed between .00035 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, encasing a coil wound on 1¾ inch diameter, is considered a small shield. With .0005 mfd. and careful coil design these proportions can 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. E. S.

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 operated so that it does not distort the 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.

Circuits and Coils

By J. E.

Technical

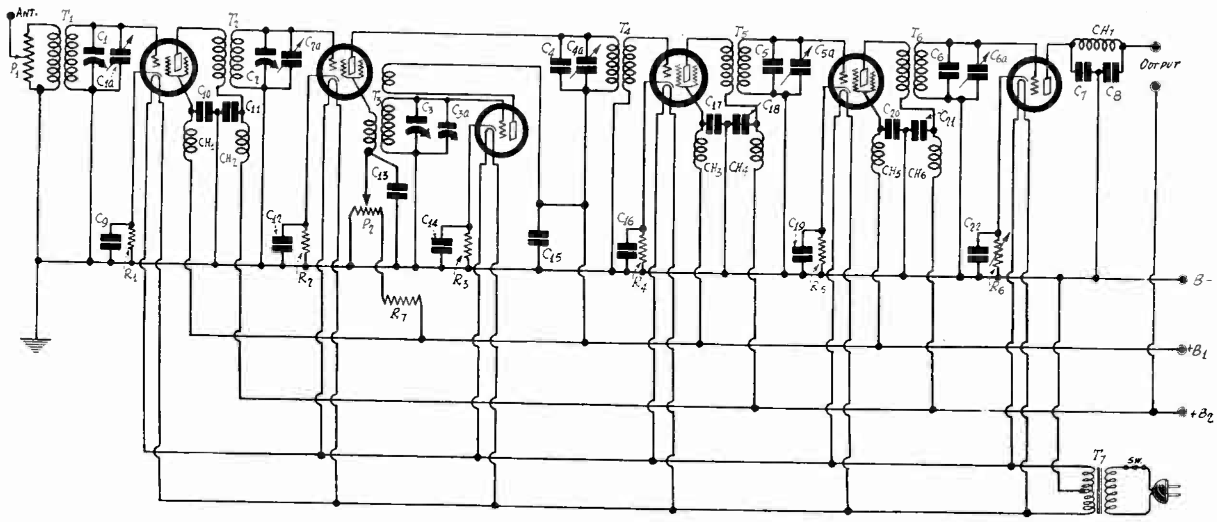

FIG. 1
THE CIRCUIT OF A SIX-TUBE SUPERHETERODYNE TUNER EMPLOYING SCREEN GRID TUBES. THE THREE TUNING CONDENSERS ARE GANGED AND THE INTERMEDIATE FREQUENCY IS 500 KC.

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

* * *

WE have explained the principles of the Superheterodyne and have discussed the various components in detail. It remains to apply these principles and to assemble the components into a complete receiver. Fig. 1 is the diagram of such a circuit.

As we have pointed out, tuned radio frequency amplification is needed, not only to increase the sensitivity, but also to provide a high degree of selectivity before the modulator to suppress image interference. The second of these is the more important, for if there were any lack of sensitivity it could easily be made up in the intermediate frequency amplifier by adding an extra stage, but there is no satisfactory substitute for high selectivity in the high frequency level to remove image interference.

While this selectivity could be obtained by tuners alone, it is more practical to use tuned radio frequency amplification, that is, to put amplifier tubes between the tuners.

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 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 amplifier is controlled by a 30,000 ohm potentiometer P1 connected across the primary of the first transformer T1. One side of this potentiometer is grounded and the slider is connected 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 pick-up coil on T3 is connected in series with the screen lead. If it is desired to introduce the oscillations in the grid circuit, it is only necessary to transfer the pick-up 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 pick-up coil are joined together. Both these methods of pick-up work satisfactorily, but the one illustrated is somewhat simpler constructionally.

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 three tuners, and the intermediate frequency is adjusted to approximately 500 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 interference. 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 transformers 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 cathode lead. 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 coupler between the detector and the first audio amplifier is resistive. However, there is no reason why transformer coupling should not be used.

Grid Bias Provision

In each cathode lead, except the detector's, is a 300 ohm grid bias resistor, marked from R1 to R5, and each is shunted by a condenser of .01 mfd. capacity. This capacity should be regarded as the minimum rather than the optimum. As the frequency involved in any case is never less than about 500 kc, a .01 mfd. condenser is quite effective as a by-pass.

The by-pass condenser C22 across the bias resistor R6 should not be smaller than 2 mfd., because this operates at audio frequencies as well as at the intermediate frequency. The value of the resistor should be about 20,000 ohms but should have a maximum value of 30,000 ohms to allow for some adjustment of the bias. With a by-pass condenser of 2 mfd. and a bias resistor of 20,000 ohms the impedance of the combination at the intermediate frequency is .159 ohm. At 25 cycles, which may be taken as the lowest audio frequency involved, the impedance is 3,140 ohms, and at 10,000 cycles the impedance is about 8 ohms. Hence even with a condenser as large as 2 mfd. there will be some discrimination among audio frequencies. Still it is not necessary to use a higher value.

Supply Circuit Filtering

In every screen lead, except in that of the modulator, there is a radio frequency choke. Likewise, in every plate lead below 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

for a Superheterodyne

Anderson

Editor

from 1 to 125 millihenries is suitable. Standard chokes of 50, 65, 85 and 125 millihenries are on the market. A good choke of approximately one millihenry can be made by winding 220 turns of No. 36 enameled 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 choke, for without the condenser a 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, these filter condensers 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 Ch7 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 minimum value for the choke should be one millihenry. This assumes that the intermediate frequency is not much lower than 500 kc. The maximum values 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 .0005 mfd. tuning condensers because smaller condensers, as a rule, do not cover the entire band. Suitable coils 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 1.75 inch bakelite tubing with 60 turns of No. 28 double silk covered wire, with the turns as close as the insulation permits. 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 550 kc falls about 95 on the dial.

Since high selectivity is more important in this tuner than high sensitivity, the primaries of these coils should be smaller than usual for screen grid tubes and the coupling should also be looser. 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 T1 and 20 turns for the primary 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 tuned 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 .00035 mfd. condensers and then connect larger condenser across them. A coil that has been wound for a .00035 mfd. condenser to reach the 550 kc limit of the broadcast band will require .000424 mfd. to reach 500 kc. Thus 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 .000424 is 74 mmfd.

In the case of T4 it is the primary which should be wound for .00035 mfd. The secondary of this transformer should have at least as many turns as the primary. Suitable coils intended for tuning the primary are available.

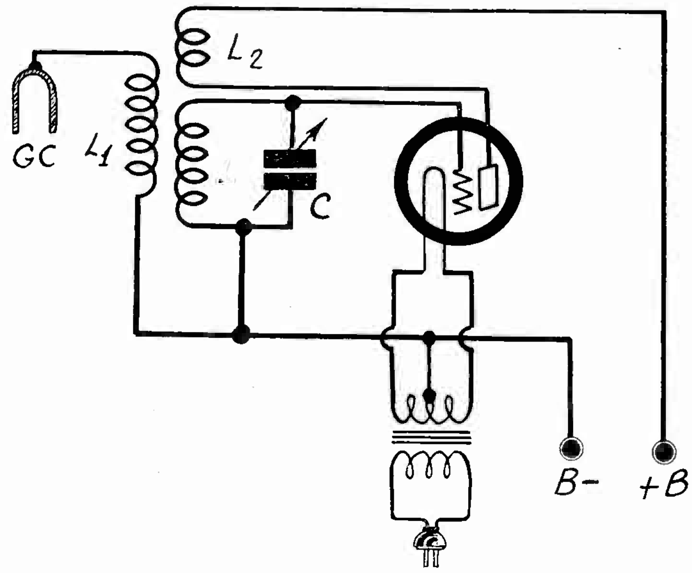

FIG. 2

AN AUXILIARY OSCILLATOR GENERATING A MODULATED INTERMEDIATE FREQUENCY WHICH MAY BE USED AS AN AID IN ADJUSTING THE INTERMEDIATE FREQUENCY TUNER.

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 50 mmfd. 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 mmfd. 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 1.5 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 winding will be 1.67 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, 1.5 inches in diameter, so that the coupling may be varied by sliding the form in or out without projecting outside of the longer 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.

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 care to wind up.

This coil design is so proportioned that a spark of from ⅜ inch to 1 inch may be obtained using the same sizes of primary and secondary insulated conductor, respectively.

I have 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 1/16 inch pitch thread for a distance of 1¼ inches. The inside diameter of this tube may be from ⅝ inch to ¾ inch, the ¾ inch being preferable.

Windings Are Mechanical Aids

The coil form ends are made of ¼ inch to 5/16 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 1½ lbs. of No. 22 gauge soft iron wire and cut it into 7-inch lengths and have same ready for insertion into the primary tubing when the coil is wound.

The problem now is to provide the 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 breast drill that will take drill sizes up to ⅜ inch.

To mount the coil form ready for winding, mount the breast drill in the vise so that it is horizontal and obtain a ⅜ 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 ½ inch or so projects from the nut at 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 "pillow" 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 5-64 inch radially outward from surface of primary core insulating tube.

One hole is drilled in the end piece near the tube and the other just above it (about a 1/16 inch separation).

Special Precautions Necessary

The secondary coil winding lead holes require some special precautions, though, and of prime importance is the fact that both the top and bottom leads 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 1¾ inches using an extension drill (size No. 30) and at a point 1¾ 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 5½ inches, thus providing at least a ¼-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 a four layer, .040 inch per layer (total .160 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 slightly smaller 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 there are to be around 550 turns per layer, and you are to 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 lopsided.

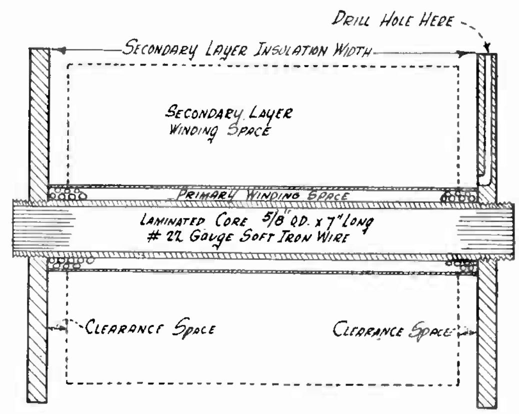

FIG 1
THE RELATIVE ARRANGEMENT OF PRIMARY, SECONDARY, PRIMARY CORE, TUBING AND SPOOL LENDS.

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. The secondary coil wire is passed through the tubing first, then both are inserted and passed through the end piece hole.

For a ⅜ inch to ½ inch spark (15,000 to 20,000 volts at the secondary) 1 lb. of No. 34 double silk enamel covered wire is sufficient. The complete winding space for the secondary will take 2½ lbs. of wire.

