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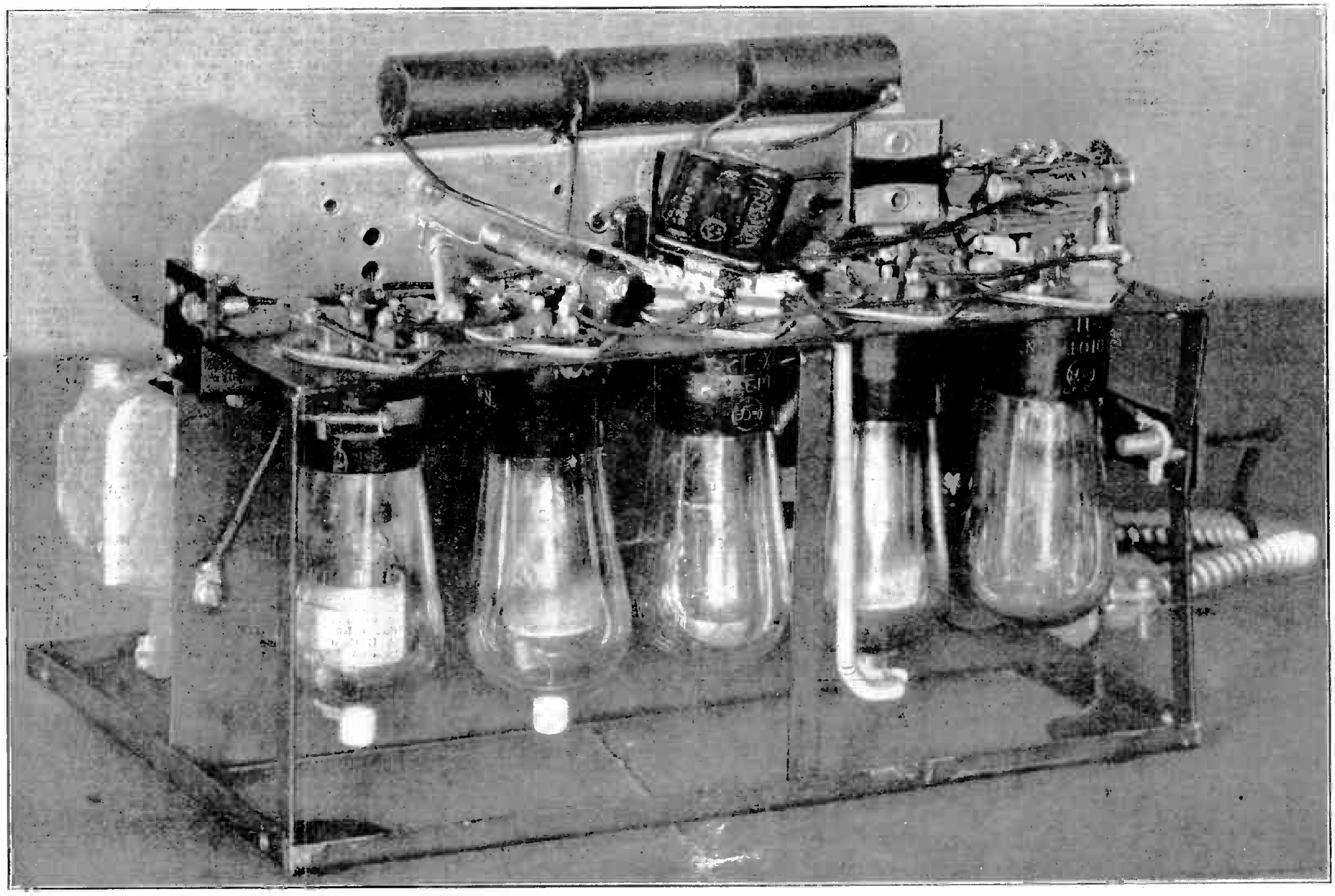

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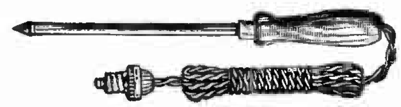

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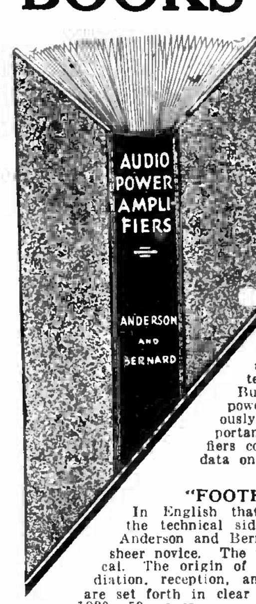

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New Short Wave Adapter

By Herman Bernard

THE two ways of bringing in short waves in conjunction with your regular broadcast receiver are (1) use of a one-tube adapter, that plugs into the detector socket, and does not use the radio frequency amplification of the broadcast receiver, and (2) use of a converter that changes the short waves received by the converter to an intermediate frequency that the entire RF channel of the broadcast receiver amplifies. In both instances the audio amplification of the broadcast receiver is used.

Against the one-tube adapter stands the record of poor performance, which is not upset by the fact that some remarkable reception has been obtained with some adapters in some locations, on some receivers. To be worth while an adapter should be good enough to work on any receiver, but the adapter has always left plenty of grief in its trail. The reasons were low sensitivity and absence of regeneration, the two reasons being merely the last-named in some instances, because when regeneration failed you received next to nothing.

Seen From New Angles

Another point against the adapter is that it is not adaptable to all types of receivers when it does work. For instance, a converter, using AC tubes, with filament transformer built in, will work with any set at all, although the degree of results depends on the amount of the receiver's radio frequency amplification.

Therefore it is well to consider the adapter from some new angles. One of them is that radio frequency amplification be built into it. Such examples are shown in Figs. 1 and 2, which are respectively for AC sets and battery-operated sets.

The simple consideration here is the inclusion of RF amplification, and it was found to produce good enough results to justify the verdict of passable. But it was not enough of an improvement over the dubious single-tube adapter to make it worth while.

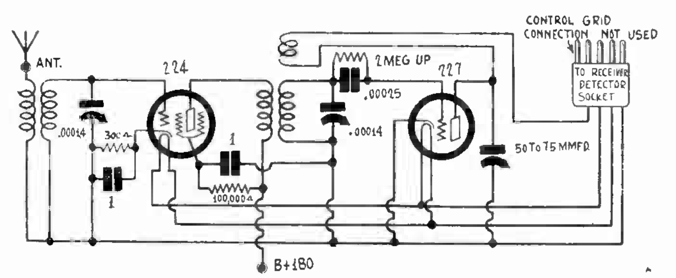
Looking at Fig. 1, it will be seen that a cabled plug is used. This plugs into the detector socket of the broadcast receiver and picks up the cathode, plate and two heater leads. The fifth prong has a lead emerging from it, too, representing the grid, but this is not used. It is handier to leave the prong intact, as plugging-in is more readily done, due to better fit when all prongs are used. The reason for omitting any connection to this lead is that it would pick up the grid of the detector grid circuit of the broadcast receiver, hence the two secondaries, the adapter's and the receiver's, and the two tuning condensers across them, would be in parallel. The short-wave grid input to the detector socket in the adapter is maintained exclusively as such, while the grid circuit of the detector socket in the receiver is open, or, rather, out of circuit entirely.

How to Work the Adapter

To work the adapter, the antenna is disconnected from the broadcast receiver, and instead is connected to the antenna post of the adapter. The detector tube, which must be a 227, is removed from the socket in the receiver and placed in the detector socket of the adapter.

In some manner access must be obtained to 180 volts in the receiver, the lead being brought to the binding post therefor on the adapter. An easy way to do this would be to remove an RF tube from the receiver, if it is a screen grid set, and using a phone tip with insulated wire soldered thereto, insert the tip in the plate post spring of the RF socket, connecting the end of the insulated wire to the binding post on the adapter. Then the switch of the receiver to "on" position, and you are ready for operation.

Tuning is done with the two dials. It would be possible to retain two tuned circuits, with single control, if a double condenser were used, with a trimmer across one. This trimmer, about one-tenth the capacity of the tuning condenser, would have to be a front panel control.



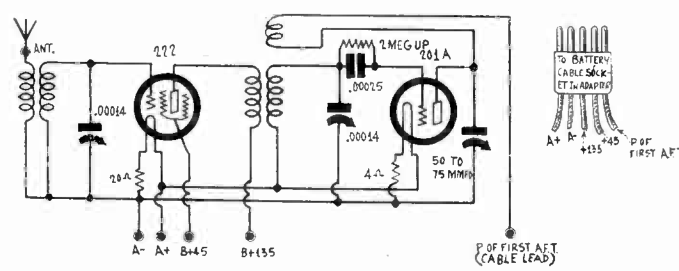


FIG. 1 (top)

A SHORT-WAVE ADAPTER, WITH ONE RF STAGE BUILT IN, FOR USE WITH AC SETS OF ANY KIND, HAVING 227 DETECTOR.

FIG 2 (bottom)

DESIGN FOR AN ADAPTER FOR BATTERY-OPERATED RECEIVERS OF ANY KIND.

Five Interesting Points

It will be noticed that:

(1)—A biasing resistor and condenser across it are required for the first tube.

(2)—A high resistance with a condenser to ground is required to reduce the 180 volts to about 75 volts, for screen grid voltage.

(3)—A separate means is necessary for obtaining 180 volts from the receiver for application to the adapter.

(4)—There are two tuned circuits.

(5)—Regeneration is obtained or rather suppressed through the small variable shunt condenser used (50 to 75 mfd.).

Taking these up in the order named:

The cathode-to-ground resistor and its bypass condenser may be omitted if means are provided for obtaining the bias directly from the receiver.

The high resistance and its bypass condenser likewise may be omitted if suitable access is had to the receiver for screen grid voltage.

The 180 volts may be introduced directly from the receiver by means of plugging in.

One tuned circuit will be found sufficient for an adapter, and tuning and construction simplified, while cost is kept down.

Regeneration Problem

Regeneration is difficult to assure, as one does not know what type of load is on the detector plate circuit: the primary of an audio transformer, an impedance coil or a resistor. Particularly

(*Continued on next page*)

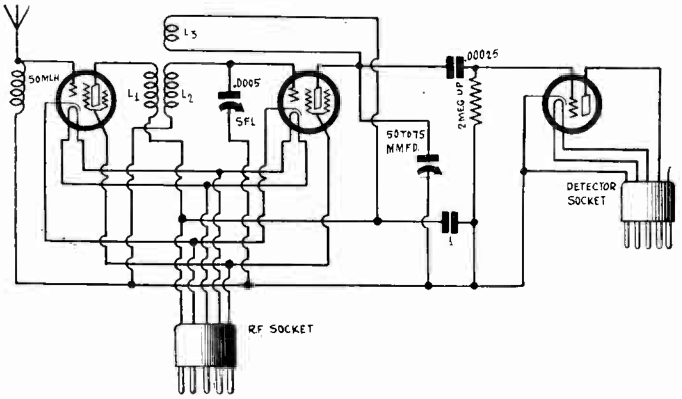


FIG. 3

THIS SHORT-WAVE ADAPTER FOR AC SETS USING SCREEN GRID RF AND HAVING A *227* DETECTOR OBTAINS ALL VOLTAGES FROM THE RECEIVER BY PLUGGING IN, EXCEPT THE ANTENNA INPUT. THIS IS THE FIRST PRESENTATION OF SUCH A SERVICEABLE ADAPTER.

risky is it to depend on a resistance-coupled amplifier when regeneration is sought, as the presence or absence of regeneration may be depend on the value of the resistor used, or no regeneration at all may be obtained, practically, because the plate resistor (in the receiver) would have to be so low to attain even a little regeneration that the amplification from the detector may be not only nearly zero, but less than zero.

The position of the regeneration condenser, from plate to ground, is that of a low impedance to high frequencies, so it is in fact a shorting condenser, and the coil design must be such that there is regeneration present always (if possible) and the condenser is used simply as a regeneration suppressor. By moving the regeneration condenser over, so that it goes from the end of the tickler coil to ground, it is in parallel with any detector plate bypass condenser that may be across the plate load, so the two are in parallel, one large in respect to the other, and again no reliance may be placed on the system for obtaining regeneration, since the large fixed condenser may act as a virtual short to the effect of the small variable one.