That is sufficient No. 34 D. S. E. to wind up to ¼ inch of the flat sides of the 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 real tightly), 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 proper.

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

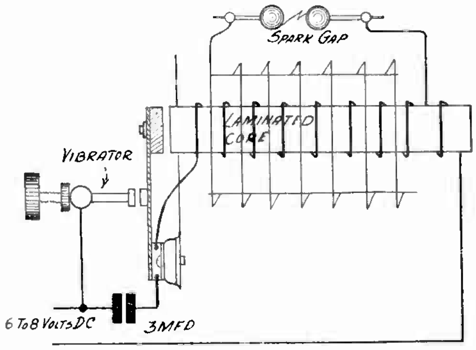

FIG. 2
VIBRATOR AND ASSOCIATED SHUNT CONDENSER, AND SCHEMATIC WIRING CIRCUIT.

Such breakdown voltages are usually given as occurring between copper or brass spheres 1 inch in diameter or so.

Fig. 3 shows a Tesla Coil schematic diagram.

One of the prime requirements for the successful operation of this circuit is that the input circuit should be oscillating. The Leyden jar condensers and Tesla coil primary supply the necessary capacity and inductance and the spark gap completes this oscillatory circuit.

A variety of oscillating circuits may be operated by a good spark coil, and Fig. 3 may be modified so that the inductance in series with the 20,000 volt gap may be made variable. If a coil of the correct inductance value be connected to one side of the system (the side connected to the "high side" of the spark coil secondary winding) and the other side be grounded, and the free end of the substituted inductance be provided with a metallic pointed end or terminal, an adjustment may be found where the pointed terminal will give off long streamers of "electrical fire."

This effect will appear to be much enhanced if the room be darkened, and if under these conditions the adjustable inductance be varied the streamers will cease being given off at the metallic point and will shift to various points along the pointed coil.

Burnt-Out Electric Lamp Excited

Another interesting experiment for the darkened room is to excite fluorescence in an old burnt-out electric lamp by locating the lamp near the field of the oscillation transformer of Fig. 3. The lamp is supported on an insulated member and will glow when the circuit is excited.

If a fairly strong magnet be placed near the lamp when it is glowing a sudden shift of the glow will be observed. If the position of the magnet be changed the shift of the lamp's glow will be altered also.

Thus we have evidence of weak induced currents within the lamp, proving that the lamp contains some traces of gas. A new lamp might not exhibit this phenomenon so clearly, and in fact if it were devoid of any traces of gas whatsoever it would never glow at all, in the strongest oscillatory field.

Geissler tubes, Moore lights, Neon signs and early gas filled X-ray tubes all depend for their operation on the application of a large potential difference suitably impressed on a column of gas at low pressure.

The behavior of a given kind of gas under a potential difference of several hundred volts may be very conveniently observed when the sample of gas to be studied is enclosed in a long glass tubing, say one that is 6 inches in diameter and 6 feet in length and if both the potential difference and the gas pressure can be varied so much the better.

Dark Space and Glow Rings

A long tubing such as briefly described above will exhibit very many more interesting things than the lamp did, among which are a large "dark space" at the cathode end of the glass tubing and a series of glow rings whose number and brilliance increase as the applied potential difference is increased, and finally these rings seem to move up near the anode end of the tubing, resulting in the "dark space" getting longer.

When various gases are introduced into the tubing the characteristic color betrays their presence.

Argon fluoresces pink, mercury green, hydrogen red, while violet and other colors and tints are due to various mixtures.

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 experimenter 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 enameled 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.

* * *

IS THERE any other method in recording sound than the methods used in talkies, that is, sound on film and sound on a disc?—K. K. W.

One of the earliest methods, developed by Poulsen, of Denmark, was based on the magnetization of a steel wire. The sound was converted into magnetic impulses and impressed transversely on the wire. Later the magnetized wire was run between the special pick-up device and the sound was recreated. This method never did become popular or commercial.

* * *

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 WF=300,000, in which W is the wavelength in meters and F 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 celocity of any wave.

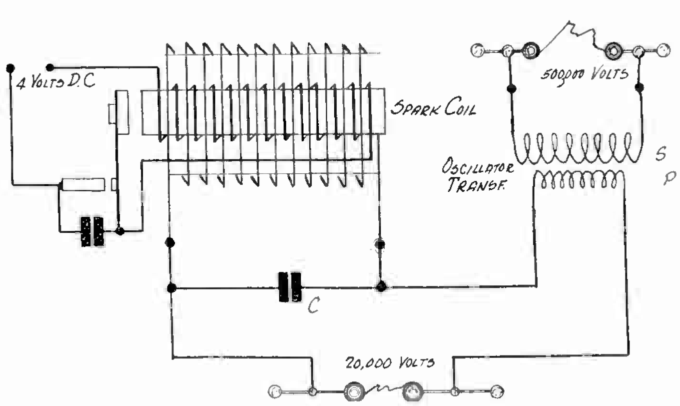

FIG. 3
OSCILLATORY CIRCUIT FORMED BY A SPARK GAP CONDENSERS & TESLA COIL, ALL OPERATED BY THE SPARK COIL.

Moving-Coil

By John C.

[This is one of a series of articles on experiments for novices.—Editor.]

MAGNETIC braking action involves only one direct force, which is the resultant of the inter action of two fluxes. Magnetic rectifiers, however, necessarily involve the inter-action 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,

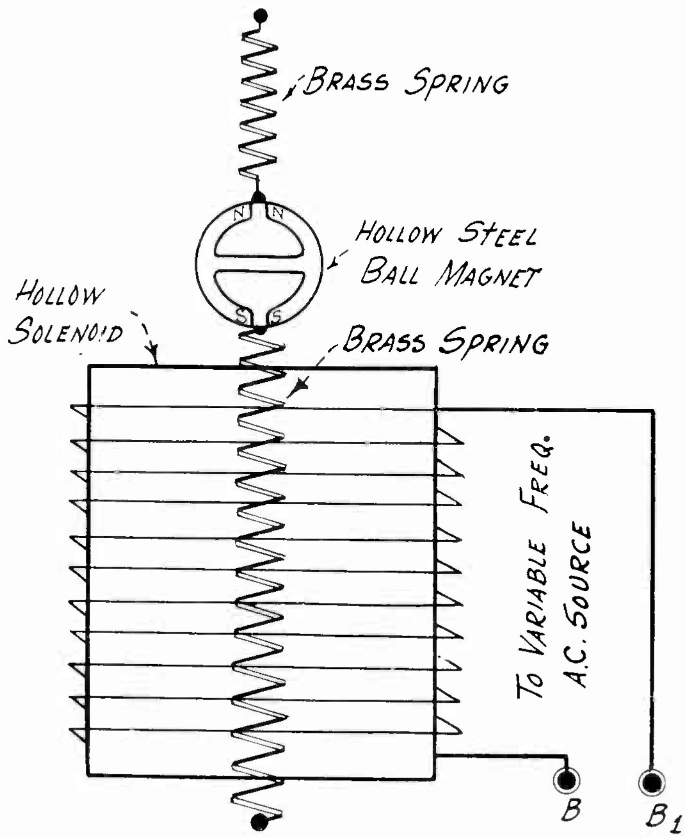

FIG. 1
A MECHANICAL SYSTEM WITH PERIOD OF VIBRATION INFLUENCED BY A VARIABLE MAGNETIC FLUX.

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 2½-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_1.

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 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 recurring series of excursions of lesser and greater amplitude.

The exciting frequency is raised and the length of the recurring series of excursions is increased (increased amplitude of vertical motion) and finally the ball magnet's excursions reach their 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 magnetic 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 inter action 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.

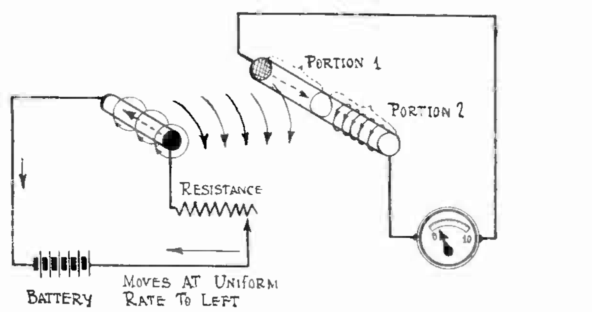

FIG. 2
PARALLEL CIRCUITS SET UP MUTUALLY ACTING MAGNETIC FLUXES.

So accordingly I lower the applied AC frequency to the stationary coil and notice that the amplitude of vibration of the movable coil is considerably reduced. In fact, on close inspection it is found to agree closely with the previously observed amplitude when the ball magnet is used. So now we raise the applied frequency slowly and as we approach 40 cycles again the amplitude of the moving coil gets large again and as the freauency of excitation is raised still further the amplitude begins to fall off again, proving once again that the degree of response of the moving coil system is related very definitely to the periodicity of the exciting emf.

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 amplitude of motion 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 greater.

But we now have a system in which forced vibrations as well as resonance effects are present when the coil is vibrating. But when I apply AC to the moving coil the resonance effect does not predominate as it did formerly and so it is more or less obscure under various conditions of excitation.

The extent of the number of experiments that can be made with this magnetic device while not limitless is at any rate considerable. Because of this I will not attempt to go into the full ramifications at this writing.

Nevertheless some interesting analogies utilized in receiving circuits may be shown in the form of moving coil excursions in such way that they will help the experimenter to visualize what's going on.

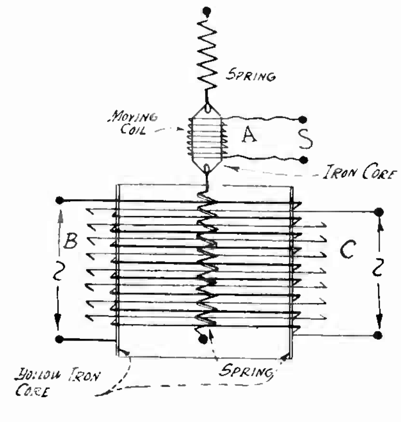

FIG. 3
A TRIPLE-COIL MAGNETIC RESONANCE INDICATOR

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 of events is allowed to continue so that the next succeeding negative pulse passes through the system the final result will be the same, insofar as mechanical motion of the moving coil is concerned, but the current passing through the coils will heat them up somewhat. This represents wasted energy of course.

Let us now see what happens if we apply 40 cycles to the two coils from the individual sources so 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 to 42 cycles the resultant mechanical frequency will be 2 cycles because it represents the difference between the periodicity of the two applied emf's 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 is by contrast more sharply defined than under previous conditions.