Another Tube Solves Problem

So it would be advisable if regeneration were dependable, and to make it so another tube would be added, giving a three-tube adapter useful on AC screen grid sets that have a *227* as detector, no matter what form of detection is used.

If there is a biasing resistor in the receiver's detector circuit this bias may be shorted out automatically, due to the return of the cathode to ground, in the adapter. As previously stated, there is no functioning in the receiver's detector circuit.

We are now prepared to consider the design of an adapter for screen grid receivers, where the detector is a *227*, as most detectors are in AC circuits. The design is to utilize three tubes, one of which is the detector, and there is to be only one tuned circuit.

The prime considerations now are that all voltages are to be obtained from the receiver, and all other necessary connections made to it merely by plugging in, except as to the antenna, and that regeneration should be unfailing.

Progress Made

Before we proceed to a discussion of the AC design, let us look a moment at the battery model adapter, which is the same as the one for AC use, except for the difference in tubes, sockets and other incidentals that constitute the familiar differences between AC and battery operation. (Fig. 2).

On account of the filament resistors in the receiver it is not safe to plug into the detector socket for the filament voltage for both tubes. Since we need the two independent A leads, we may as well include a third socket, this one having five prongs, so we can solder connections to the prongs of this socket and plug in a five-lead cable, the same type as used in the AC model, but using it this time as a battery cable. The idea is represented in Fig. 2.

Both circuits in Figs. 1 and 2 call for .00014 mfd. tuning condensers, requiring three coils for each tuned circuit, to cover from 15 to 135 meters, or a total of six coils, yet simplification of tuning, confining tuning to one circuit, would cut the six to three, while use of a .0005 mfd. straight frequency line tuning condenser would permit tuning from 15 to a little more than 120 meters with only two coils.

Advantages Incorporated

Now we shall revert to the desired design for the AC model adapter, embodying all the advantages outlined previously as being most desirable.

The design is shown in schematic form in Fig. 3. We have a stage of untuned radio frequency amplification, and a stage of tuned radio frequency amplification, the second stage regenerated, and a detector. The type of coupling to the detector is fixed, so that we need have no worries about failure of regeneration due to uncertainties of plate loads.

The trick is turned not only by the circuit diagram, but by a mechanical means as well, this of course consisting of the use of two cable plugs.

To make the adapter operative, then, the right-hand plug is inserted in the receiver's detector socket, along the lines formerly discussed, while the left-hand adapter is inserted in one of the screen grid radio frequency sockets of the receiver. The detector tube taken from the receiver, as well as the screen grid tube likewise removed, is placed in the correct adapter socket. Also it is possible to "borrow" another screen grid RF tube from the receiver, to complete the three tubes needed to work the adapter. That is, all three tubes are taken from the receiver, a further point of economy, and the load on the heater secondary of the receiver remains identical.

What Bias Is Obtained

The adaptation novelty lies in obtaining voltages by connection through a plugged cable to the RF socket of the receiver, therefore these leads will be detailed.

Notice that the cathodes of the two stages of screen grid RF used in the adapter are joined. If they are separate in the receiver they will be parallel now. If equal in the receiver they will be of half the resistance of either. But the plate and screen currents are doubled, since there are two tubes, so the bias is the same. Suppose the biasing is obtained in the receiver through a common biasing resistor from cathode to ground. The situation remains unchanged, the commonness is retained, the bias is unaffected. Suppose the bias is obtained from the B voltage divider. The situation remains unchanged again. It is still obtained in the same way.

The joined cathode leads of the RF tubes are connected to the cable lead that represents the RF cathodes. If the five-prong socket is viewed from the top so that the heater connections, side by side, are toward you, then the grid connection is farthest away from you, and these three may be taken to represent the points of a triangle, with an imaginary line from heater to heater as the base, and the lines from one heater to grid and the other heater to grid the rest of the isosceles. Then cathode is at left and plate at right.

Plate Voltage Bypassed

The low ends of the plate loads for first and second RF are interconnected and brought to the plate lead of the cable. This gives the desired 180 volts, only there is a coil in the receiver, representing the plate load there, usually the primary of a radio frequency transformer. This would act as a choke coil and stop the flow of signal current in the adapter, but a bypass condenser will prevent any such harmful effect, indeed will unite with the otherwise interfering plate load to form a satisfactory filter circuit. This condenser is shown between the plate and grid returns at right in Fig. 3.

The heater voltage is obtained from the RF tube socket, and it is better to introduce it this way, especially as in some hookups the heater for the detector is fed separately. Even if that is so, the adapter will work well, as the isolation is retained. Never, so far as I know, does any one RF tube get its heater voltage from any other source than do the other RF tubes. Also, use of two cable plugs permits grounding the detector cathode without grounding the other cathodes.

The remaining consideration is the screen grid voltage. This is obtained by direct connection, and as the receiver conditions in that respect are exactly duplicated, as explained.

Pointers on Operation

As for pointers on operation:

The regeneration condenser is hooked up so that increase of capacity decreases regeneration. This is a case of forced oscillations, with a condenser or other device used negatively, that is, to suppress them.

The caps of leads intended for screen grid tubes in the receiver are left unconnected, with the precaution taken that they do not touch any metal part of the receiver, such as a shield, when the tubes are removed for insertion in the adapter.

(*Continued on next page*)

LIST OF PARTS

(for Fig. 3)

L1, L2, L3—Two plug-in coils to cover 15 meters, to about 120 meters, with .0005 mfd. straight frequency line condenser.
One straight frequency line .0005 mfd. Hammarlund condenser.
One radio frequency choke, 50 millihenries.
Two five-prong cable connector plugs, with color-identified leads.
One 50 or 75 mmfd. maximum capacity midget condenser.
One 2 meg. leak, or higher resistance, with mounting.
One .00025 mfd. fixed condenser, mica dielectric.
One 1 mfd. bypass condenser.
Three UY sockets.
One panel.
One cabinet, with coil socket (UY).
One antenna binding post.
One dial.

Tuning is easy and may be calibrated. The regeneration condenser will change the calibration only slightly, not enough to tune out the signal. Where regeneration does decrease volume it is due to the slight detuning, so retune a trifle to make up for this effect common to all forms of regeneration.

Regeneration is as smooth as can be expected on short waves. It is easy to handle.

Use of a .0005 mfd. tuning condenser, of straight frequency line characteristics, with a fine vernier dial, gives ease of wavelength tuning. With a phosphor bronze pigtail on the condenser, so as not to depend on wiping contact, scratching reception and noisy tuning are avoided on the very high frequencies where otherwise present.

Fig. 3 represents an improved short-wave adapter, one that embodies a new convenience, that of omitting the necessity of bringing out leads to inaccessible points in the receiver, and yet it is one that also cures the vice of endangered regeneration. It is recommended that this design be followed, if one has an AC screen grid receiver that uses a 227 detector tube. The design was confined to that type of receiver both because of the popularity of such a receiver and because some particular receiver has to be in mind. Strict universality is not obtainable with this circuit.

For instance, suppose the detector tube in your AC screen grid set is a 224, that is, another screen grid tube. A change is necessary in the adapter, but it is only a slight one. The detector control grid lead, previously not used, now brings over the screen grid voltage of the detector socket in the receiver to the adapter. It is no longer a "control grid" lead, of course, but is the screen grid lead of the detector only. The control grid would go to the clip connected from the grid leak to the cap of the detector tube in the adapter. That is the only change, and a simple one you must admit.

However, suppose you have an AC set using some other type of tubes, e.g., 226 for RF and 227 as detector. Now the change would exist in the RF stages, not in the detector socket. The voltage plug at left instead of being of the five-prong type (UY), would be of the four-prong type (UX), since no cathode and screen grid connections exist. It would then be a problem only of wiring up the four-prong plug so that its terminals are connected properly—the two thick ones for the filament, and the plate prong for the positive B lead. The grid connection to the plug in this instance would not be used, just as the control grid connection was not used in Fig. 3, and for the same reason.

So while the design seems at first rather restricted in use, one finds out that it is adaptable to any AC receiver by a few minutes' work.

Referring to Fig. 2, we see again the battery model adapter, with only one stage of RF, or total of two tubes. It is easy enough to use the Fig. 3 circuit for battery operation, but the plugging-in or mechanical feature cannot be duplicated in the battery model, because of the uncertainty of how the voltage is dropped from the battery value to filament value in the receiver. Hence a cable plug is used here as in the battery representation of the Fig. 3 circuit.

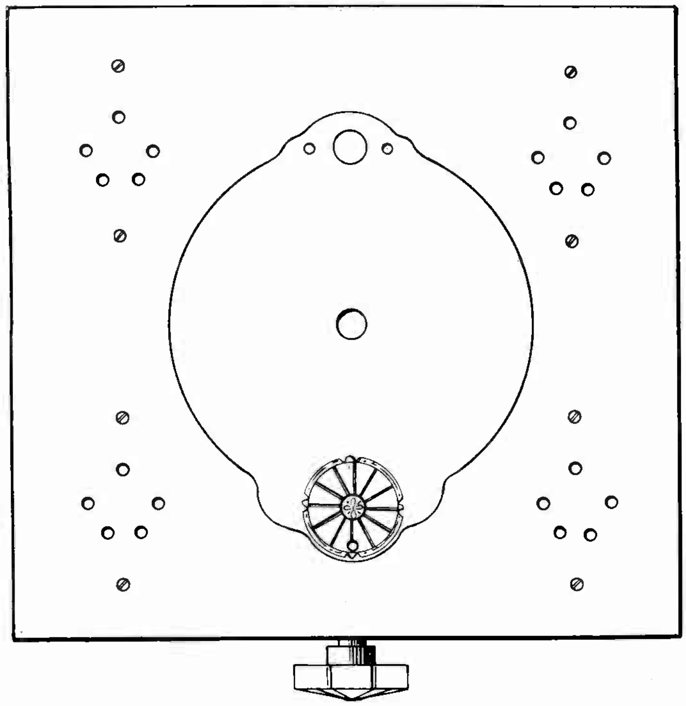


FIG. 4

ARRANGEMENT OF THE PANEL. THERE ARE FOUR SIMILAR SOCKETS, BUT ONE OF THESE IS FOR THE PLUG-IN COIL. THE REGENERATION CONTROL IS AT FRONT, ON THE CABINET. SO WOULD BE THE ANTENNA POST AT REAR. THE TWO CABLES WOULD EMERGE AT REAR ALSO. A 7x7 INCH PANEL MAY BE USED, WITH CABINET 3 INCHES DEEP.

[Data on coils, and other construction features, as well as information on results, will be published in next week's issue, dated August 2d.—Editor.]

Right or Wrong?

QUESTIONS

(1)—Twisting of heater leads in a radio frequency amplifier is not necessary, because tuned circuits cannot pick up the hum and therefore no hum can enter the signal by induction.

(2)—The effectiveness of a radio frequency choke in suppressing radio frequency currents depends on the inductance of the choke alone and is independent of the impedance connected in series with the choke.

(3)—Magnetic storms, that is, violent changes in the intensity and direction of the earth's magnetic field, cause disturbances both in radio and wire communication.

(4)—In a Superheterodyne receiver, or in a short-wave converter working on the Superheterodyne principle, the first intermediate frequency transformer should be so constructed that the primary can be tuned to the intermediate frequency.

(5)—A condenser in series with the loudspeaker, or in series with any part of the line, suppresses the low notes, and if the condenser is small enough the output will sound thin and tinny.

(6)—A condenser in parallel with the loudspeaker or one across any part of the line has exactly the same effect as a condenser in series.

(7)—If the speaker blasts on a certain frequency due to excessive amplification at that frequency or due to any resonance effect at that frequency, this blasting may be removed by connecting a resonant shunt across the line and tuning this shunt to the frequency at which the blasting occurs.

(8—The combination of a low value grid leak resistance and a small stopping condenser reduces the amplification on the low notes because the signal voltage drop across the condenser is large and that across the grid leak, the useful voltage, is small.

(9)—A sensitivity of one microvolt per meter is rarely attained in commercial receivers, even in those receivers rated as highly sensitive.

ANSWERS

(1)—Wrong. To prove that 60-cycle hum may be picked up by the radio frequency amplifier it is only necessary to bring a power transformer near the set, provided the transformer is being actuated by 60 cycle current. Or it can be proved by simply bringing alternating current carrying wires near the amplifier, especially near the grid circuits. The hum is largely picked up by capacity coupling.