So if the difference frequency be still further increased the movable coil, under the present conditions will continue to respond and when the difference frequency approaches 80 cycles the next maxima of vibration of the moving coil will be found.

It will be realized now that under the previously described free vibrating condition this phenomenon would never have occurred.

This next highest vibrational 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 want to do because it would have altered the natural period of vibration.

Now that I have shown briefly the possibilities of regulating or otherwise controlling 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 obtainable 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 my reader 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 sources invariably produce harmonic voltages, and consequently are unsuited 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 winding on the moving 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.

To simplify matters a little I am going to label the three coils in this diagram A B and C—"A" 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 now going to mix 3 frequencies and expect the vibrating coil "A" to indicate the resultant of these three inter acting individual AC fluxes.

It must be borne in mind that the moving coil moves up and down only.

From previous experiments we know that when the excitation frequency was 40 cycles and the moving coil frequency was 42 cycles 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 2 cycles then if we apply a 2 cycle emf so that it adds to the collective frequency the final result 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.

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 life 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 excursions 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—hence 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 all "good coils" 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.

Resolved, that Supe

AFFIRMATIVE

By Henry Roscoe

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 increase in 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.

Because of this attitude on the part of certain officials broadcast stations are limited to 25 kilowatts on a regular basis and 25 kilowatts additional for experimental purposes. However, certain stations are allowed additional power for experimental purposes during hours when little interference can result. Thus WGY, Schenectady, N. Y., has been using 200,000 watts on special authority for experimental purposes only. KDKA, Pittsburgh, Pa., has filed application with the Federal Radio Commission for permission to erect and use a transmitter capable of handling up to 400 kilowatts, to be used for experimental purposes only between 1 a.m. to 6 a.m.

Advantages of High Power

That high power is advantageous is recognized by radio engineers throughout the world. In Italy a 100-kilowatt station is in regular service. In Russia several of such stations are being planned and other stations of the order of 30 kilowatts have been in service there for some time. In Lahti, Finland, is a high power station giving good service in face of natural 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 only one major difference between reception of distant stations and local stations, and that is the relative amounts of noise mixed with the signal. Reception from local stations is nearly always good. Reception from distant stations is nearly always poor. If the power of the transmitting station is increased, the signal strength everywhere is increased, but the amount of noise at a given distance from the station remains constant. Hence when the power is increased good reception is assured at greater distances from the station.

How Signals Vary

The signal strength from a given station varies inversely as the distance from that station under ideal conditions. It also varies directly as the power of the station. Thus if the signal strength 100 miles from a station is 10 millivolts per meter the signal strength at 200 miles is 5 millivolts per meter. If the power of the transmitting station is double, the signal strength at 100 miles becomes 20 millivolts per meter and at 200 miles it becomes 10 millivolts. A receiver 400 miles from the station will now get a signal strength of 5 millivolts per meter.

If we assume that the population in the service area is uniformly distributed it becomes clear that increasing the power of a station is economical. Suppose 5 millivolts per meter is the minimum satisfactory signal strength. If a station radiating 25 kilowatts will lay this signal down at 200 miles, a station radiating 50 kilowatts will lay the same signal down at 400 miles. The number of people living in a circular area the radius of which is 400 miles is four times as great as the number of people living in a circular area of 200-mile radius. Thus, by doubling the power of the station the number of people served with a satisfactory signal is increased four-fold. No one can deny the economy of that.

Objections Raised

The main objection raised against high power stations is that they blanket other stations, that people living close to the high power stations cannot receive any other stations without interference from the powerful station.

Whether this objection is valid or not depends on the selectivity of the receiver in question, on the proximity of the receiver to the high power station, on the power of that station, and on the power and distance away of other stations desired.

Modern receivers are so selective that even when they are within one mile of a 10,000-watt station they can select a large number of outside stations without interference from the local. This has been tested time and time again. Of course, there are still many receivers in service that are not selective enough for cases of that kind. But the existence of these out-of-date receivers cannot be used to stop progress that is intended to improve the service to the great majority of people. It is far better to treat the obsolete receivers so that they will cope with modern conditions rather than to penalize those who keep up with the times. The most effective treatment, of course, is to junk the old receiver and get a new one. But some people will not be in financial position to do that, and they can resort to minor changes which will effect the necessary improvement in the selectivity.

Confession of Obsolescence

Those who use their own receivers as proof that high power stations will blanket other stations by saying that some high power station can be received at all settings of the tuning control merely tell the world that they are still dignifying a pile of junk with the title radio receiver. Such pieces of junk are usually handed down to the foolish recipients as a convenient way of getting rid of them. Sometimes they have been retained since the early days of radio broadcasting for sentimental reasons. But most of these relics, retained for reasons of sentiment, are usually kept in the attic. Now and then they are retained in service, and strange to say, their characteristics are used as arguments against high power by those who have the greatest opportunity to keep up with the times.

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. As the power is increased the blanketing area is 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 place only 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 rendering since they raised the power.

For experimental purposes even higher power should receive the encouragement by both officials and the public. Engineers believe that they can reconstruct the 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.

Million-Watt Stations

If the scheme works out there is a strong probability that we shall have broadcast stations radiating 1,000 kilowatts or more, when one station will serve the entire country as well as a few foreign countries. It will then not be necessary to have chains of stations broadcasting the same programs, but one station for each program. Channels will be released for other programs and the service will be improved in all departments. With this in view shall we continue to insist limiting the power of broadcast stations to 5,000 watts? Even those who still champion the rights of the piles of junk will become supporters of higher and higher power.

r-Power is Desirable

NEGATIVE

By A. C. N. Fellowes

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 than 96 programs, one for each channel in the broadcast band. It is not that any listener tunes in on all the 96 channels, but that he wants to have the ether clear in case that he should desire to pick out any one of the 96.

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 selecting a 5-watt midget 3,000 miles away without the slightest interference from the giant near by, even when there is only a 10 kc separation between the carriers of the two stations. Anybody who says that such receivers are modern must already 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 use today are those of 1929, for the 1930 receivers have not yet been offered to the public. Among the very best of the 1929 receivers there is 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 that 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 from the local station will be as loud as those from the 1,000-mile station, even if the carrier separation is 50 kilocycles.

And if the local station is a 50,000-watter and the distant station is a 500-watter, the local station will not interfere with the distant when the set is tuned to the distant station, but the distant station will interfere, perhaps, with the local. "Coming in all over the dial" is a reality in even the most modern practical receiver under such conditions.

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 1928 is just as selective and just as sensitive as the set of 1930. The later receiver simply has a few more adjuncts supposed to be improvements. They are improvements of the same nature as a door handle of new design is an improvement in an automobile. They are devices 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. Just because advertisers desire 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 advertisers to shout so loudly that no one else can be heard? Should we permit hundreds of thousands of receivers to be forced out of date or into silence just because advertisers pay for the snatches of dubious entertainment mingled with the advertising copy?

It may be that in the future high power will be standard and that it will improve reception, but the change from medium to high 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 fortunate, indeed, that some of the Radio 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 rest. Thus, if several of the stations carry offensive programs 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 set off. And it will be admitted that many of the high power stations do carry offensive programs a large part of the time.

Among the receivers not designed to cope with the high signal strengths laid down by the high power stations are those that are intended primarily for high quality local reception. These are not sensitive because they were not intended to go outside for programs. They are not selective for this reason also because their primary object is to reproduce high quality signals. If there is one giant station near such a receiver, this station is the only one that can be brought in without cross talk. The owner of such a receiver may wish to listen to an orchestra selection and consequently he tunes his set to a station radiating such music. But he derives little satisfaction from the orchestral music when on top of the music is a blatant discourse on toothpaste, fertilizers, bug killers, purgatives, or any one of a thousand different products of no greater artistic value. Indeed, he does not derive much pleasure if his music is mixed strongly with intriguing talks on candy, cooling drinks, or perfumes, or if it mixed with poetry, drama, travel talks or politics. He tuned in on orchestral music at the time and that is what he wants and nothing else. But he can't have what he wants at any time if there is a giant station close by pouring out its stuff, whether that stuff be good or bad.

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 to the advertising, willy nilly, just because station owners and their clients are not satisfied with reaching a just proportion of the total listeners, but must hog the show? It is only fair to give these fellows an even break.

To have one giant station in each large center is the same as to enforce a law compelling all people to take a certain newspaper, if they take any at all, a newspaper that is devoting 99 per cent. of its space to blatant and offensive advertising, one per cent. to news. Nay, more, it is the same as if all people were compelled to read all that advertising before they can find the news item.

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 those 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 high selectivity are mutually inconsistent, and that stage will last for a long time. As long as it lasts medium 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 bringing them in by short-wave relay radio or by wire lines. 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 we may reasonably 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 rather than a few high power stations. 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.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. The reply is mailed to the member. Join now!

RADIO UNIVERSITY

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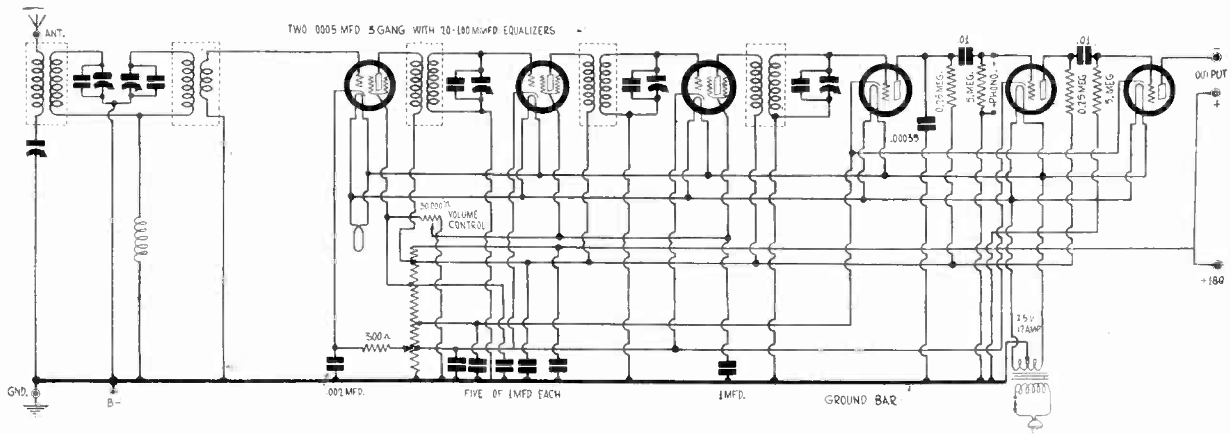


FIG. 832
THE CIRCUIT DIAGRAM OF A COMPLETE RECEIVER IN WHICH A BAND-PASS FILTER IS USED BETWEEN THE ANTENNA AND THE FIRST TUBE.