(2)—Wrong. If the impedance in series with the choke coil is high enough it will have no effect on the radio frequency currents. For example, if a choke about 85 millihenries is connected in series with a one megohm resistor is suppresses 52 per cent. of the signal. If the choke is connected in series with only 1,000 ohms it suppresses nearly 100 per cent.

(3)—Right. Wire communication systems are frequently upset by magnetic storms and radio communication is disturbed even more often by these storms.

(4)—Right. If the primary is tuned the impedance offered to the plate circuit of the modulator is very high, which is one condition for transferring a high signal voltage from the modulator to the intermediate frequency amplifier. Moreover, the tuning condenser in the primary serves as a large by-pass condenser for the radio frequency components in the output of the modulator, and this increases the detecting efficiency of the circuit.

(5)—Right. A condenser through which an alternating current must flow always suppresses the low frequencies more than the high. But the effectiveness of any given capacity at any given frequency depends on the impedance in series with the condenser, such as the impedance of the speaker or the impedance of a transformer primary. The higher the impedance in series with the condenser the smaller is the relative drop in the condenser.

(6)—Wrong. A condenser in shunt with the speaker, or with any part of the line, has exactly the opposite effect of a condenser in series. It suppresses the high frequencies by diverting them from the speaker.

(7)—Right. This is one of the methods devised for improving the quality sound reproduction. Response peaks due to resonance in the amplifier or in the speaker, or even in the room, can be leveled in this manner.

(8)—Right. Only the signal voltage drop across the grid leak is useful. The drop across the condenser is wasted. The smaller the condenser the greater the drop in it. Also, the lower the frequency the greater the drop.

(9)—Right. Receivers of such sensitivity are rare, for it really is a great sensitivity. However, there are receivers which are even more sensitive than this. The MB-30 is one example. This has a maximum sensitivity of about one-fourth microvolt per meter.

A New Auto Receiver

By Neal Fitzalan

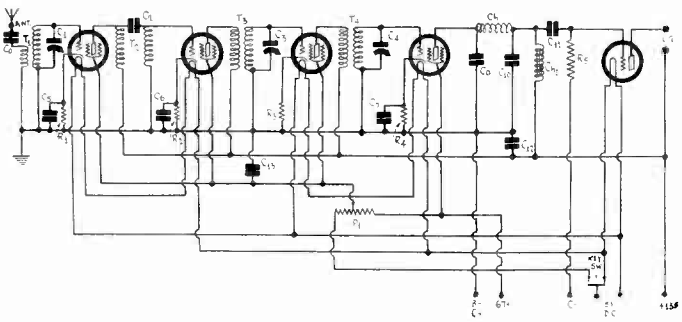
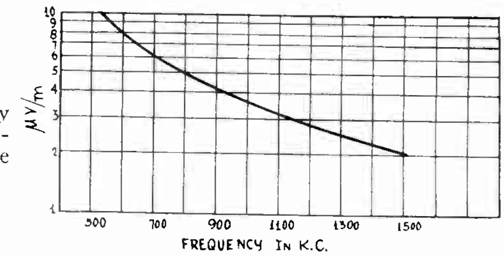


FIG. 1
THE CIRCUIT DIAGRAM OF THE NATIONAL FIVE-TUBE AUTOMOBILE RECEIVER.

FIG. 2.
The sensitivity curve of the National automobile receiver.



AN automobile receiver must have certain characteristics which are not absolutely essential in a fixed receiver. It must be compact for there is little room in the car. It must be dustproof, for if it is not, road dust would enter the set and make it noisy and inefficient. It must be waterproof, for if it is not moisture would enter in damp weather and this would decrease the efficiency of the coils, condensers and the insulation. It must be vibration proof, for if it is not the tubes will vibrate and introduce microphonic noises and the tuning condensers would continually jar out of tune. It must be highly sensitive, for the automobile may be taken to points removed from broadcast stations where the field strength is weak, and besides, it must be sensitive enough to overcome the poor pick-up by the type of antenna and ground that can be provided on a car.

In respect to selectivity no special requirements are necessary. Yet it must not be broad because the car may be taken to some location in the vicinity of a high power station.

Requirements of Filament Circuit

It is generally agreed that the best tubes for automobile receivers are the AC screen grid tubes, except for the output tube, which is usually either a 171A or a 112A.

Since the filament supply is the storage battery in the car, and its voltage is six volts and the tubes require only 2.5 volts, it is most economical to connect the heaters of the screen grid tubes in series parallel. That is, two heaters are connected in series and this series is then connected across the battery. When there are four screen grid tubes there will be two such heater combinations in parallel. With this arrangement it is possible to supply a receiver of four screen grid tubes and one 171A type power tube without drawing more than 3.75 amperes from the battery. If all the heaters and filaments were connected in parallel the total drain from the battery for the receiver alone would be 7.25 amperes, which would be excessive if the receiver were to be operated for any length of time. But a current of 3.75 amperes can be drawn from the battery for considerable periods without any need of recharging the battery. However, this depends on the charging rate of the generator in the car and on the frequency with which the starter is operated on the battery.

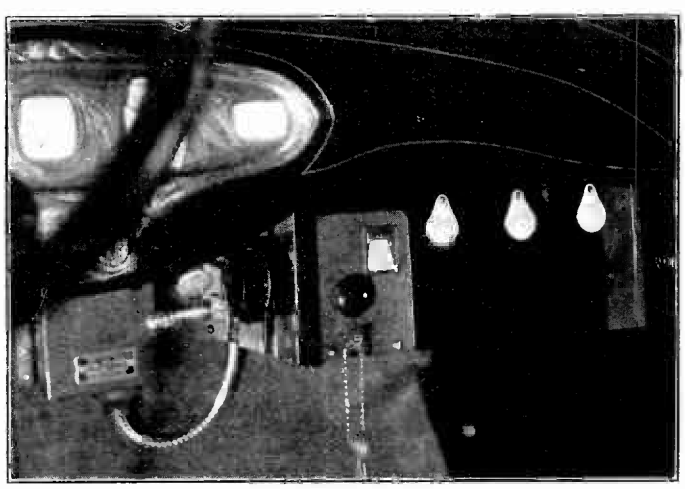


FIG. 3
VIEW OF THE INSTALLATION IN A CAR.

B Battery Requirements

In view of the fact that the B batteries must be used to operate the receiver, and the fact that these must not be excessively heavy, it is necessary that the receiver be designed so that the total plate current is as low as is consistent with satisfactory operation. This condition is met with screen grid tubes for each of these takes only a small current. The power tube, however, takes a large current, especially when it is of the 171A type, but this current can also be kept down by using the proper grid bias and by using a moderately high plate voltage on the tube.

In this connection it is well to remember that the output volume required is not great since it is not necessary to entertain or annoy everybody outdoors with the set. Soft and low music in the car is all that is required, and this can be obtained without distortion by limiting the plate voltage on the power tube to 135 volts. It is not necessary to use a higher voltage on the plates of the screen grid tubes.

With this limitation on the plate voltage only three 45-volt dry cell batteries are needed, and they can well be of the medium size.

Example of Automobile Set

In Fig. 1 is the circuit diagram of a screen grid receiver especially designed for automobile use by the engineers of the National Company, the designers of the MB-29, the MB-30 and the MB-29A, as well as many other well known receivers. This receiver has been designed so as to meet all the requirements mentioned above. It is economical as to filament and plate current, compact in assembly, sensitive and selective, dust, moisture and vibration proof, stable in operation, easily installed.

As will be noted on the diagram of this receiver, the heaters of the first two radio frequency amplifiers are connected in series, as are those of the third amplifier and the detector. The filament of the output tube is connected directly across the battery leads.

There are three tuned circuits in the receiver, all tuned with a triple-gang condenser. There is also an untuned transformer T2 between the first and second tubes, with a coupling condenser C2 of .006 mfd. capacity between the plate and the grid. The object of using this untuned coupler, as was explained in connection with the MB-30, is to improve the sensitivity at the low broadcast frequencies.

The equalization of the sensitivity over the broadcast range has not been carried as far in this automobile receiver as it was in the MB-30, but still the sensitivity characteristic is satisfactory as is evidenced by the curve in Fig. 2. This shows that the sensitivity at 1,500 kc is 2 microvolts per meter and at 550 kc 9 microvolts per meter. This is not a large variation at all and it has the advantage that the receiver is most sensitive in the frequency region where most of the weak stations are operating.

Type of Audio Used

The detector in the circuit is a screen grid tube operating on the negative bias principle. Since the tube is a sensitive detector and as there is sufficient amplification ahead of it to support grid bias detection, there is only one audio frequency stage, which is coupled to the detector by a high inductance choke Ch2, a stopping condenser C11 of .01 mfd., and a grid leak R5 of one megohm. The use of this high impedance coupler after the screen grid detector makes the detecting efficiency very high and takes advantage of the properties of the tube to the fullest practical extent.

The low pass filter in the plate circuit of the detector is composed of two .001 mfd. condensers C9 and C10 and a radio frequency choke Ch1.

The receiver is available in kit form or ready wired.

De Forest's Classic Story

DR. LEE DE FOREST recently recalled the early days of his research in vacuum tubes and told of the first small beginnings of the radio industry, which is now the sixth largest in the United States.

At the time he was working on a new type of detector for radio wireless, at the Armour Institute, Lodge Slobey and Marconi, also working in the radio wireless field, were using the Branley coherer. This small glass tube filled with silver filings has a property of cohering when high frequency electric waves pass through it.

While Dr. DeForest was working on an electric type of detector he observed one night in his hall bedroom that, while carrying on experiments under the night light of a Wellsbach gas burner, as he actuated his spark from a small transmitter, the Wellsbach light dimmed abruptly. When the spark was stopped, the gas burner came back to normal.

Immediately, the inventor jumped to the conclusion that he had here accidentally made a marvelous discovery. The gases in combustion must be sensitive to high frequency waves.

Realizes Falsity of First Idea

For several weeks he worked with this idea in mind, before realizing that it was but a delusion. The falsity of his conclusion was demonstrated when someone accidentally shut the door, and the effect Dr. DeForest had discovered obviously was acoustic and not electric. Of course, it was a tremendous disappointment, but he had been thinking over the whole subject long enough to work out in his mind an explanation for this electric phenomenon of the gases. He made up his mind that since this condition existed he would discover it some time.

A year or two later Dr. DeForest found opportunity to resume his work on this gas detector and did find the effect that he was looking for in the Bunsen burner, in which he had located two platinum electrodes. By carefully adjusting the wires he got the response in the telephone receiver for which he was looking. It was a real electric response. Much encouraged by this effect, he continued his research work along those lines.

Puts Filament Inside the Envelope

At this time wireless was limited to ship-to-shore communication. Dr. DeForest thought that an electric arc might supply the needed heated gases. But the arc being in a very unstable condition, an incandescent filament was thought best.

By putting such a filament in a glass vessel containing gas at the proper pressure the inventor thought he could heat the gas electrically and with a cold electrode in the vessel pass the positive current through the heated gas to the filament. This was akin to the phenomenon which had been discovered many years before by Edison and called the "Edison Effect." The difference was that DeForest always employed in his early gas flame experiments a second battery which he called the B battery, and which has continued to be so called ever since.

In the words of Dr. Lee DeForest:

"I finally got a lamp maker in New York to make one of these tubes, with which I got the desired effect. That put it in practical form. This new detector was quiet and required no adjustment of electrodes.

Third Element Wrapped Outside

"The next step was to increase the sensitivity of the device. I figured that the battery circuit leading from one electrode to the other was acting as a shunt and taking some of the energy away down into the ground. To avoid this I thought of putting the incoming energy into another electrode. This third operation of receivers incorporating the new tubes. The data on the characteristics of the three tubes, including the 0.130 ampere rating of the 231, will be found in the next column.

"Next I found that this control electrode was much more active if I put it inside the tubes. So I got my lamp maker to blow me another tube with two plates, one on each side of the filament. The sensitivity was greatly increased, and it was at this stage that I conceived the idea that this new device might be a telephone repeater as well as a detector for radio wireless signals.

"Although the amplifying effect was very slight indeed, nevertheless there was an amplification of telephonic frequencies and I applied for patents covering this idea of the three electrode tube, the vacuum tube as a telephone repeater.

The Grid Between Filament and Plate

"Having in mind above all the use of this device as a wireless detector, I found that the control electrode would be more efficient if placed between the filament and the second plate. That was common sense. So I made another tube, this time with the third electrode in the form of a grid between the filament and the plate. This was in 1906, five years after my first observation of the gas flame.

"From there on progress was rapid. But the tube was still quite gaseous. Gradually I came to the conclusion that the gas was not necessary, in fact, it was a detriment. I made a larger tube. I used a larger B battery. I used more current. I found that if I went above 20 or 30 volts the tube turned blue and lost its sensitivity. I got to the limit of the lamp pumps, but still I wanted more power.

"I went to a maker of X-ray tubes and exhausted the tubes to the highest degree of vacuum which he was capable of producing. Now I could put 250 volts on the plate without having the tube turn blue.

The Oscillating Audion

"In 1912, while refining my three-element vacuum tube, which I called the audion, I discovered for the first time that this telephone repeater was also an oscillator. Shortly after I discovered the possibility of heterodyning and using the device as a receiver to detect signals from arc transmitters.

"In 1912 I brought the cascade audion amplifier to New York and showed it to the Telephone Company. Here was the repeater for which they had been looking for many years. At first they were rather skeptical. I left it there and came back the next day to find a surprising change in their attitude. Their indifference of the first day had been transformed over night to keen interest.

"They watched my various tests and then asked me to leave the apparatus with them. I did, for an entire year. It was only after this long interval that they communicated with me again. I later learned that they had installed the repeater in several locations on their line between New York and Salt Lake City and had been able by means of it to telephone three-quarters of the way across the continent.

"They bought the telephone rights to this amplifier, on the basis of which two years later they hooked up a transcontinental service between New York and San Francisco, using batteries of these amplifiers at five points along the line."

Progress of Industry

Dr. DeForest continued by outlining the progress of the radio industry at the hands of the "ham" operators, the amateur wireless enthusiasts, and, after the war, by great industrialists. He then went on to describe the various uses of the vacuum tube and radio aside from broadcasting and communication, and tried to take a peak behind the curtains of tomorrow at the place that radio will hold in the lives of our children.

Dr. Lee DeForest, one of the few scientists who has lived to see his brainchild become the basis of many large industries and to see its uses widen every day, still takes an active interest in the industry which he founded. He enjoys reminiscences about the early days, as only a handful of radio pioneers can do, and never tires of telling the classic story of his audion. He also enjoys working in the present and dreaming about the future of radio.

231 Filament Rating Reduced to 130 Milliamps

A change in the filament rating of the new 231 recently announced by the RCA Radiotron Company, Inc., has been effected, according to information issued by the company. This new power tube was previously rated as having a filament current requirement of 0.150 ampere but is is now rated at 0.130 ampere. The change was introduced to effect greater economy in operation of receivers incorporating the new tubes. The data on the characteristics of the three tubes, including the 0.130 ampere rating of the 231, will be found in the next column.

The 230 is a general purpose tube that may be used as radio and audio frequency amplifier and detector. The 231 is an output tube and should be used in the last stage only. The 232 is a screen grid tube that may be used in specially designed circuits for radio frequency amplification.

	230	231	232
Filament voltage	2.0	2.0	2.0
Filament current, amperes	.06	.130	.06
Plate voltage, max.	90	135	135
Grid Voltage, max.	—4.5	—22.5	—3
Plate current (ma.)	2 0	8.0	1.5
Plate resistance (ohms)	12.500	4.000	800,000
Amplification factor	8	3.5	400
Mutual conductance (micromhos)	700	875	550
Effective grid-plate cap. (m.mfd.)	6	6	0.02 (max.)
Undist'd power output (milliwatts)	...	170	...
Screen voltage, max.	...	...	67.5
Screen current (max.)	...	...	0.5 or less
Latest list price	$2.20	$2.20	$3.30

Magnetic Experim

By John

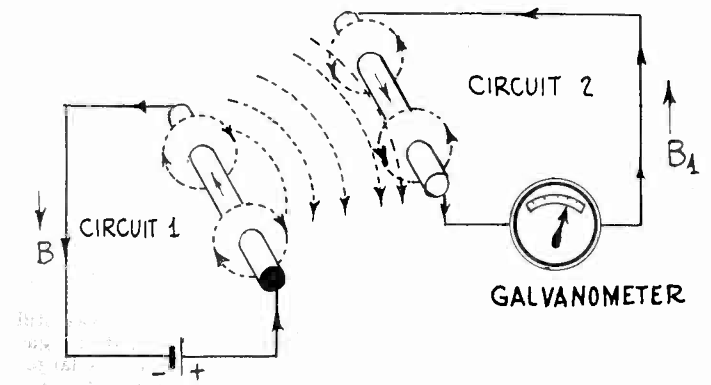


FIG. 1
MAGNETICALLY COUPLED CIRCUITS WITH SIMILAR PERIODS

[*This is one of a series of articles for novices and experimenters.* —*Editor.*]

SINCE we are utilizing resonance phenomena whenever we visualize or construct radio receiving apparatus in almost any of the prevalent forms which radio sets assume, this fact becomes so familiar that some of us lose sight of it because familiarity does breed indifference in this case.

The resultant effect of a train of events that originates with the generation of induced alternating e m f's in the wire space that is called the antenna is collectively understood by radio fans. Many of these fans also can analyze and have analyzed the operations of the component parts of a receiving set.

Also, many of these in addition, know how to combine various parts and know why some combinations work and others don't. As a consequence of all this experience they achieve a goodly measure of valuable radio knowledge that is at the same time highly practical.

If these individuals can learn to discern some of the essential requirements, in other words get at the pith of what they are seeking, the results will eventually be that these selected few will have mastered the subject.

The Antenna an Induction Generator

It is the desire of the writer to attempt to set forth some ideas in such form as can be readily assimilated by those who belong to the category of serious and analytically minded fans.

It has been stated elsewhere that magnetic flux effects in various forms predominate in radio sets, and upon this point I think that all interested readers will agree that the shape of coils and the distribution of wire on any given sized coil form also are a very deciding factor in the set's performance.

But before discussing group conditions that are effective or ineffective I would like to return to the antenna or induction generator, as it truly is.

Fig. 1 shows a coupled pair of circuits. I am going to ask the reader to imagine that circuit No. 1 is a popular broadcasting station whence alternating magnetic fluxes in the form of music originate, or more plainly speaking "electro-magnetic music," and that circuit No. 2 comprises your radio receiver, by means of which the music is received and made audible.

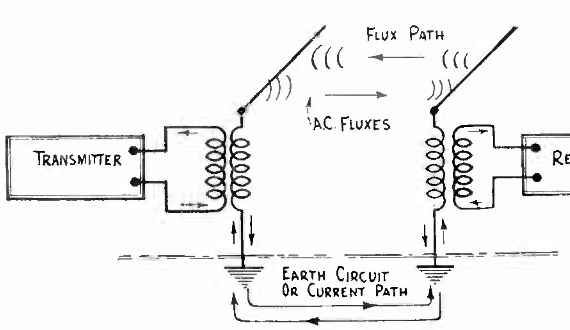


FIG. 2
RADIO TRANSMISSION USES TWO DIFFERENT CIRCUITS

So that there may be a magnetic field around the heavy conductor of circuit No. 1 it is essential that there be a current (so many amperes, or fractions thereof) flowing in the wire, whether it be unidirectional pulsating, or alternating, in character. If there is to be a current then the basic requirement is that there shall be a potential difference at least been the extreme ends of the heavy conductor.

Assuming that necessary transmitting conditions are such that the required operative magnetic flux is being radiated toward circuit No. 2 let us look at the heavy conductor of this receiving system and see what's going on within and without.

Currents Out of Phase

It can be seen by inspection that the direction of flow of current in current No. 2 is opposite to that of circuit No. 1 and this same relationship holds also if the respective circuits are the broadcasting station antenna, and the receiving inductor generator operating your set.

Most receiving sets have some form of pick-up circuit arrangement which is called "aperiodic." Just how is this designation to be reconciled with the known fact that all electrical systems and even straight wires are anything but strictly aperiodic? All objects that occur in nature, whether they are electrical conductors or not, possess a fundamental resonance frequency that is dictated by their atomic structure and physical dimensions.

Therefore this aperiodic designation becomes a name for the measure of the relative perodicity of two associated circuits, and only in the light of this viewpoint does it assume any significance whatever.

So the natural period of our receiving antenna circuit and pick-up coil is assumed to be such that all broadcast frequencies will flow through it with approximately equal facility.

The snag that we run up against now is that Fig. 1 does not represent actual receiving and transmitting circuit conditions. So we will have to refer to Fig. 2, whence it will be realized that radio transmission involves an earth current circuit and an air-magnetic flux circuit.

Practical Limit to Field

Physicists agree that the extent of the effect of a magnetic field regardless of its character is theoretically infinite, but at the same time they are fully aware of its practical utilitarian limits and their opinions are consequently tempered.

But the effective range of an alternating magnetic flux presents a curious paradox when it is compared to the effects of mechanical forces, the comparison made on an inertia basis. If I apply a lot of little intermittent forces to a given mass I don't move it very effectively, whereas if I increase the frequency of my radiated magnetic flux I can cover much greater distances with a given amount of power. In other words a steady push (of zero frequency) will move the mechanical mass, while zero magnetic field frequency will not affect the most sensitive radio set no matter if millions of kilowatts were expended in its maintenance.

So this statement logically leads to the reader's query: "What is the relationship between alternating magnetic flux radiation frequency, and the distances over which it is effective, assuming that no refraction occurs?"

The answer in general terms is that the higher the frequency is, with a given amount of radiated power, the less transmission resistance it will encounter. This general statement is true also of conditions met in properly designed radio receiving circuits. Experimenters have found this to be true when excessive stage losses in the particular radio frequency amplifier which they had under consideration were at minimum.

I am, however, more interested in receiving circuits just now than in transmission effects; therefore I will return to the consideration of imaginary component parts and effects of the circuit No. 2 of Fig. 1.

Condenser Discharges Into Coil

If all the broadcasting frequencies are assumed existent in the heavy conductor of circuit No. 2 then these may be selected at will by means of an adjustable resonator.

The coil of few turns that carries the inductor-generator current because it is in series with the generator is not unlike the primary winding of a transformer and the secondary, or winding that comprise the coil part of the adjustable resonator.

We know from experience that the conditions here indicate

ents With RF Coils

Williams

the possibility of parallel circuit effects—which is true to a degree—but I have in addition another operating condition which is the effect obtained with alternating magnetic fluxes which produce currents of similar nature.

If the secondary coil in this case was not connected to anything I think it is obvious that there would be no effective reaction between the coils at all, but the coil is connected to a condenser and this condenser discharges a current through the coil, and the frequency of this current is inversely proportional to the degree with which the plates are meshed. Frequency also varies more or less directly with the condenser's AC resistance (usually called the "reactance") the degree of variance being influenced somewhat by the shape of the fixed and movable plates.

But the selective property of the secondary coil and condenser, as previously hinted, is not perfect, because although the primary fluxes set up by the primary coil induce the currents of the desired frequency in the secondary coil, the induced currents of the same selected frequency in the secondary coil reinduce opposing currents of lower magnitude in the primary. Under these conditions it would almost appear as if transfer of electrical energy by magnetic induction was not as effectual as it might be, but actually this feedback is enough less than the value of the first induction to enable us to regard it as a leakage loss and forget about it for the time being.

It was previously stated that all the broadcast frequencies as well as the one frequency selected were flowing through the coil in series with the antenna circuit, and since it is so we may as well investigate this phase of the situation.

Tight Coupling of Similar Coils Harmful

The turns comprising the primary coil that is in series with the inductor generator are wound on the same bakelite tubing as are the secondary turns.

Since the coils are wound with the same size and kind of insulated conductor the periodicity of a single turn on each coil is the same, but it does not quite follow that if the primary coil is composed of 50 turns and the secondary is composed of 50 turns that 40 per cent of the secondary coil turns has the same periodicity as the primary coil, since the inductance varies as the square of the number of close turns. But the selectivity depends mainly upon how much artificial alteration of the period of the tunable secondary is required in order to enable the operator to make the circuit correspond to the desired frequency existent in the primary coil, it is apparent that if the two coils have characteristics that are somewhat similar to begin with that it is not as easy to exclude unwanted frequencies.