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? If there is a simple method, will you please explain it?—O. R. T.

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 that will fit 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 mmfd., 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 small coil on 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 Superheterodynes in which the oscillation is impressed on the plate circuit of the detector.—F. I. 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 Superheterodynes 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 is 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.

Leakage in Resistance Audio

I HAVE a resistance-coupled amplifier 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 figure out what the trouble is. Please suggest the cause and a 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 plates to the control grid. The leakage may be over or through 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, mounts and stopping condenser. This is important, 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 used and 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 would control the volume more thoroughly.—P. C.

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 intensity is concerned. When the radio frequency voltage is 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

RECENTLY you referred to the intense wind that accompanies 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 small compared with the size of the flame and then the hot gases around the wick are not carried away and therefore 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 1,100 by the frequency. A 10,000 cycle frequency would have half a wavelength of 0.66 inches.

* * *

Modulator Plate Filtration

IS 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 practically kills 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

WHEN 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 type 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.

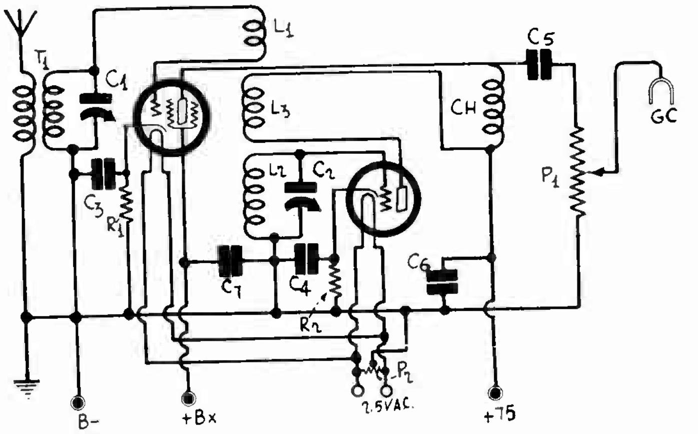


FIG. 833
A TWO-TUBE SHORT-WAVE CONVERTER BY MEANS OF WHICH ANY BROADCAST RECEIVER USING A SCREEN GRID TUBE IN THE FIRST STAGE MAY BE CONVERTED TO A SUPERHETERODYNE.

* * *

Short-Wave Converter

PLEASE PUBLISH the diagram of a two-tube short-wave converter utilizing one screen grid tube for modulation and one 227 for oscillator. I want one that can be coupled directly to the first screen grid tube in a broadcast receiver.—D. E. A.

Fig. 833 shows the circuit of such a converter. The by-pass condensers in this converter should be .01 mfd., the bias resistors 300 ohms, P1 half megohm, P2 20 ohms or so with adjustable center-tap. C5 need not be larger than .0005 mfd. The tuning coils are standard short-wave plug-in coils and the tuning condensers may be .0005 mfd. or smaller. It is well to use a broadcast tuning coil for Ch and tune this with a variable condenser to the intermediate frequency, or to the frequency to which the broadcast receiver is tuned. The voltage applied to plus Bx should be about 3 volts.

KDKA REQUESTS 400,000 WATTS TO MAKE TESTS

Washington.

An application has been received from Westinghouse Electric and Manufacturing Company for permission to use up to 400,000 watts power in experimental broadcasts from KDKA, Pittsburgh, from 1 a. m. to 6 a. m., for scientific purposes.

The maximum power sought is greater than any power used by any station anywhere on earth. The record so far is held by an Italian station, using 100,000 watts regularly, while stations using about the same power are being planned in Russia. However, WGY, Schenectady, N. Y., in experiments during the past few months, has been using 200,000 watts, under special authority. Otherwise the greatest power used in the United States is 50,000 watts, there being nine stations on the air at that power and several others getting ready to use as much.

While the studio of KDKA is in Pittsburgh, the transmitting antenna is near Saxonburg, Pa. The application is for a construction permit to use up to 400,000 watts experimentally, with intention to feed the maximum into the antenna on many occasions during the prescribed hours.

Cost Estimated at $172,000

A new transmitter would be required, and would be suitable for any wattage from 50,000 to 400,000 watts. The cost of the new transmitter is estimated at $172,000.

The same frequency, 980 kc, would be used as is used for regular broadcasts by KDKA. The wavelength is 306 meters.

The application, states Westinghouse, is for an experimental license in the interest of developing broadcasting equipment with special reference to the following problems:

1. Design and operation of antennas to reduce or eliminate blanketing effects in near-by areas.

2. Development of high power vacuum tubes in actual service.

3. The development of precision frequency control apparatus suitable for high power transmitters.

4. The development of 12 phase pool type mercury rectifiers for use in radio transmitters where extremely high voltages are necessary.

5. The comprehensive study of receiving conditions over a wide area where a transmitter is used employing powers of the order of 400 kilowatts (400,000 watts).

6. A study of fading conditions over the country when two stations of considerable power are automatically synchronized on the same wavelength.

Accurate to Plus or Minus 20 Cycles

From the technical viewpoint, the application brings out, the transmitter would be controlled as to frequency both by automatic crystal controls and tuning forks.

It is equipped for both high and low modulation, and should maintain its frequency, plus or minus to a maximum deviation of 20 cycles.

First Protest Made On 50 Kw for WOR

Protest against the issue to WOR, of Newark, N. J., of a construction permit for a 50,000-watt transmitter, on the ground that WKBO, Jersey City, which sends out many religious programs, would be blanketed, was made by the Young People's Division of the Methodist Episcopal Churches and Epworth League. A telegram sent to Senator Kean at Washington and submitted by the Senator to the Federal Radio Commission, read:

"Methodist Episcopal Churches, Young People's Division, and Epworth League, 1,000 churches, 22,500 square miles, 317,000 members, protest against 50,000-watt transmitter station for WOR. Same will blanket our service in WKBO, Jersey City, and interfere with reception. Protestant, Catholic and Jewish people take part and are interested in service. Kindly voice our protest to Radio Commission before it adjourns."

The application by WOR had been put over until the Fall for action. The WKBO protest was the first one received.

KFI GETS RIGHT TO USE 50 KW

Washington.

A construction permit to use 50,000 watts was granted by the Federal Radio Commission to KFI, Los Angeles, owned by Earle C. Anthony, Inc.

The station previously had obtained such an authorization, but had permitted two years to elapse, which constituted a forfeiture, its reason being that use of such high power was entirely experimental two years ago, and also that no equipment could be purchased then with a promise of delivery in less than one year.

The argument for granting of new authorization to use the high power was made by Arthur F. Kale, manager of the station, who said that no interference would result, as the station nearest in frequency to KFI is 40 kc. removed, and KFI would be able to enlarge its service area as comprehensively as the present high type of its programs justifies. It now uses 5,000 watts on 640 kc. (469 meters).

Immediately upon obtaining the construction permit the station ordered the necessary apparatus. However, before the station can go on the air at 50,000 watts not only must it have the proper plant installation, but must get a license from the Commission to operate at that power. The license follows the construction permit as a matter of course if there is no untoward conduct by the station meanwhile, and if the installation is approved technically by the radio inspector.

With KFI on the air at 50,000 watts the total number of stations actually using that power will be ten. The others are WBAP, WEAF, WENR, WFAA, WGY, WTAM, WLW, WTIC and KDKA.

50 KW ACTION IS POSTPONED TILL THE FALL

Washington.

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.; WEAF, 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; WLS, Chicago; WOAI, San Antonio, Tex.; KFI, Los Angeles; KMOX, St. Louis, and KNX, Los Angeles. Total, six stations.

Stations that have filed applications for 50,000-watt construction permits, on which action is pending: WAPI, Birmingham, Ala.; WCFL, Chicago, Ill.; WFBM, Indianapolis; WHAM, Rochester, N. Y.; WHO-WOC, Des Moines and Davenport, Ia.; WOR, Newark, N. J.; WOWO, Fort Wayne, Ind.; WRVA, Richmond, Va.; WSB, Atlanta, Ga.; WSM, Nashville, Tenn.; WWJ, Detroit; KGO; KTNT, Muscatine, Ia., and KWKH, Shreveport, La. 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, while one key station of a chain, WABC, has a construction permit, and another, WOR, has an application on file. If KGO is granted 50,000 watts, while WGY has the same power, the First and the Fourth Zones might be taxed with only one-half cleared channel for each such station, which would open the way to granting 50,000-watt licenses to both WABC and WOR.

RECORDS USED BY WOR ON AIR IN BOLD TEST

Believing that improvement in recordings and methods of reproduction in the past few years has been so great that the time has arrived for the use of specially recorded programs for broadcasting, WOR, Newark, N. J., has gone in for putting records on the air in the afternoon.

These are not standard phonograph records but are specially made for broadcasting, the object being to enable stations to present excellent musicians and voices which would be beyond their financial reach if personal performance before the microphone were required. Such special records are made by Sound Studios, Inc., Brunswick, Columbia and Stanley, while others plan to enter the field.

Tests have been made, so that expert listeners heard the original artist, and also the records, through the microphone circuit, listening to a loudspeaker in another room in the same 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 distinguish between the two, or picked the wrong one, to heighten confidence in the feasibility of using the recordings on the air. Also, the output quality, at the speaker, was compared on an oscillograph, and found to be so excellent that it was felt no complaint could be made reasonably by listeners if records were used, especially during "off hours," for the time being.

There has been much prejudice against the playing of phonograph records, because in the early days of broadcasting the air was overladen with this type of "program," and besides the stations often tried to create the impression that an orchestra was playing in the studio. The "studio orchestra" was credited with many a performance that the Victor Orchestra had committed to a record. Besides, electrical recording was not used in those days, and the reproducing unit and tone chamber were different, so the quality, even listening to just a phonograph, was not nearly as high as it is to-day. Poor station equipment in those days did further violence to the integrity of the music. Besides, records were played that any one could buy and play on his own phonograph.

Must Reveal It Is a Record

The Federal Radio Commission now has a rule that a phonograph record must be identified as such in the announcement of the number. The rule, as at present constituted, would apply also to playing special records, such as those WOR uses. Playing of records is discouraged by the Commission, but special records may not come within this scope.

Western Electric apparatus has been installed at the New York branch studios of WOR, at 1440 Broadway. Four turntables are on hand. Two revolve thirty-three and one-third times a minute, and the other pair seventy-eight times a minute. They are driven by twin motors. The slower-speed records enable the reproduction of a continuous program, as a mechanical means is provided for automatically 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 enables the playing of the finest music without attenuation 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 departure, as it is a 5,000-watt station, with a reputation for putting on good programs. It was formerly key station of the Columbia Broadcasting System, under contract, but now is an individual station, furnishing its own programs exclusively, except that occasionally it ties in with WLW, Cincinnati; WMAQ, Chicago, and WMBF, Binghamton, N. Y., to form the so-called Quality Group for a four-link chain broadcast.