Because this condition of near-similarity is prevalent in these days of multi-tuned screen grid circuits, a simple exposition of the causes and effects and general influence of factors related to the phenomenon of radio reception constitutes a timely topic for experimenters, especially novices.

What then is necessary in order that selectivity of a satisfactory order shall be obtained, and also how is selectivity related to response? And what part does the phenomenon of resonance play in all of the above?

Factors Determining Efficiency

Response is of course basically dependent upon the intensity of the various frequency currents that exist in the primary coil but if the feedback flux previously referred to is too great, due to the coils being too close or too nearly alike it is apparent from what has gone on before that the actual energy transfer from one coil to the other may suffer quite seriously. In fact the efficiency of a maladjusted system may be less than 50 per cent compared to maximum transfer. This is purely a condition that requires adjustment of the coupling. Since I am talking about a single frequency at present it will not be too difficult to satisfy the optimum conditions that are indicated. I merely separate the two coils a little.

But it will be found shortly that magnetic coupling conditions that are optimum for one frequency are not optimum for other frequencies. In fact, a very critical examination of these effects would reveal considerable disparagement for the degree of magnetic coupling necessary to enable us to obtain equal secondary coil current or voltage at the various regular broadcast frequencies.

Can Compensate for Discrimination

So in this case as in many others we have to resort to various design compromises to attempt to get around this difficulty.

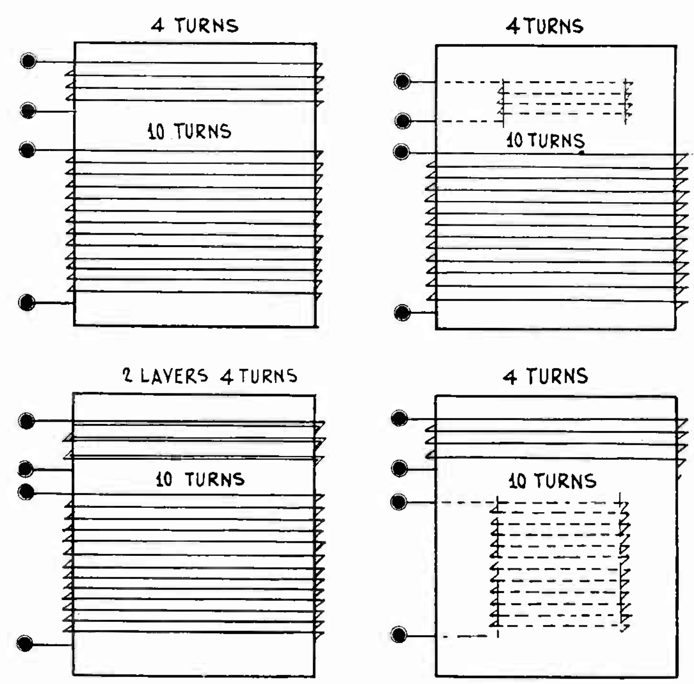


FIG. 3

SOLENOIDS OF SIMILAR WIRE, AND TURNS, BUT DIFFERENT PERIODS

More coupling schemes and theories of their operation have been devised than you can imagine.

Fig. 3 shows four solenoid groups of which each unit consists of a primary (4 turn coil) and a secondary (10 turn coil).

These coil units all have the same number of turns and are wound with the same kind of insulated wire and the center to center distance of adjacent turns is the same.

Yet the coils are not similar as to their individual periodicity as simple resonance response tests would quickly show.

"But why then," it is asked, "do I see a goodly number of radio set coils arranged with primary and secondary windings of the same diameter, and relatively few sets containing coils arranged otherwise?"

Economic Reasons Enter

One answer is that economic reasons may have dictated the policy in one case, while in another the overall efficiency of the design may have been compensated to atone for such dissimilarity.

In many commercial receivers good coil design has been deliberately violated because to do so led to a much better overall receiver.

The novice can easily make up coils using similar wire, turns

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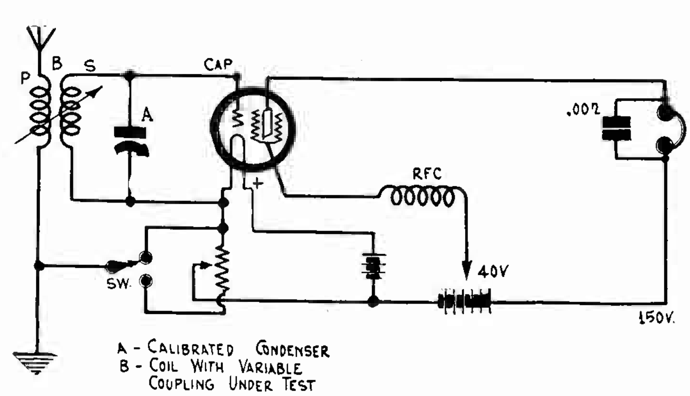

FIG. 4

SIMPLE RECEIVING CIRCUIT FOR TESTING COIL COUPLING ADJUSTMENT AT DIFFERENT FREQUENCIES

Screen Grid, Battery Op

By J. E.

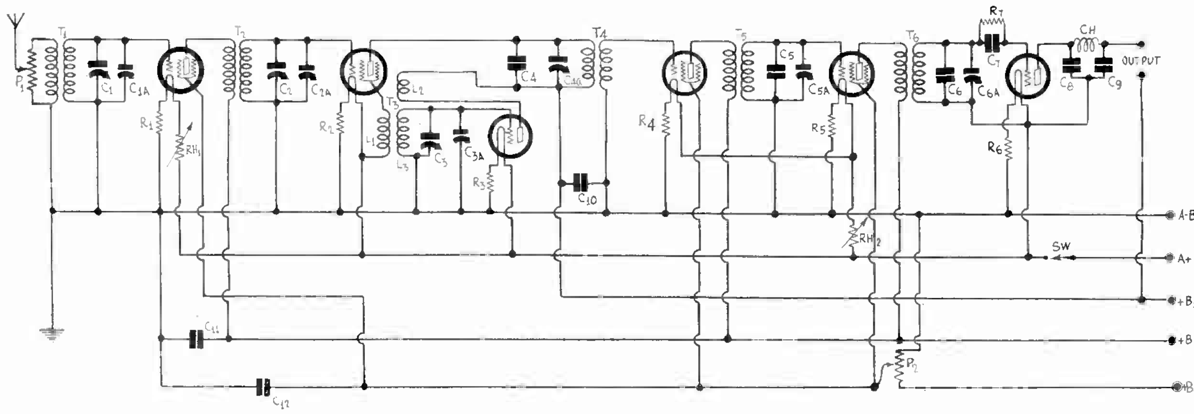

FIG. 4

THE CIRCUIT DIAGRAM OF A SIX-TUBE BATTERY OPERATED SUPERHETERODYNE SIMILAR TO THE AC CIRCUIT GIVEN IN FIG. 1.

All the tuned windings in the intermediate amplifier must be adjusted accurately to the same frequency, whatever that frequency may be, and this adjustment must be made when the receiver is otherwise completed, with the shielding in its final form and position.

As an aid in adjusting the intermediate frequency tuner it is convenient to construct an oscillator generating a hum-modulated frequency equal to that desired. The diagram of such an oscillator is shown in Fig. 2. A three-element, filament type tube is used and its filament is heated directly with alternating current. This modulates the high frequency generated by a hum frequency which can be used as an aural guide in tuning the intermediate circuit.

The coil L in the oscillator might be a duplicate of the tuned windings in the intermediate coils and L2 might be a duplicate of the primary of T5 or T6. Likewise the condenser C might be a duplicate of the condensers used in the other coils. That is, it may be made up of a fixed condenser of .00035 mfd. and a trimmer of 100 mmfd. L1 is a small pick-up coil which may be wound on either of the other forms or may be a detached coil coupled closely to the oscillator coil L. No special requirements are needed of this coil and any handy coil may be used. In case no coil is available wrap some twenty turns of wire around the fingers and then slip the coil thus formed over the oscillator coil.

One terminal of this pick-up coil should be provided with a grid clip which should be connected to the cap of the modulator tube. The other terminal should be connected to ground or to B minus on the receiver. It need not be connected to the oscillator circuit at all, although it may be connected as shown in the figure. Use a plate voltage of 45 or 90 volts.

When this circuit is set into oscillation, a hum-modulated signal is impressed on the modulator tube, which is amplified by the intermediate frequency amplifier and may be heard in a headset connected to the output terminals. Each tuned circuit in the amplifier is then adjusted by turning the screw on the trimmer until the signal heard is as loud as possible. During this process it is important that the adjustment of the auxiliary oscillator be not changed. If it is found that all three circuits cannot be tuned to the frequency generated by the oscillator, the frequency should be changed slightly in one direction or the other and the entire tuning repeated. This should be continued until all the tuned circuits can be tuned in with the trimmers.

If this is found impossible due to large differences between the intermediate coils, first check the number of turns to make sure that they are equal. If they are, note whether more capacity than is contained in the trimmer is needed in one of the circuits. In that case a turn may be added to the corresponding coil, or a turn may be removed from each of the other two. In the event that two of the trimmers are all the way out while the other is in when the tuning point is approached, a turn should be removed from each coil requiring the least trimmer capacity.

It is not likely that any difficulty will be met except, possibly, in T4, which is different from the other two. But this may be avoided by putting on a few more turns than necessary on the primary of T4 so that this tuner may be adjusted to the other two by removing turns rather than by adding.

During the process of tuning and adjusting the intermediate frequency amplifier, to which some time should be given, it is well to try various degrees of coupling between the windings of T5 and T6, retuning the circuit after each change. The coupling in both cases should be the same at every stage of adjustment. It is also well to adjust the bias resistor R6 to find the value that gives loudest response. This adjustment will vary with the effective voltage on the detector tube, and therefore it should be readjusted every time the applied voltage is changed as well as every time the load impedance has been changed.

Design of the Oscillator

As soon as the intermediate frequency amplifier and the detector have been adjusted we are through with the auxiliary oscillator, and we are ready to adjust the permanent oscillator.

The design of this oscillator is somewhat of a problem when the tuning condenser is to be part of a gang. Since we have selected an intermediate frequency of 500 kc, the oscillator must be designed to cover a range from 1,050 to 2,000 kc. Moreover, since the capacity change needed in the oscillator will be different from the change needed in the RF tuners, we must provide a trimmer having a capacity range of at least 100 mmfd. In the diagram this trimmer is represented by C3a.

If we use a total capacity of .0006 mfd. the required coil will be very small and the rate of change of the capacity will be such that the trimmer specified will not compensate for differences throughout the range. Therefore we have to put a fixed con-

LIST OF PARTS

P1—One 30,000 ohm volume control potentiometer.
P2—One 2,000 ohm potentiometer.
R1, R2, R3, R4, R5—Five 300 ohm grid bias resistors.
R6—One 30,000 ohm variable resistor.
R7—One 10,000 ohm resistor.
T1, T2—Two radio frequency transformers as described.
T3—One oscillator coil as described.
T4, T5, T6—Three intermediate frequency transformers as described.
T7—One heavy duty, 2.5 volt filament transformer with center tapped secondary.
Ch1, Ch2, Ch3, Ch4, Ch5, Ch6, Ch7—Seven radio frequency choke coils as specified or as described.
C1, C2, C3—One three-section variable condenser, .0005 mfd per section.
C1a, C2a, C4a, C5a, C6a—Five 100 mmfd. trimmer condensers with screw adjuster.
C3a—One 100 mmfd. midget tuning condenser.
C3b—One .0005 mfd. fixed mica condenser (not shown in diagram).
C4, C5, C6—Three .0005 mfd. fixed condensers.
C7, C8—Two .00025 mfd. fixed condensers.
C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21—Thirteen .01 mfd., or larger, by-pass condensers.
C22—One 2 mfd. or larger by-pass condenser.
Sw—One line switch in 110 volt line.
Six UY sockets.
One drum dial with pilot light.
Seven binding posts.
One metal chassis.
A quantity of shielding material.

erated Superheterodyne

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denser in series with the main section C3, and on the grid side of that condenser. This fixed condenser, which should be of the mica dielectric type and be of .0005 mfd. capacity, is not shown in the drawing. The trimmer condenser should be connected across the other two, that is, the trimmer should be connected as in the diagram.