Recently WOR, which is owned by the Bamberger Broadcasting Company, and is operated in the interest of the Bamberger department store in Newark, applied for 50,000 watts. This move was taken as an intention of becoming part of a large chain.

No Records for NBC or CBS

In contrast with WOR's attitude on playing even special records, the Columbia Broadcasting System, with WABC in New York as its key station, and the National Broadcasting Company, with WEAF and WJZ as its key stations, state that they do not play records for broadcasting. In fact, the NBC even asserts that when a continuity calls for the playing of a phonograph, as sometimes happens in a sketch, the orchestra present in the studio or some singer or instrumental musician, imitates a phonograph rendition, aided by appropriate sound effects!

Tradiograms

The Dayton Scientific Corporation has recently been incorporated in Ohio. Offices and plant will be located in Dayton. The present address is 12 North Jefferson Street. Manufacturing of radio and electrical devices and also research in these lines will be done. The officers are: Oscar H. Hulberg, president; H. L. Burns, vice-president and treasurer, and George F. Holland, secretary. One of the first products of this corporation will be a short wave receiver.

* * *

Radic Distributing Corporation, with offices at Newark, Trenton and Asbury Park, N. Y., will establish a free course of intensive training in sales and service, open to all Radisco RCA dealers and their employes. The school will be located on the second floor of Radisco's Newark headquarters building, at 560 Broad Street, and will be conducted in cooperation with RCA Institutes, Inc., a subsidiary of the Radio Corporation of America, who are occupants of the same building. A regular school procedure will be maintained and a complete course of study covering sixteen hours of instruction. Each course will occupy a period of one month, 8 to 10 p. m., every Tuesday and Thursday.

PILOT STATION MOVES

Washington.

The Pilot Laboratories, Inc., formerly of Brooklyn, N. Y., was authorized by the Federal Radio Commission to move its television transmitter to Lawrence, Mass., where the company recently moved its factory.

JINX PURSUES WABC AS NEW SITE IS FOUND

The jinx that has been pursuing the Columbia Broadcasting System in its various efforts to locate more favorably its key transmitter, WABC, is still at work.

The first attempts to locate in New Jersey met with preliminary approval from the Federal Radio Commission, only to be frustrated by local sentiment against an "alien invader," which would use high power and blanket the dials of the citizenry, as WABC is a New York station.

"Don't Worry"

Next some tentative surveys were made in the Long Island territory, with equal results, and now the station is trying to win enough approval to get up its antenna towers at a new site, at Hempstead, Long Island. And again there is a rumpus. A public hearing will be held in Hempstead in a few days to determine what the folk of that town and environs think of a station of possibly 50,000 watts power being located there.

The terms of the lease have been settled tentatively, as the Hempstead Development Commission recommended to the town board that the negotiations be concluded on the agreed basis, a sixty-five year lease on forty acres, at $33,800 for the total of the first fifteen years, an impartial commission to determine the rental for the remaining twenty-five years when the first fifteen years are up.

Quotes Starbuck Letter

The Hempstead Development Commission made the recommendation, said Robert Christie, vice-chairman of that commission, because it was satisfied with a letter it received from William D. L. Starbuck, Federal Radio Commissioner, appointed from the first zone. Some persons understood Mr. Christie to have quoted Commissioner Starbuck as saying that the Hempstead Commission need not worry about complaints of interference, 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 operate at the high power. The new 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.

Starbuck Denies Assurances

Washington.

Denial was made by Commissioner Starbuck that he said or wrote that the Federal Radio Commission would take care of complaints of interference due to the presence of WABC in a new location at Hempstead, N. Y. The Commissioner said he wrote a letter to "an interested party" and in this letter, he asserts, all he said was:

"In passing upon a station's application for approval of a proposed site for the erection of a new transmitter the Federal Radio Commission does give consideration, among other things, to the situation and rights of inhabitants of the area immediately surrounding the proposed site.

"Nevertheless, this does not mean that the approval so given is irrevocable, and not subject to change in the light of additional facts thereafter coming to the attention of the commission, or experience justifying a change in the public interest."

RADIO WORLD

Trade Mark Reg. U. S. Pat. Off.

The First and Only National Radio Weekly
Ninth Year

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

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

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 fully the purpose for which they were intended.

Many stations, even some using 5,000 watts, find it extremely difficult to fill in the "off hours" with suitable programs, especially in the afternoon. While some stations may clamor for more time on the air, they may have no better excuse than that they can not loftily use up the time already allotted! Stations that put on fine programs during the precious evening hours often fall far short of perfection during the morning or early afternoon, and the use of recorded programs would be a great help to them.

The public need not feel now that it is being cheated. That feeling was justifiable in the early days of broadcasting, when standard phonograph records were played mechanically, and an unforgivable output from a poor tone chamber fed into a fair microphone and a bad amplifier, until the radiated wave was adulterated. However, the wave was received on sets that themselves produced indifferent results. This mitigated the acoustical offense somewhat, on the legal ground that joint offenders are not to be heard to complain against each other. But the moral offense was without mitigating circumstances. The phonograph records were played and played, and all the while unblushingly announced as renditions by "the studio orchestra."

Even to-day, it will surprise chronic chain listeners to learn, the use of phonograph records of the sort purchasable 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 low-grade broadcasting with the thought that perhaps poor taste has less to do with it 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 playing of the record from hearing the performer originally. Besides, no standard records are to be used, but special ones, made purposely for broadcasting, and the whole system so united that, by automatic switching from one record to another, a continuous performance 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. Now WOR is trying out the special radio records, as afternoon offerings. In the evening this station, situated in Newark, N. J., and maintained on behalf of a department store, puts on excellent programs. There are times during the day, however, when its offering is not as good as it might hope. Despite its 5,000 watts, it is no doubt pressed hard for first-class offerings during some part of each day. Is it better to offer something indifferent, only because of being originally sung or played, or it be better to offer the recording of a far superior musician or speaker?

Great stations no doubt will not seize upon the recorded program. The pride of presenting nothing but the original in person runs high, and it is creditable that the National Broadcasting Company and the Columbia Broadcasting System feel that pride. They appreciate the trust imposed on them by the great powers they possess both by Federal grant and by their own native ability. They may never use phonograph records at their key stations, or at any stations they control.

The problem met by 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 interest, however.

Starting as "fillers" the recorded programs may rise to such importance that, instead of chains carrying so much of the high-priced talent on the air, the United States Post Office's air mail service will be many chains, carrying recorded programs to member stations, for broadcasting on a coast-to-coast basis. And the payments to the telephone company, arising from the costly transmission by wire from key station to member stations, would not figure in the picture. What a boomerang that would be to the Bell laboratory that engineered the recorded program!

Robinson Decides

DELICACY was not the keynote of a speech made recently by Ira E. Robinson, Federal Radio Commissioner, before the meeting held by the Institute for Education by Radio, at Columbus, O. In discussing a radio monopoly he was not bold enough to state outright that there is monopoly, but only "that a monopoly of radio is now insistently claimed by a group."

If he has to render a decision on a subject now before the courts for adjudication he might as well go the limit and speak plainly, saying, "there is a monopoly of radio," and then the Federal Court in the Delaware District would have the benefit of a former Judge's volatile decree on a subject somewhat outside his jurisdiction. But, as it is, the Delaware court has only innuendo to guide it, for it is scarcely true that monopoly is "claimed" by a group, if the word "claimed" is used in its ordinary meaning, and not in some special meaning invented by the former jurist for the educational occasion.

A sort of proprietary assertion is made by a group that it enjoys a monopoly of radio, one is led to believe, whereas an inspection of the records shows that the alleged monopolists deny the existence of any monopoly. Do they want to amend their answers, now that Robinson has been heard out of court? If so, the former judge could tell them just what motions to offer to the court, and he knows.

Now, without having expressly charged the existence of a monopoly, the former judge did paint a picture consistent only with the actual, present and ominous existence of such a monopoly. It can not be gainsaid, he continued, that "its power and influence are so subtle and effective as to portend the greatest danger to the fundamentals of American republican government."

Where there is existence of such power and influence, as he charges in the same breath as he speaks of a "claimed" monopoly, we assume he tries to convey the idea that there is a monopoly, but that he does not have the open bravery to say so. He may have desired to gain the result without running the risk, to take the gold medal, if one was to be awarded, but to leave ample room for escape in the event any ear-wringing was to be the result.

Wanted: A 50-KW. Site

MANY stations are now especially interested in obtaining 50,000-watt transmitters, since it has been proved abundantly that the service area is increased thereby. The procedure is to apply to the Federal Radio Commission for a construction permit to use that power. Getting the permit has not been so difficult. When the avenue to 50,000 watts was open to forty cleared channels only nine stations were on the air at that power, but now that the Commission has decided to limit the number of cleared channels to twenty, or four for each of the five zones, the desire to use 50,000 has increased, perhaps due to the human failing of wanting most that which is hardest to get.

Having obtained a construction permit the next step is to obtain a license. In the absence of any untoward act by the station, this might follow as a matter of course, only some stations must not use 50,000 watts at their present location, due to the blanketing effect on other stations, and the difficulty then would consist of finding a suitable site.

WABC, New York City, key station of the Columbia Broadcasting System, is in such a fix. After canvassing New Jersey, only to meet hostile local sentiment, which feared blanketing of small stations there by the big transmitter of a station regarded as an "invader," WABC turned to that part of Long Island beyond the Borough of Queens. Here again the citizenry was aroused.

Now, in a second attempt to obtain a Long Island site, this time in Nassau County, still more remote from the congested part of the Island, another rumpus is raised, the scene being in the Town Hall at Hempstead. Opponents of the location of the transmitter in Hempstead charge that money is being paid to buy off local opposition, and that the nephew of one of the officials who must vote on the proposition has been hired as an attorney to help plead the case for the station.

KDKA's 400,000 Watts

THERE will be more staying up late at night than is common with the American people, who now go in for that sort of thing on a pretty large scale, if the Federal Radio Commission grants authority to KDKA to use 400,000 watts, the greatest power of any station in the world.

The station desires to broadcast from 1 a.m. until 6 a.m., using this enormous power much of the time, and also using lesser power, down to a bare 50,000 watts, so that the comparative penetration effects can be studied, and also developmental work conducted at the station consistent with the possibility of commercial use of enormous power.

In connection with the 400,000-watt experiment, it would be easy for those technically inclined to act as observers for the station, and measure the output in the power tube plate circuit, by rectifying the signal frequencies, and inserting a sensitive direct current indicating device in series, such as a 0-1 milliammeter.

If that high power is used it would be well for radio technicians to contribute this assistance. A standard method of measurement could be established, the regular broadcast signal strength plotted during evening hours and the test program when the big kick is put into the wave.

ANSWERS DENY ILLEGALITY OF PATENT POOL

Washington.

Answers to the Federal Government's suit against them for alleged conspiracy, combination in restraint of trade and monopoly, were filed by Radio Corporation of America, American Telephone and Telegraph Company, 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 exists, and also that cross-licensing was established, but there was no illegal intent or effect in any of these acts, state the answers.

RCA Photophone, RCA Victor Company and RCA Radiotron Company filed separate answers, but they were virtually identical to the answer of RCA.

Main Question Relates to Legality

From the answers it is apparent that the main consideration in dispute is one of law, whether the acts complained of are illegal. Some disputes are forecast as to matters of fact, including what are the actual terms of the pool's contract with licensees that manufacture receivers and power amplifiers. Also, the answers indicate a quarrel over the state of the art of broadcasting at various periods covered in the complaint, the presence or absence of competition or even the existence of a real market in the early days of radio, and the state in which some of the defendants were incorporated.

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

"Radio Corporation admits, upon information and belief, that each 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 used and useful in the manufacture, use and sale of radio apparatus in combination with inventions of the other primary defendants, but avers that no one company owned or had rights under 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 radio by any one of the primary defendants alone impossible and that the task of establishing modern radio called for and made imperative the joining together of the patents and patent rights and the inventive power of the laboratories of the several primary defendants working free from patent limitations of all of them and of the patent rights subsequently acquired by the Radio Corporation."

Many Patents Held

Regarding the patents the RCA answer sets forth:

"Radio Corporation admits that it owns and controls and that other defendants severally own and control many patents relating to various features of radio apparatus, possibly more than 4,000 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 part of such development 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 be, as they were, superseded by later inventions and become obsolete; and that many inventions would be made, as they were, which utilized earlier inventions but added to and improved upon them and were supplemental thereto.

"That the development which has been conducted by these primary defendants has created the modern radio art is due 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 those defendants so that, by co-operative effort, results have been secured that would otherwise have been impossible."

Literature Wanted

THE 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, or a post card or letter will do instead.

RADIO WORLD,
145 West 45th St., N. Y. City.
I desire to receive radio literature

Name ....

Address ....

City or town ....

State ....

Wendell Focht, 449 Belden, Chicago, Ill.
Louis S. Reynolds, 1352 Dancy St., Jacksonville, Fla.
C. T. Hawthorne, 3500 W. Monroe, Chicago, Ill.
Oscar Peltonen, 1141 E. Pierson Pl., Flint, Mich.
Joseph J. Piatkowski, 5545 Prescott Ave., Detroit, Mich.
C. A. Feltes, 2026 Cullom Ave., Chicago, Ill.
Anthony Wiener, 734-6th Ave., Coraopolis, Pa.
S. Silein, 2936-3rd Ave., Council Bluffs, Iowa.
C. J. Schrock, 114 E. Miami, Logansport, Ind.
Andrew VerBance, 1932 Wager St., Columbus, Ohio.
Floyd Wilkins, Seaside Park, N. J.
Andrew Henry, 134 E. Martin St., Del Rio, Texas.
C. A. Youngs, 42 Division St., New Rochelle, N. Y.
J. M. Winer, 5 Columbus Circle, c/o Dynamic Radio Service, New York, N. Y.
Charles Pierce, 422-4th Street, Monongahela, Pa.
Norman Bernstein, 627 Tasker St., Phila., Pa.
James Ringland, 2510 Marsh Ave., Norwood, Ohio.
Troy L. Thompson, R. F. D. No. 1, Dry Fork, Va.
L. P. Waterman, 2140 Kirby West, Detroit, Mich.
Michael Kovalchuk, R. F. D. No. 2, Asbury Park, N. J.
Benj. Wood, R. F. D. No 4, Waterville, Maine.
William Lannom, 4408 No. Sacramento, Chicago, Ill.

New Incorporations

Breakfast Treat, radio broadcasting—Attys. Barry, Wainwright, Thatcher & Symmers, 72 Wall St., New York, N. Y.
Joseph E. Frank Corp., Newark, radio equipment—Atty., Louis D. Schwartz, New York, N. Y.
Cormier's Electric & Radio Shop, Oyster Bay—Atty., W. F. Foster, Glen Cove, N. Y.
Radio & Television Co.—Atty., J. T. P. Sullivan, 247 Park Place, New York, N. Y.
Belmont Radio Shop—Atty., J. J. Pantell, 601 Tremont Ave., Bronx, New York, N. Y.
Lenox Radio Stores—Attys., Klein & Klein, 305 Broadway, New York, N.Y.
Howert, radios—Atty., N. Herbsman, 50 East 42d St., New York, N. Y.
Pyric Radio Corp., Wilmington, Del., radio supplies—Delaware Registration Trust Co.
Genessee Radio Corp.—Attys. Tomposky & Tromposky, Utica, N. Y.
Nathaniel Friedberg, radios—Attys. Sigemeister & Rayfield, 26 Court St., Brooklyn, N. Y.
Radio Film Shooting Device Corp., motion picture apparatus—Atty. F. W. Scholem, 10 East 40th St., New York, N. Y.

MONOPOLY NOW A REAL DANGER, SAYS ROBINSON

Columbus, O.

In a recent speech here before the Institute for education by Radio, Ira E. Robinson, Federal Radio Commissioner, and formerly chairman of the Radio Commission, inveighed against any 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 wavelength is before the United States Supreme Court for settlement.

Commissioner Robinson did not charge specifically that there exists a radio 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 that 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."

Regarding property right in the air, Commissioner Robinson said:

"Congress, by salutary law, has stamped radio as the people's own. It is to be regulated and used wholly in the public interest. By Congressional mandate it is so licensed. No licensee can have a property right in the air. The licensee is merely a trustee for the public. He holds his license indeed with the promise that he will return to the people in exchange therefor 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 lauded the profession 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 broadcasting of the national open golf championship finals from the International course at Minneapolis. The transmitter was carried about 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 addendum to existing licenses.

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 have enabled manufacturers to build highly sensitive and selective tuned radio frequency receivers that had stability of operation, as well, but sensitivity and selectivity are more easily maintained at a high level by Superheterodyne construction, even though other problems enter. The Superheterodyne is the most difficult circuit to engineer for quantity factory production, but the patent pool imparts to the licensees the result 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.

The 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 set on the market may turn 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, which enabled reception without squealing and without critical tuning adjustment. The advent of the screen grid tube introduced stability, plus increased sensitivity, in tuned radio frequency receivers, and crowded the Neutrodyne out of popularity. Meanwhile the Superheterodyne had been featured as a de luxe receiver at a high price, but in the last few years 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, will be on the market. RCA, General Electric, Graybar, Westinghouse, Victor and General Motors will market these models, which will be the same sets, only with different labels. RCA plans to have a lobby display of its receivers in all Radio-Keith-Orpheum theatres.

Models and Prices

Although these screen-grid Superheterodynes will not be released until next month, with official price announcements August 1st, the following are the model numbers and reputed prices:

No. 80, price $142.

No. 82, price $179, 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 quality. One station might 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 one might be assured of a particular type of program. In addition there might be 100 local transmitters of low power 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 it is conservative to 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 a vengeance. If 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 to cover our pills of education with chocolate or licorice or peppermint if we are going to reach the people to whom the information should be most welcome. Education by radio, therefore, must carry 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., radios—Atty. B. B. Turkus, 105 Court St., Brooklyn, N. Y.

The Ohio Supply Co., Inc., Long Branch, radio supplies—Atty. L. S. Throckmorton, Long Branch, N. J.

The Dale Co., Wilmington, Del., radio tubes, wireless and radio sets—Corp. Trust Co.

Electro-Broadcasters Corp., radio broadcasting—Atty. A. Sapiro, 11 West 42nd St., New York, N. Y.

Nu-Era Radio Stores—Atty. M. Davidoff, 1463 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 42,860,000 cycles (1 to 7 meters) are exceptionally well suited for clarity of reception, according to Prof. Albert Esau, 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 almost 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 encouraging 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 mixing 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 stated that, so far as his experiments had progressed, the short waves used could be regarded as "immune" from both types of static. As for the tonal advantage, this was said to be due to the high ratio of the carrier frequency of voice and music modulation.

The Professor teaches physics in 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 ease of interesting the general public in short waves, since the regular broadcast receiver is used conjunctively, 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 has been doing some transmitting himself, to afford reception suitable for comparison. He has the audio component measured as to wave form and frequency distortion, at the sending end, and again at the receiving end, so that his superimposed oscillograms will have scientific value.

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 set manufacturers are up to date in the payment of royalties. The contract calls for a minimum royalty of $100,000 a year, but the licensees are to 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 of payment thereof, and in place a deposit would be required to guarantee payments, depending on the prospective scale of business and the credit standing. For AA-1 credit of $250,000 or more possibly no deposit would be required.

Atwater Kent and Majestic have paid the largest royalties.

DISPUTE OVER 'BULOVA TIME' OBSERVATORY

The Bulova Watch Company, states the National Better Business Bureau, Inc., gives the impression it is broadcasting time signals determined by Bulova at its observatory, whereas executives of the company and of the advertising agency that handles the Bulova account say the 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: "Investigation shows that Bulova Watch Company uses Western Union time in broadcasting Bulova time announcements."

The Bulova time signals are familiar to radio listeners throughout the country, as a large number of stations gives the time regularly as paid advertising.

Other aspects of the company's advertising were 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 opinions on matters of astronomy, and it is only natural they will let themselves in for situations of this kind when they touch on subjects 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 use Western Union time, but 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 booth atop 580 Fifth Avenue, New York, the dimensions being 5 feet wide, 8 feet long and about 6 feet 2 inches high."

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

The Bureau representative was informed, continues the report, that a Bulova astronomer carries a chronometer up to the booth from the Bulova offices and workshop on the eleventh floor of the building when astronomical readings are taken, but the report compares this with the same 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 as an '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.

Air Purged of One More Blurb

Washington.

The Federal Trade Commission is assisting in the attempt to purify the air now somewhat polluted by over-enthusiastic claims of advertisers. These same claims are used in newspaper and other advertising.

A recent example is that of a coffee manufacturer, who made claims that proved to be more than the facts warranted. The Commission did not disclose the identity of the offender, but said he had signed stipulation No. 544, promising to desist. The facts are disclosed by the Commission as a warning and guide to other advertisers who overstep the mark.

The announcement follows:

"Stipulation No. 554: An individual selling and distributing coffee will cease employing in his catalogs, radio talks, and in other advertising, words which would indicate that his coffee has been treated with a ripening process involving fungus growth, when in fact it has not been so ripened or treated. He agreed to stop using also a representation that his ripening process consists of a treatment under high temperature for two weeks and from other expressions which might mislead the public regarding the process."