If the tuning condenser has a capacity of .0005 mfd. and the fixed condenser in series with a like capacity, the maximum capacity is .00025 mfd., and since the trimmer is in parallel with this combination and has a maximum value of 100 mmfd., the maximum capacity of the entire assembly is .00035 mfd. The coil is to be wound so that the lowest frequency is 1,050 kc. This requires an inductance of 65.5 microhenries. With this inductance the minimum capacity must be 96.4 mmfd. if the circuit is to reach 2,000 kc.

The minimum capacity of the two series condensers when the tuner condenser is set at zero is about 25 mmfd. and therefore it is possible by means of the trimmer to tune the circuit to 2,000 kc., or to any other frequency between 1.050 and 2.000 kc.

An inductance of 65.5 microhenries is obtained by winding 34 turns of No. 28 double silk covered wire on a diameter of 1.75 inches 60 turns to the inch. This is the main winding on T3. The tickler winding should be wound next to it without any separation and should contain 25 turns of the same kind of wire as was used on the oscillation winding. The tickler should be placed near the ground end of the main winding. The pick-up winding may be placed at the grid end, separated from it by about one-fourth inch, and it should contain 20 turns.

Voltage Adjustments

The voltage between B2 and B minus should be 180 volts and that between B1 and B minus should be 67 volts. Both should be adjusted with the aid of a high resistance voltmeter. The voltage on the screen of the modulator tube that gives best modulation is about 3 volts positive. To obtain this without a battery a voltage divider is resorted to, made up of a 2,000 ohm potentiometer P2 and a fixed resistance of 12,000 ohms. These are approximately values only. Either or both may be increased somewhat but neither should be decreased. This arrangement permits a screen voltage variation from zero to 10 volts, within which range the optimum voltage will be found.

The diagram in Fig. 1 indicates two different plate voltages, B1 and B2. The voltage between B minus and B1 should be 67.5 volts and that between B minus and B2 should be 180 volts. Of course, considerable variation is permissible in these voltages as the circuit may work equally well if either is reduced somewhat.

As will be noted B1 is not only the plate voltage for the oscillator and the modulator but it is also the screen voltage for all the screen grid tubes. While this arrangement works satisfactorily in most instances it is sometimes preferable to arrange the voltage supply so that the screen voltage and the plate voltage on the modulator and the oscillator may be adjusted independently. For example, it may be desirable to lower the screen voltage on all the tubes to insure quietness and stability and at the same time to raise the plate voltage to insure oscillation and increase the detecting efficiency of the modulator tube.

If this arrangement is desired the high voltage supply circuit may be wired as shown in Fig. 3. In this circuit B1 has been broken up into two, B1a and B1b. B1a is the supply for the plates of the oscillator and the modulator and for the screen of the modulator tube. A voltage as high as 90 volts may be applied at the terminal marked B1a. The screens of all the remaining screen grid tubes are returned to B1b, on which a voltage of 67.5 or less should be applied. If this terminal is connected to the slider of a 30,000 ohm potentiometer across which is 67.5 volts, a convenient means is provided for varying the screen voltage between zero and 67.5 volts and thus to find the voltage that gives most satisfactory operation in any case.

The chokes, condensers and resistances in Fig. 3 marked to correspond with the same parts in Fig. 1 as an aid in making the rearrangement of the circuit. Wherever an open lead is marked "to plate of" the understanding is that the lead goes to the low potential end of the load impedance, that is, to the B plus terminal of the primary of the transformer. When an open lead is marked "to screen" the understanding is that it goes directly to the screen without the intervention of any impedance.

Type of Shielding

It is strongly recommended that the shielding be of the box or compartment type, each compartment containing one stage with its auxiliary chokes and condensers. For example, the first shield compartment should contain T1, C9, R1, C10, Ch1, and the first tube. The second compartment should contain T2, C11, Ch2, C11, C12, R2, and the modulator tube. The dividing line in each case should be directly after a tube so that the screen grid choke and condenser are in one compartment and the plate choke and condenser in the next. In some compartments there will be two choke coils, one screen choke and one plate choke, and these should be placed as far apart inside the compartment as possible, and at the same time it is well to place them at right angles so as to minimize the coupling between them.

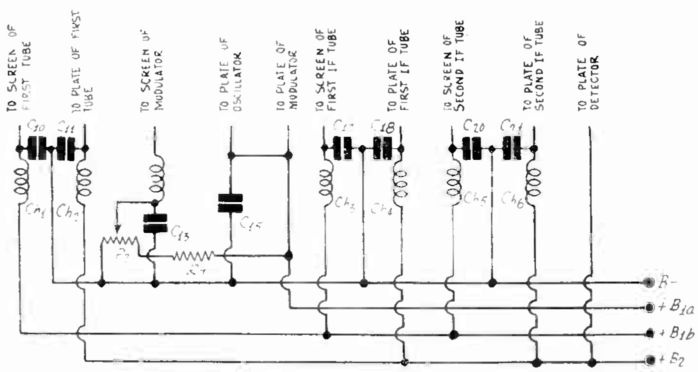

FIG. 3
DIAGRAM SHOWING THE ARRANGEMENT OF THE PLATE AND SCREEN SUPPLY LEADS OF THE SIX-TUBE SUPERHETERODYNE WHEN DIFFERENT VOLTAGES ARE APPLIED TO THE PLATES OF THE OSCILLATOR AND THE MODULATOR AND THE SCREENS.

The shield compartments may be made of aluminum, brass, or copper, or combinations of these metals. Iron, steel, tin plate and high resistance metals should not be employed in any case. Copper is the best because it is not only the best common shielding material but it is also easily worked and takes solder easily.

The size of a compartment should be as great as practical. For the coils described, the smallest dimension should not be less than three inches. If this dimension be made 3.5 inches the length of the chassis will become 21 inches, since there are six tubes and six coils. This size is recommended.

The front-to-back dimension of the shield compartment should be such that the coil is no nearer the shielding in front than it is at the sides. It may be quite close to the tube, since there is little metal in the tube compared with the metal in the shield walls. Moreover, the tube may be placed quite close to the back wall of the shield compartment. An approriate front-to-back dimension for the compartment is 5.5 inches, although 5 inches may be used when compactness is important and 6 should be used if there is plenty of room available.

The height of the compartment is largely determined by the height of the screen grid tube, measured from the bottom of the base to the top of the grid cap. This dimension should not be less than 5 inches, but it is not necessary to make it much greater than this. The actual height of the top of the shield depends on the type of socket used. If the socket is mounted under the sub-panel, as is now customary, it is not necessary to make any allowance for the socket, but if it is mounted on top of the sub-panel it is necessary to add the height of the socket.

Placing the Coils

The tuning coil should be centered inside the compartment. That is, it should be raised so that the center of the tuned winding is just as far from the bottom as from the top of the shield, and it should also be centered in the direction from left to right. In the other direction it cannot very well be centered on account of the presence of the tube, but as was previously stated, it should be at least as far from the front wall as from either side.

It will be recalled that the tuning condensers were not included in the list of parts contained in a shield. The three-gang tuning condenser should be surrounded by a separate shield connected to the common rotor. Small holes should be cut in this shield for the leads from the stator plates to the grid side of the tuning coils. If these leads are exposed to each other in running from the condenser shield to the shield compartments they should be shielded from each other. To avoid any special shield here it is well to fit the shields together so that there is no space between them.

If the trimmer condensers are not built into the tuning condensers, they may be attached to them or to the shielding either of the tuning condenser or of the coil. Wherever they are

(*Continued on next page*)

Radio Ter

Adopted Standards

Standards for radio advertising, recently adopted by the National Federation of Radio Associations and the Radio Wholesalers Association, set forth not only the standards as interesting to manufacturers and others who are advertisers, but also give what constitute definitions of technical terms frequently used in radio.

In fact, the two considerations go hand in hand. The standards frequently consist of the definitions, as the object of standardization is not only to set up a code of fair business dealing but also to help the advertiser who otherwise might unwittingly make a broader claim than justified, or fail to be explicit enough, for want of the proper definition.

The Better Business Bureau of Chicago aided in the compilation.

The complete text of the standards follows and is printed by special permission:

STANDARDS FOR RADIO ADVERTISING

1. Battery Operated Radio Receiver

A radio receiver designed to operate from primary and/or storage batteries shall be known as a "Battery Operated Radio Receiver."

2. Socket Powered Radio Receiver

A radio receiver of the "Battery Operated" type, when connected to a power unit operating from the electric light line, supplying both filament and plate potentials to the tubes of the receiver, shall be known as a "Socket-Powered Radio Receiver."

3. Electrified

Such terms as "Electrified," "Completely Electrified," "Electrically Equipped," should be followed by an explanation of the manner in which this is accomplished. Such terms may be used properly to describe a set which was originally manufactured to operate with batteries, but which is now equipped with some type of a power unit.

4. Electric

This word is used properly to describe a set which operates directly from an electric light socket and which was designated for such operation by the manufacturer. A battery operated set should not be described as "electric" or "electrified."

5. A.C. Tube Electric Radio Receiver

An electric radio receiver employing tubes, all of which obtain their filament or heater currents from an alternating current electric light line without the use of rectifying devices, shall be known as "A.C. Tube Electric Radio Receiver."

6. D.C. Electric Radio Receiver

An electric radio receiver employing tubes, all of which obtain their filament or heater currents from the direct current electric light line, shall be known as a "D.C. Electric Radio Receiver."

7. Screen Grid Radio Receiver

A radio receiver designed to utilize screen grid tubes in tuned radio frequency circuits may properly be classified as a screen grid receiver.

8. One Adjustment

The statement of "one adjustment" and statements of similar import should mean that the radio has only one adjustment. A set with three rheostats and one dial has four adjustments and should be so described. Such a set, however, may be featured as a "one dial set." A dial shall refer to a tuning adjustment.

9. Magnetic Loud Speaker

A magnetic loud speaker is one in which the mechanical forces result from the reaction of a permanent field magnet.

10. Electro Dynamic Loud Speaker

An electro dynamic loud speaker is one in which a portion of the conductor carrying the voice currents is a part of the moving system, the force producing the motion being due to the location of this conductor in an electro magnetic field.

11. Inductor Dynamic Loud Speaker

An inductor dynamic loud speaker is a moving coil speaker in which the mechanical forces result from the reaction of the moving coil in a permanent magnetic field.

NOTE: Both the electro dynamic and the inductor dynamic speakers are of the dynamic type known as the moving coil loud speaker. There is considerable difference in the cost as well as in the performance of the two speakers. For this reason they should not be confused in advertising.

12. "Complete," "Nothing Else to Buy"

When such statements are used as "$125.00 complete," "Nothing else to buy," "Ready to Operate in Your Home," etc., there should be no additional expense to the purchaser, such as installation or interest charge. If there is an installation charge above the advertised price, this fact should be stated, and if there is no installation charge, this fact might well be stated. For further clarity, it is recommended that when sets are advertised "complete" at a designated price, the equipment be identified when space permits.

13. Less Tubes

Advertising of radio receiving sets, offering them at a price in which tubes are not included, should clearly state "less tubes" or, "tubes not included."

14. Tubes

In stating the number of tubes in a set, if the power conversion or rectifier tubes are included in the count, it is recommended that they be clearly specified by such a statement as—"7 tubes, including two rectifiers."

15. Standard Equipment

The term "standard equipment" should not be used unless further qualified by the names or the brand names of the accessories. If a set is advertised complete with "Standard Make Tubes, etc." name of tubes should be specified.

16. Accessories

Such devices as wave-traps, howl arrestors, lightning arrestors, static eliminators, etc., operate with varying degrees of success and satisfaction under different climatic conditions. The performance of such accessories should be commented on from the usual rather than the exceptional results. Static may be decreased, but seldom totally eliminated, according to a concensus of expert opinion. It is, therefore, considered inaccurate to advertise a device as a "Static Eliminator."

17. Assembled Sets

When a radio set, including chassis and speaker or chassis, speaker, and cabinet, is advertised as being the product of the manufacturer of the chassis, the whole set, including the chassis and speaker or the chassis, speaker, and cabinet as the case may be, must be the product of the manufacturer of that certain chassis, unless a clear explanation to the contrary is made; provided however, that the manufacturer of the chassis in question also sells a set which includes a chassis and speaker or a chassis, speaker, and cabinet.

18. Used Sets

All sets and equipment, if used, should be advertised as such. The public has a legal right to assume that all merchandise advertised and not otherwise qualified is new and in good order.