TELEVISION AID TO DEAF SHOWN

Television in colors, whereby the deaf may communicate by lip-reading, was demonstrated recently by the Bell Telephone Laboratories, at 463 West Street, New York City.

Miss Evelyn Parry, totally deaf, was in a television booth in the laboratory, while a little more than two miles away, in a similar booth, sat her teacher, Miss Marie Pless, who is partly deaf. The television was fairly clear, the coloring was good and the lip-reading was successful.

The television impulses were sent on a high frequency. Also, the spoken words of the two young women were transmitted for part of the time, this work being done on telephone wires. Therefore, the test showed the excellent progress made in legibility and also the feasibility of "teletalkies."

Of particular interest was the success attending the transmission of the colors of the image.

Officials of the company said that the demonstration merely showed again that progress in television is being made.

NBC Stops Sending Music from Casino

The National Broadcasting Company has discontinued broadcasts of music from the Central Park Casino, which was the scene of a dramatic raid by prohibition agents in evening dress. The NBC stated that difficulty in establishing satisfactory microphone pickup when the Casino is crowded caused the discontinuance of the broadcasts.

Reisman's Orchestra, which played at the Casino, is managed by the NBC, and its music was carried over the two chains of that company. The Casino is in the heart of the park, on New York City's property, but is leased to private operators.

TELEVISION ALL EXPERIMENTAL, IS BOARD VIEW

Washington.

The status of television is experimental, and the encouragement of the manufacture of television receivers is not in the public interest, said the Federal Radio Commission in a brief filed with the Court of Appeals of the District of Columbia, answering the injunction suit of the Short Wave and Television Laboratory, Inc., of Boston, Mass. The company sought a frequency in the broadcast band, to be used for sending out the audible accompaniment of its television transmission on short waves. When denied this petition for a "sound track," it obtained a temporary injunction, which the Commission is trying to have vacated.

The position taken by the company is that the refusal of the frequency for a sound track is injurious to the development of radio talkies, as it is conceded that images alone, without audible accompaniment, do not offer much commercial prospect. The fascination of the combination of the two is compelling, the company asserts, and it wants to be assisted, rather than hindered, in its efforts to bring practical radio talkies nearer commercial accomplishment.

Calls Sound Track Necessary

Therefore, it argues, the grant of experimental licenses is fully justified, as there can be no experiments otherwise, and the authority to use a broadcast wave, also, is required so that full development can progress at the desired pace.

The company wants to operate the sound track on 1,370 kc, using 100 watts, during specific hours in the evening when that wave is not used in the locality, anyway. But the Commission said no, following an established policy of reserving the broadcast band for regular sound broadcasting.

The television transmission on short waves carries with it the right to use five channels of 100 kc each, or 500 kc in all, whereas the broadcast channel is 10 kc only, the Commission's brief pointed out.

This brief also set forth the following:

"Television is not yet ready to offer to the public as a whole. It is not yet possible to foresee exactly or with any degree of certainty just what engineering developments will take place in this highly technical field of radio activity."

Never Designated for Sound Track

"None of the frequencies in the broadcast spectrum, covering the territory from 550 to 1,500 kilocycles, has ever been designated by law or international treaty or by regulation of the Commission for use as a sound track for programs to be synchronized with visual broadcasts, the court is informed."

One of the primary reasons for the application "was admitted by appellant to be an effort to secure a medium for the direct promotion of the sale of television receivers manufactured by appellant," the Commission states.

"The Commission did not regard this as a ground for denial of the application," continues the brief, "yet the Commission felt that this fact alone, or taken in connection with the other facts herein involved, did not constitute a sufficient showing that public interest, convenience or necessity would be served by the granting of appellant's application."

HOOVER SIGNS BILL TO LIMIT COURT APPEAL

Washington.

President Hoover signed the Lehlbach bill, which confines the jurisdiction of the District of Columbia Court of Appeals to questions of law arising from decisions of the Federal Radio Commission, "unless it shall clearly appear that the findings of the Commission are arbitrary or capricious." Previously the court reviewed 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 frequency, hours on the air and power, because of a higher approach to finality attaching to such rulings.

The Commission has felt handicapped because almost every act of any 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 besides 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, however, to review by the Supreme Court of the United States upon writ of certiorari on petition therefor under section 347 of title 28 of the Judicial Code by appellant, by the Commission, or by any interested party intervening in the appeal."

Thad H. Brown, general counsel of the Commission, welcomed the new provision. He said:

"It provides that the lower court sit as a judicial tribunal and that appeals from it may be taken to the Supreme Court. The lower court heretofore has been an administrative body, reviewing, primarily on the facts, cases appealed from the Commission. The new amendment, however, provides that the court take only judicial action, and in that way fundamental questions in this new field of jurisprudence will be settled, eventually by the Supreme Court."

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 district court assumed jurisdiction, ruling on questions of fact, in the WGY case, which was argued for the station by Charles Evans Hughes. WGY, Schenectady, N. Y., appealed the Board's decision denying the station full time on 790 kc. and won. The Supreme Court interrupted its hearing of argument, ruling 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 ever since then.

The bill was passed unanimously by House and Senate.

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 of Health in New York City, 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 places the loudspeakers were producing plenty of volume. The owners had heard about the new ordinance, and when Mr. Brown asked their co-operation in noise-abatement they consented, and he went on his merry way home.

NIELDS NAMED AS U. S. JUDGE

Washington.

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 intervene, after Judge Morris had sent in his resignation. The reason given privately by the Judge for resigning was that he desired to improve his financial condition.

Senator Norris, of Nebraska, had sided with Dill on the desirability of having Judge Morris remain, especially as the Government's suits against the radio pool are to be tried 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 long, but being "kicked upstairs" through the intervention of large corporate interests. They matched the fact that Judge 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 making it unpleasant for Samuel Insull, "who managed all the public utilities in Chicago," and when important litigation affecting the Insull interests was about to come before the court.

The Senate Judiciary Committee heard John P. Nields, whom President Hoover nominated to succeed Judge Morris. 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 General Motors Corporation, one of the defendants in the Government suit. It was found he had no connections with the companies named in the pool suit and had not been Mr. DuPont's attorney, so the committee approved him.

Capital Police Get Radio Station Permit

Washington.

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.

VOICE TRAVELS AROUND WORLD IN $\frac{1}{8}$ SECOND

Schenectady, N. Y.

Around the world in an eighth of a second.

Nellie Bly and later day round-the-world travelers have been put to shame. C. D. Wagoner's voice circumnavigated the world in a fraction of a second, establishing two records: the first round-the-world broadcast and the longest recorded broadcast.

Since it was possible to reach Australia in a westerly direction, it occurred to the engineers that with the cooperation of the Phillips Radio in Holland and Java, it might be possible to reach Australia in an easterly direction and through the powerful Sydney short wave transmitter complete the circuit of the globe.

Voice Returns as Echo

A preliminary test was arranged in co-operation with Phillips Radio of Holland, and the Amalgamated Wireless Australasia Limited of Australia, operators of 2ME, the powerful short-wave transmitter. Unexpectedly the premilinary 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.

Two days later the voice of Mr. Wagoner left Schenectady on W2XAD, 19.58 meters, was received in Huizen, Holland, where it was rebroadcast or relayed by PHI, 16.88 meters, received by PLW at Bandoeng, Java, and retransmitted on 36.5 meters to Sydney, where the engineers using 2ME, 28.5 meters, sent it on to Schenectady. Mr. Wagoner talked to himself. His voice came back as an echo, each syllable repeating itself an eighth of a second later, and the most surprising feature was that at times the returned words were easily understood.

Covered 22,900 Miles

Electrical impulses travel at a speed of 186,000 miles per second. The distance covered was approximately 22,900 miles and a very small fractional part of a second was taken in retransmitting at the widely separated points.

Mr. Wagoner was confronted with the problem of what to talk to himself about, knowing that at the same time his little chat with himself was available, via radio, to the whole world. Because of the unexpected success of the preliminary test, the signal was put on the long wave of WGY, and so Mr. Wagoner decided that he would tell every one as well as himself just what was taking place.

Record Played, Too

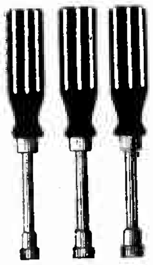
He described the route his voice was taking, the stations involved and the wavelengths used.

As an additional novelty, a phonograph record electrically reproduced was sent via W2XAD over the round-the-world circuit and reproduced on its return. The listeners on WGY heard only the received signal, but the music was sufficiently clear in parts for listeners to identify it as "I Love You Truly."

This was followed by a sign-off of each of the stations involved in the rebroadcast, first PHI, Holland, then PLW, Java, and last, 2ME, Sydney.

The entire "performance" was recorded on phonograph records.

Set of SOCKET WRENCHES *FREE!*



FOR turning nuts down or up there is nothing as efficient and handy as a socket wrench. Here is a set of three wrenches for hexagonal nuts, enabling use with 5/32, 6/32, 8/32 and 10/32 nuts. Fit the nut into the proper socket and turn down or up. The three different size sockets, one size on each wrench, enables use of three different outside diameters of nuts, but at least ten different sizes of threads. Send 50 cents for four weeks subscription for RADIO WORLD and get this set of three wrenches FREE!

RADIO WORLD, 145 W. 45th St., New York, N.Y.
50 cents enclosed for 4 weeks' subscription for RADIO WORLD. Send socket wrenches free!

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"Firsts" only—at Bargain Prices!

224 @ $1.20	UX199 @ $1.20
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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 them. Note the prices. Remit with order. Generous replacement policy.

112A	50c	227	50c
UV or UX-199	50c	245	50c
201A	45c	171A	50c
224	65c	280	50c
226	50c	281	60c

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Cat. ACSW5, National complete parts for 5-tube AC Short Wave Thrill Box; list price, $79.50, net price $45.35

Cat. DCSW5, National complete parts for 5-tube battery operated short-wave Thrill Box; list price, $75; net price $42.75

Wired by Jackson Laboratories, $5.70 extra. Add letter "W" to catalogue symbols.

AC model uses two UY224, three UY227, with provision for pentode in RF stage if preferred. Cat. ACSW5 does not include power supply. Use National A and B power unit, 2.5 v. AC, 180 plate volts, Cat. 5880-AB; list, $34.50; net $19.66. One 280 tube required. Order 280. Key tube @ .... $1.13 net

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HAMMARLUND DOUBLE DRUM DIAL—Each section individually tunable. List price $6—our price, $3. Guaranty Radio Goods Co., 143 W. 45th St., New York.

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ERLA-DYNAMIC CHASSIS, WESTINGHOUSE RECTIFIER. Sensitive and efficient dynamic speaker chassis. List price, $25; our net price, $12.50. Guaranty Radio Goods Co., 143 W. 45th St., New York.

FOR SALE—Ultradyne and Hi-Q30. F. L. Hanson, Ilion, N. Y.

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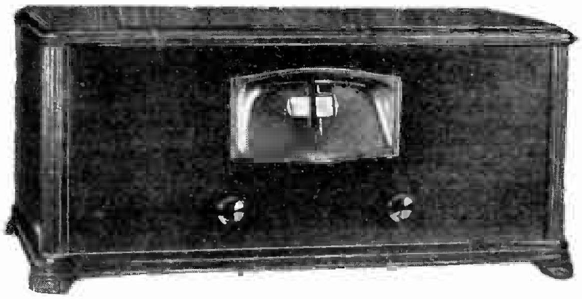
BARGAINS in first-class, highest grade merchandise. B-B-L phonograph pick-up, theatre type, suitable for home, with vol. control, $6.57; phono-link pick-up with vol. control and adapter, $3.50; steel cabinet for HB Compact, $3.00; four-gang .00035 mfd. with trimmers built in, $1.95; .00025 mfd. Dubilier grid condenser with clips, 18c. P. Cohen, Room 1214, at 143 West 45th Street, N. Y. City.

Balkite Push-Pull Receiver



The Balkite A-5 Neutrodyne, one of the most sensitive commercial receivers ever developed; 8 tubes, including 280 rectifier. Wholly AC operated, 105-120 v. 50-60 cycles; in a table model cabinet, genuine walnut, made by Berkey & Gay.

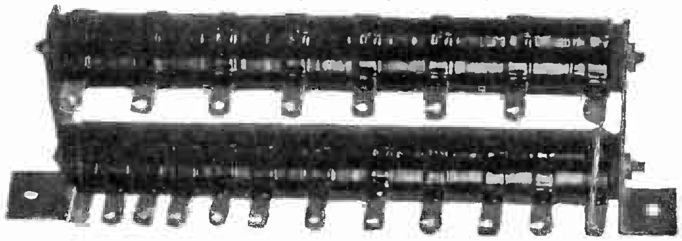
Three stages of tuned RF, neutralized, so there's no squealing; easy tuning; operation on short piece of wire indoors perfectly satisfactory; no repeat tuning points; no hum; phonograph pickup jack built in; excellent tone quality; good selectivity. Two posts are accessible for connecting the field coil of a DC dynamic speaker.

The parts of which this receiver is made are all ace-high and the wiring is done with extreme expertness, by Gilfillan. The power supply is exceptionally fine, the set being worked at 50% less than the rated capacity of the power transformer and chokes, assuring long life. There is no hum, as filtration is remarkably good.

The illuminated drum dial, at center, reads 0-100 at left, and at right has a blank space in which to write call letters. The little knob at left is the volume control, and the one at right is the AC switch. Each RF stage is filtered and bypassed individually, and the RF coils, tuning condenser and power transformer are separately and totally shielded. The lead from antenna binding post to antenna winding of the first coil is of shielded wire that is grounded. Also, the receiver as a whole is totally shielded, with metal chassis and metal undercover, so there is no stray pickup. Cat. BAL-A5, list price $135; net price......... **$44.00**

New Multi-Tap Voltage Divider

3,000 3,000 2,000 2,000 800 700



0 50 50 50 100 200 400 450 500 550 600 650

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-sided ones, in which the current rating of 100 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. Higher voltages may be used at lesser drain.

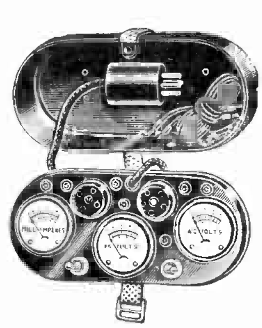
The expertness of design and construction will be appreciated by those whose knowledge teaches them to appreciate parts finely made.

When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. By making connection of grid returns to ground, the lower voltages may be used for negative bias by connecting filament center, or, in 227 and 224 tubes, cathode to a higher voltage.

If push-pull is used, the current in the biasing section is almost doubled, so the midtap of the power tubes' filament winding would go to a lug about half way down on the lower bank.

Order Cat. MTVD, list price $6.50, net price.................... **$3.90**

R-245 Set and Tube Tester



With the R-245 Tube and Set Tester you plug the cable into a vacated socket of a receiver, putting the removed tube in the tester, and using the receiver's power for making these tests: Plate current, on 0-20 or 0-100 ma. scale, changed by throwing a built-in switch; 0-60, 0-300 v. DC, changed by moving one of the tipped cables to another jack; filament or heater voltage (AC or DC), up to 10 volts, or any other AC voltage source, measured independently, up to 140 volts, including AC line voltage. Also screen grid voltage and screen grid current may be read by following connections specified in the new 8-page instruction sheet.

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

With this outfit you can shoot trouble in receivers and test circuits using the following tubes: 201A, 200A, UX199, UX120, 210, 171, 171A, 112, 112A, 245, 224, 222, 226, 227, and pentodes.

When the R-245 is plugged into the vacated socket of a set and the removed tube is placed in the proper socket of the Tester, the receiver's power supplies all the voltages and currents. You see the vital tests made right before your eyes, all three meters registering immediately, all three reading at the same time.

Here are some of the questions answered by the Tester when plugged into the receiver:

What is the filament or heater voltage (no matter if DC or AC)? What is the plate voltage at the plate itself? What is the plate current drawn by the tube? Is the tube in good condition or does it require replacement? What is the grid bias voltage? What is the cathode voltage? What is the screen grid voltage? Besides, when meters are used independently, you can answer these questions: What is the screen grid current? What is the line voltage (no mater if AC or DC)? Is the circuit continuous or is it open? What is the total plate current drawn in the receiver? What are the respective B voltages at the B batteries or voltage divider?

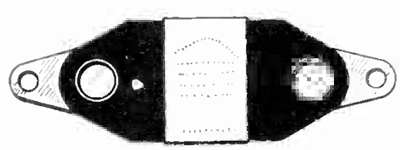
Order Cat. R-245. List price, $20; net price........... **$11.40**

Silver-Plated Coils

Wound with non-insulated wire plated with genuine silver, on grooved forms, these coils afford high efficiency because of the low resistance that silver has to radio frequencies. The grooves in the moulded bakelite forms insure accurate space winding, thus reducing the distributed capacity, and keep the number of turns and separation constant. Hence the secondary reactances are identical and ideal for gang tuning.

The radio frequency transformer may be perpendicularly or horizontally mounted, and has braced holes for that purpose. It has a center-tapped primary, so that it may be used as antenna coil with half or all the primary in circuit, or as interstage coupler, with all the primary on a screen grid plate circuit, or half the primary for any other type tubes, including pentodes. The three-circuit tuner has a center-tapped primary, also. This tuner is of the single hole panel mount, but may be mounted on a chassis, if preferred, by using the braced holes. Pair consists of RF transformer and three-circuit tuner, both for .0005 mfd. only. Order Cat., G-RF-3CT, list price $5.00; net price.................. **$2.48**

Fixed Condensers

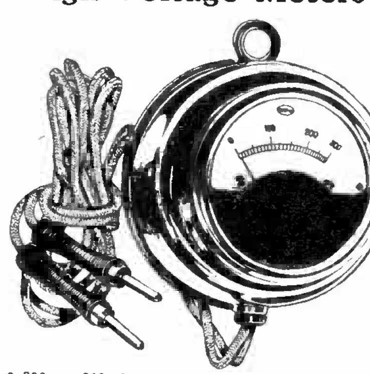


Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd.	10c	.006	20c
.00025 mfd.	10c	.00025 with clips.	20c
.0003 mfd.	10c	All are guaranteed	
.00035 mfd.	15c	electrically perfect and	
.001	17c	money back if not	
.0015	17c	satisfied within five	
.002	18c	days.	

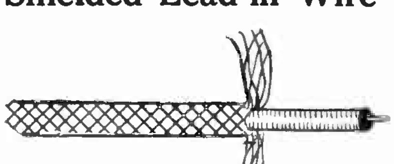
Order Cat. MICON .0001 etc. at prices stated.

High-Voltage Meters



0-300 v., 200 ohms per volt. Cat. F-300 @ $2.59
0-500 v., 233 o.p.v. Cat. F-500 @...... 3.73
0-600 v., AC and DC (same meter reads both); 100 ohms p.v. Order Cat. M-600 @ 4.95

Shielded Lead-in Wire



No 18 solid wire, surrounded by a solid rubber insulation covering, and above that a covering of braided copper mesh wire, which braid is to be grounded, to prevent stray pick-up. This wire is exceptionally good for antenna lead-in, to avoid pick-up of man-made static, such as from electrical machines. Also used to advantage in the wiring of receivers, as from antenna post of set to antenna coil, or for plate leads, or any leads, if long. This method of wiring a set improves selectivity and reduces hum. This wire is now appearing on the general market for the first time although long used in the best grade of commercial receivers. Order Cat. SH-LW. List price 9c per ft.; net price per foot **5c**

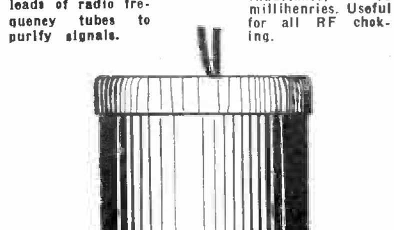
Double Drum Dial

Hammarlund double drum dial, each section individually tunable. Order Cat. H-DDD. List price $6.00; net price **$3.00**

Shielded RF Choke

Excellent in detector plate circuit or in B-plus RF leads of radio frequency tubes to purify signals.

An efficient radio frequency choke in a shielded case. Inductance, 50 millihenries. Useful for all RF choking.



In some instances one outlead is connected to case, so use this lead for B-plus or for ground, otherwise ground the case additionally. Order Cat. SH-RFC. List price, $1.00; net price **50c**

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

Enclosed please find $................................ (Canadian must be express or post office money order, for which please ship:

☐ BAL-AS @. $44.00 ☐ Ft. of SH-LW @.......5c p. f. ☐ M-600 @.... $4.95
☐ MTVD @ ... 3.90 ☐ F-300 @..... $2.59
☐ G-RF-3CT @ 2.48 ☐ H-DDD @... $3.00 ☐ F-500 @..... 3.73
☐ R-245 @..... 11.40 ☐ SH-RFC @... 50c ☐ MICON.... @ ....
☐ MICON.... @ ....
☐ If C.O.D. shipment is desired put cross here.

Your Name ....

Address ....

City .... State ....