19. Allowances

Offers of allowances for old sets should be actually given, and the price allowed should not be added to the normal price of the set or accessories. Advertisements of such allowances, for

Sensitive Batter

(Concluded from the preceding page)

mounted they should be placed so that the adjusting screw is accessible through a hole in the top of the shielding so that the trimming may be effected with a screwdriver.

The fixed condenser in each of he intermediate frequency tuned circuits may be put inside the shield with the coil, and may even be mounted on the coil itself. It is better to put it inside the shield than under the sub-panel, where it is sometimes placed, because it permits shorter leads. The trimmer condensers in the intermediate frequency tuner should be mounted on the shielding so that the adjusting screws can be reached with a screwdriver from above. Accessibility of the trimmers from above facilitates final adjustment of the tuned circuits.

Accessibility of Tubes

Since it is necessary to have access to the tubes in the shield compartments, it is recommended that the top of all the shields be made so that it can be removed or turned on hinges. Either way it is done it is a simple mechanical job.

The trimmer condensers, at least those for the intermediate frequency circuits, can be mounted on the partitions of the compartments, near the top, and holes can be placed in the metal lid so that when the lid is closed these holes are directly over the adjusting screws of the condensers.

Battery Operated Superheterodyne

If direct current tubes are to be used in the Superheterodyne, the circuit diagram shown in Fig. 4 may be used. There is little difference between this circuit and that in Fig. 1, except in the filament circuit. The design of the tuners in the radio frequency amplifier, the oscillator, and the intermediate frequency amplifier is the same, condenser for condenser and coil for coil.

By-pass condensers across the grid bias resistors are omitted because the resistance values are so low that condensers of reasonable values would be of little effect. Moreover, due to the small values of the bias resistances there is so little feed back through them that by-passing is unnecessary.

The plate supply circuit of this battery operated receiver is essentially that illustrated in Fig. 3. That is, the plates of the modulator, the oscillator, and the detector are served by a lead separate from the lead supplying the screens. The detector in this case, being of the grid condenser and grid leak type, will operate satisfactorily on the same plate voltage as that applied to the modulator and the oscillator.

If the screen grid tubes are of the 222 type and the oscillator

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for Radio Advertising

example, "$25.00 allowance on your old set" should be clear as to whether such allowance applies to all or only certain sets advertised or to all sets in the store.

20. Bait Advertising

"Bait" practices usually consist of offers of merchandise at low prices, limited in quantity, which salespeople endeavor not to sell and which they usually disparage in order to interest the customer in higher priced articles or those in which larger profits are made. Such practices are unethical and have been declared illegal. Sufficient quantities of advertised merchandise should always be on sale and should not be disparaged. When only a limited quantity is available for sale at the advertised price, this fact should be clearly stated.

21. Cuts and Layouts

Illustrations or cuts should truthfully depict merchandise for sale and should not convey any false or misleading impression as to size, appearance or model of merchandise. When illustrations and prices are used, the layout should be sufficiently clear as to leave no chance for misunderstanding. The actual selling price should occupy a position nearest the article to which it refers and not be placed where the reader would misconstrue it to apply to any illustration other than the one to which it belongs.

22. Name the Cabinet Woods

The standards for naming furniture woods, as issued by the Federal Trade Commission, should be followed. If in doubt, ask the Better Business Bureau. To illustrate—birch finished like mahogany is not "solid mahogany" nor "all mahogany." It can be called "mahogany finish." The same is true of gum, finished like walnut. If two or more woods are used they should be named, but if they are not known to the advertiser, they may be designated by the word "hardwood."

23. Discontinued Models

A model which has been superseded by a new model at the same approximate price or a model which is no longer being manufactured is a discontinued model. When discontinued models are offered for sale they should be described as such. Any reference to the former selling price should be fully explained. For example: A set which originally sold for $150.00 and has been discontinued and is, therefore, being offered for $75.00, should not be advertised as a $150.00 radio or a $150.00 value for $75.00, but rather should be advertised as a discontinued model which formerly or originally sold for $150.00 but is now being offered at $75.00.

24. Model Number

Advertised receiving sets should be identified by stating the maker's model number or year. This will avoid confusion in the public mind and make for fair competition.

25. Distance and Selectivity Claims

When claims are made for distance and performance, they should be based on the average and not the exceptional performance.

Due to the present broadcasting and reception conditions, it is suggested that such claims if used at all be extremely conservative.

26. Superlative Claims—Unrestricted Statements

Claims of superiority, the use of superlatives, exaggerated and restricted statements such as, "The Greatest Radio Sale in ——," "The Most Astonishing Price Reduction in the City," "The Best Radio at Any Price," etc., should be avoided. Such statements are difficult to prove and usually lend themselves to abuse and mis-use and encourage counter-claims of greater proportions by competitors. Other exaggerated statements commonly called "puffery" should be avoided.

27. Comparative Prices

The word "regularly" or "regular price" should apply only to the price from which temporary reductions are made and should not be applied to the prices of models that have been replaced or which are obsolete, or on which there is a general reduction. Phrases such as "formerly," "former price" or "original price" should be used to designate sets on which general price reductions have been made.

28. Free Trials

"Thirty Days Free Trial" should mean that the party responding to this advertisement has the privilege of having the set in his home with no outlay of money or obligation for a period of thirty days and at the end of that time, if the radio is not satisfactory to him, he should be able to return it without cost or obligation. "Thirty Days Free Trial" should not mean thirty days exchange privilege which explains itself, namely, that the customer can have the set thirty days with the privilege of exchanging it within that period of time if it is not satisfactory, no cancellation of the contract or obligation to be made however.

29. Guarantees

The word "guarantee" has a definite sales value to advertisers. It can be protected only by straight-forward statements as to exactly what it embraces, and by living up to it explicitly.

30. Credit Terms

Any statement used in advertising credit terms should be clear, exact and complete.

(a) Evasive practice, such as advertising "$10.00 down" or "$10.00 deposit," but demanding that more be paid before delivery is made, should not be used. The advertised "down payment" or "deposit" should assure delivery.

(b) Statements such as "$10.00 Down Delivers this Set," when an additional down payment is required to obtain tubes or other accessories, are misleading and should be eliminated. The public has a right to assume, and a legal right to demand, that sets ready to operate will be sold for the down payment offered, provided the credit risk is sound.

(c) Statements such as "$10.00 Down, $2.50 per Week," should mean that the set can be purchased and delivered for $10.00 as down payment and a weekly installment of $2.50. If this or similar statements merely indicate that the set can be obtained for a $10.00 down payment, if installments are sufficiently large (greater than $2.50 per week), or that the set can be paid for at $2.50 per week if a substantial down payment (greater than $10.00) is made, then the statement is inaccurate and misleading.

(d) The phrase "no money down" should be literally true. When this phrase or phrases of like import are used, the customer must be able to obtain without resistance the merchandise with all necessary accessories for "no money down" unless otherwise specified.

(e) Statements such as "no interest charge" indicate that cash and credit prices are identical and that no reduction of the credit price is given for cash payment.

(f) When specified pay plans are offered, such as a "20-Pay Plan," they should conform with the recommendations for accurate advertising as suggested above.

31. Disparaging Other Merchandise

The attempt to boost one's product by knocking or disparaging a competitor's merchandise represents a divergence of advertising from its proper channels. It promotes trade discord and invites retaliation. The practice tears down public faith in all advertising.

y Superheterodyne

and the detector are of the 201A type, the filament supply voltage should be 6 volts. With this voltage applied, each of the filament ballast resistors R1, R2, R4, and R5 should have a value of 20 ohms, and each of R3 and R6 should have a value of 4 ohms.

Since these ballast resistors are connected in the negative legs of the filaments and the grid returns of the first five tubes are returned to ground, the drop in each resistor is the grid bias for the corresponding tube. Thus the screen grid tubes get a bias of 2.7 volts and the oscillator gets a bias of one volt. These bias voltages are well within the limits of good operation, especially in view of the fact that the screen voltage can be varied by means of potentiometer P2, and the fact that the optimum bias depends on the screen voltage as well as on the plate voltage.

The volume control is well provided for in this circuit. P1 is a potentiometer like that used in the AC circuit with which the signal input may be controlled. Another control is the 30 ohm rheostat Rh1 in the positive leg of the filament of the first tube, and still another control is the 10 ohm rheostat Rh2 in the positive filament lead to the two intermediate frequency amplifiers. A fourth control is P2 by means of the screen voltage on the screen grid tubes may be adjusted.

By-passing

It is not necessary to put more than one of these controls on the panel, but two may be placed there advantageously. These two should be P1 and Rh1. If only one is made accessible it should be P1. The three other controls are used mainly to secure stability.

No choke coils have been put in the plate and screen circuits of the amplifier stages as in the AC receiver, but they may be used if desired, and if they are, they should have the same values as in the AC circuit. They should also be similarly placed.

A common by-pass condenser C10 is used for the three low voltage plate leads, another C11 for the three high voltage plate leads, and a third C12 for the screens, except that of the modulator which is returned to the positive of the filament. If no other filtering is used, each of these condensers should be at least 2 mfd.

The output filter Ch, C8, C9 should have the same design as the corresponding filter in the AC circuit.

The grid leak should be 2 megohms and it should be returned to the positive end of the filament. The grid condenser should have the usual value of .00025 mfd.

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RADIO UNIVERSITY

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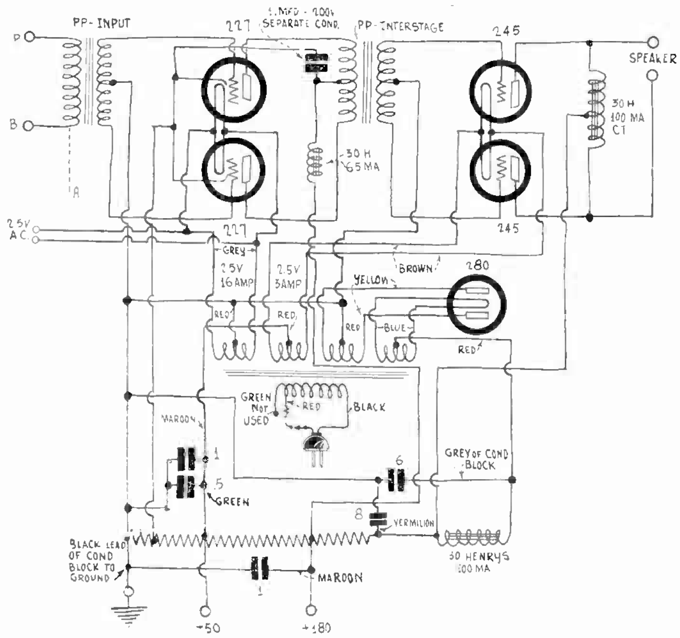


FIG. 834
THE CIRCUIT DIAGRAM OF A TWO-STAGE, DOUBLE PUSH-PULL AUDIO AMPLIFIER WITH B SUPPLY. AN EXTRA SECTION OF FILTER IS USED FOR THE FIRST STAGE

Double Push-pull Amplifier

I WISH to build a double push-pull audio amplifier using 227 and 245 tubes and should like to have a diagram of such a circuit. Will you kindly publish it in the University department? Please show how it is connected to the power supply.—T. C. R.

Such an amplifier is shown in Fig. 834. A filter section is provided especially for the first stage and consists of a 30 henry choke coil and a large condenser from the mid-tap of the coupling transformer primary to the cathodes of the tubes.

* * *

Where Current Comes From

WHERE DOES the current in the secondary of a transformer come from? There is no direct connection between the primary and the secondary windings for a voltage as high as 500 volts is impressed between them in some instances there is no current. Yet there may be a heavy current in the secondary.—A. S. T.

Suppose we connect a battery in series with a resistance and a meter. A current flows, as is indicated by the meter. Where does this current come from? From the battery? No, the battery supplies only the driving force, the electromotive force. The current is due to the movement of electrons in the wires. These electrons are there whether there is any voltage in the circuit or not, but they don't move unless there is an electromotive force in the circuit, and also unless the circuit is closed. A battery is not the only source of electromotive force. If there is a varying current in one winding of a transformer there is induced a varying, or alternating, electromotive force in any other winding on that transformer. If that winding is closed, either directly or through some load, such as a meter or a speaker or heating coil, a current flows in the closed circuit thus formed. The electrons were there all the time, but they were not set in motion until the electromotive force became active and until the circuit was closed. It is the motion of the electrons that constitutes the electric current, not the electrons themselves.

* * *

Cause of Red-Hot Rectifier

THE RECTIFIER tube of my B supply gets red hot when I try to work it. That is, the plates of the tube get hot. The output voltage is very low. What is the cause of the trouble?—F. W. K.

There is a short circuit somewhere in either the filter or in the amplifier connected to the B supply. To find where the short is proceed by elimination. First remove the amplifier leads so that no current is taken from the B supply, except that drawn by the voltage divider. If the trouble is in the amplifier the voltage output of the B supply will be high and the rectifier tube will not get hot. If the trouble is in the filter, the trouble remains. Having eliminated one or the other proceed by eliminating the various parts in the guilty part. Remove one by-pass condenser at a time, inspect the leads to the chokes, and examine the leads and the mounting of the voltage divider. It is probable that the short is in one of the by-pass condensers.

* * *

Amplifier for Television

WHAT KIND of amplifier do you recommend for television signals? Would a high class transformer coupled amplifier be satisfactory?—R. E. M

The only amplifier that will amplify good television signals satisfactorily is a resistance coupled amplifier, and it takes a well-designed amplifier of that type, too. A Loftin-White amplifier should be satisfactory. So should a Morgan amplifier. A standard resistance coupled amplifier having rather large stopping condensers and high grid leak resistance is all right.

* * *

How to Cover Broadcast Band

WHAT IS the smallest condenser that can be used for tuning so that the entire broadcast band will be tuned in? Many manufactured sets will not cover the band and I understand that this is because the tuning condensers are not large enough.—N. A. M.

What the smallest condenser that will cover the band is depends entirely on the amount of distributed capacity in the circuit. It is not the maximum capacity that counts but the ratio of the maximum to the minimum capacity. If the tuning range is to be from 550 to 1,500 kc the ratio of the maximum capacity in the circuit to the minimum must be at least 900 to 121, or 7.44. If Cm is the maximum capacity and Co is the minimum the ratio is $Cm/Co=(30/11)^2$. The ratio 30/11 is obtained from 1,500/550, and is the ratio of the highest broadcast frequency to the lowest. Cm is not the variable portion of the tuning condenser capacity but the sum of the minimum and the variable. That is, if C is the maximum change in the tuner condenser $Cm=C+Co$. The ratio of C to Co must not be smaller than 6.44.

Since the minimum capacity remains nearly constant the only way to increase the ratio is to increase the capacity of the tuning condenser. The minimum capacity depends on the minimum capacity of the tuning condenser, the grid to filament capacity of the tube, and the distributed capacity of the tuning coil. The capacity of the coil in turn depends on the diameter and length and on the manner in which it is surrounded by other conductors. When there is a shield around the coil the capacity is large, and then it is practically impossible to cover the band with a smaller condenser than .0005 mfd. With this capacity the minimum capacity should be 77.7 mmfd. or less.

* * *

How to Cover the Broadcast Band

I HAVE a receiver which does not cover the broadcast band satisfactorily. WMCA, New York, comes in at 85 on the dial and the highest frequency station I can tune in is about 1,250 kc. Is it necessary for me to substitute new coils or new tuning condensers? If there is a simpler way of adjusting the circuit, please tell me how.—A. R. F.

In view of the fact that WMCA, 570 kc station, comes in at 85 on the dial you have plenty of room at that end. Remove a turn or two of wire from each tuning coil and try again. This should just about fix it. Remove turns until WMCA comes in between 90 and 95, preferably nearer 95. When you have achieved this you should have no trouble at the other end of the dial. That is, you should be able to tune in 1,500 kc before you reach 5 on the dial.

* * *

Impedance of the Primary of a Power Transformer

WHAT IS the usual impedance of the primary of a power transformer such as is used in radio receiver for supplying filament current and the plate voltage?—F. O. U.

The impedance of the primary depends mostly on the current drawn from the secondary windings. If one of the secondary windings is short-circuited the primary impedance is very low, indeed, that too is nearly short-circuited. The only primary impedance that has a definite meaning is the impedance when the secondary windings are open, and what the open-circuit is depends on what the transformer is intended to do.

* * *

Oscillations in Automobile Engine

DO THE oscillations in the electrical circuit of an automobile due to the sparks have a definite frequency so that they could be tuned in by a suitable audio receiver?—M. R. Y.

Since there are both inductance and capacity in the circuit it is reasonable to assume that the oscillations will have a definite frequency. As a matter of fact, if there are oscillations at all they must occur at a definite frequency. There will undoubtedly be one frequency for each spark plug. A few years ago it was suggested that a radio receiver could be used for listening to the spark and thus determine whether or not the engine behaved properly, that is, whether or not the sparks occurred regularly. It was asserted by the engineer who had tried it that many engines apparently running well actually behaved irregularly when this keen test was applied.

* * *

How Radio Signals Spread

YOU HAVE stated many time that the strength of a radio signal varies inversely as the distance from the station. It is an established fact that light and sound vary inversely as the square of the distance. Now if radio waves and light are fundamentally the same why does not a radio wave vary inversely as the square of the distance?—W. H. C.

If light and sound were confined in two dimensions they would vary inversely as the distance and not inversely as the square of the distance. Radio waves of the ground type are confined to two dimensions and for that reason they vary inversely as the distance. If they could be confined to one dimension they would not vary at all, and that is the principle of the radio beam. The beam from a search light, which is almost confined to one dimension, does not vary much with distance. Likewise, sound confined to a pipe does not vary much with distance, because it is confined to one dimension. Of course, a sound could not be transmitted to any distance by means of a pipe for there are losses along the way. For the same reason a radio wave varies more rapidly as the distance increases than is accounted for by the inverse law. The meaning of losses is clear when we observe a beam from a search light. If there are fog and dust in the air the light decreases rapidly with distance even when the beam is very narrow.

* * *

Tone Control Pointers

I TRIED THE tone control you suggested in a recent issue and I find that the shunt condensers you recommended make the tone too boomy. Is there not some way in which the high notes can be reduced without making the output so low in tune?—K. W. S.

No particular value of shunt condensers was recommended. The diagrams merely showed how to connect the condensers to bring about the results. The values given were merely illustrative and it was so stated. The object of tone control is to enable each individual to select the tone he likes, which means that he should pick out the shunt capacity that best suits his tone taste. There is no way of reducing the high notes without leaving the low, except to introduce a device for cutting out the low tones also. If you only want the medium notes build an amplifier out of audio transformers that were in use eight years ago.

* * *

Explanation of Critical Coupling

WHAT IS MEANT by critical coupling between two coils or two circuits?—C. J. O.

Critical coupling is that determined by the condition that the mutual reactance is equal to the square root of the product of the primary and secondary resistance. The mutual reactance is the product of the mutual inductance between the two coils and two pi times the frequency. This coupling gives maximum voltage in the secondary circuit. If the coupling is less than the critical it is loose and if it is greater it is close. Obviously, there are different degrees of looseness and closeness. If both the primary and the secondary circuits are tuned to the same frequency the resonance curve for the combination has a single peak for loose coupling and double peak for close coupling. The greater the coupling the farther apart are the two peaks.

* * *

Resonance Formula

WHAT IS the formula that expresses the frequency of resonance in terms of inductance and capacity in a parallel tuned circuit? I know what it is in a series tuned circuit.—E. S

It is the same for parallel tuned circuits as for series tuned circuits. Multiply the capacity in farads by the inductance in henries. Extract the square root of the product. Take the reciprocal of the number, that is, divide unity by the number. Then divide the resulting number by 6.2823. The result is the frequency of resonance whether the case is one of series or parallel resonance.

* * *

Triple Detector Receiver

IS IT practical to build a short-wave receiver on the Superheterodyne principle so that the frequency is stepped down in two stages? That is, is it practical to step it down first, say to 1,500 kc and then to about 45 kc?—C. O. T.

Perhaps equally good results can be obtained by stepping it down only once, but it is certainly practical to step it down in two stages. Undoubtedly a greater sensitivity can be obtained by having two intermediate frequency amplifiers, that is, a greater sensitivity with stability. To try this scheme a broadcast Superheterodyne having two radio frequency stages could be used advantageously. It would only be necessary to prefix one short-wave tuner and one short-wave oscillator, or any one of the short-wave converters that have been described in Radio World.

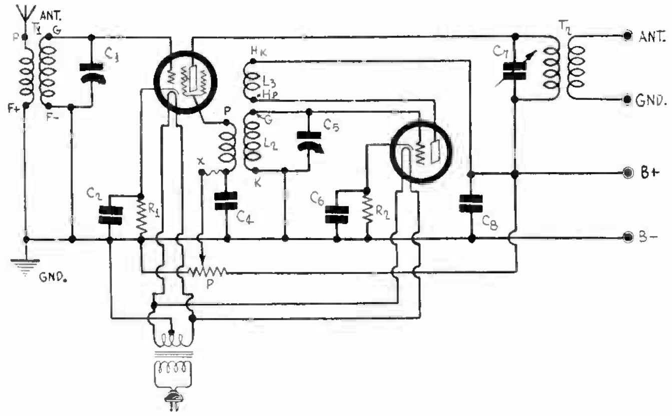


FIG. 835

A TWO-TUBE, SUPERHETERODYNE TYPE SHORT-WAVE CONVERTER IN WHICH THE PLATE CIRCUIT OF THE MODULATOR TUBE IS TUNED TO THE INTERMEDIATE FREQUENCY

* * *

Another Efficient Short-wave Converter

I SHOULD like to see a circuit diagram of a two-tube short-wave converter in which the plate circuit of the modulator tube is tuned to the intermediate frequency. A tuned circuit in high frequency level is also desirable, that is, a tuner in addition to the oscillator tuner. Will you publish such a diagram?—C. F. E.

We are glad to publish it because we believe it is a good one. You will find it in Fig. 835. If you wish a detailed description of this converter, you will find it in recent issues of Radio World.

* * *

Short-Wave Intermediate

WHAT is the reason a low intermediate frequency is not recommended for Superheterodyne type short-wave converters?—G. N. M.

The reason is that when the intermediate frequency is low the signal frequency will be practically the same as the oscillator frequency and it is almost impossible to make the oscillator function independently of the radio frequency tuner. The two tuned circuits pull in step and act as one. When that occurs no signals can be received.

ROCKETS WITH METERS TO AID LAYER STUDY

Worcester, Mass.

Experiments by Professor Robert H. Goddard of Clark University in efficient rocket propulsion to reach extreme altitudes give so much promise of valuable contributions to science in general that Daniel Guggenheim has made a grant for the continuation of the work, which has already been in progress for fifteen years.

The rocket is propelled by the recoil produced by expelled gases created either by igniting powder or causing the combustion of two liquids. It works on the principle of a shot gun which shoots gases rather than shot, and it is the motion of the gun which is the important thing sought. It is essentially the same in principle as a skyrocket used for signaling and for Fourth of July celebrations.

Air Is Hindrance

Some believe that the motion of the rocket is due to the pressure of the expelled gases against the air, but this opinion is erroneous. The air is a hindrance rather than an aid and the rocket will move with greater facility in the highly rarefied gases 25 to 250 miles up than it will near the surface of the earth.

The importance of the rocket experiments in radio is that it offers a means of studying the electrical properties of the atmosphere in the region of the Kennelly-Heaviside layer, a region which has assumed great importance since the discovery of skip-distance, group velocities, radio echoes, selective fading and kindred phenomena in which most fundamental research has been done in radio the last few years.

Perfection Will Take Years

When the rocket has been perfected, which is admittedly a matter of years, much valuable information will undoubtedly be obtained in the fields of meteorology, astronomy, radio transmission, aviation, ballistics and in science in general.

The experiments with the rocket, based on Prof. Goddard's theory, have been so successful that they will be continued under the direction of a committee consisting of Dr. J. C. Merriam, president of Carnegie Institution; Dr. Charles G. Abbot, of the Smithsonian Institution; Charles F. Marvin, of the U. S. Weather Bureau; Colonel Charles A. Lindburgh; Dr. R. A. Milliken, of California Institute of Technology; Dr. Walter S. Adams, of Mount Wilson Observatory, Passadena, California; John A. Fleming, acting director of the Department of Terrestrial Magnetism of Carnegie Institute, and Henry Breckenridge.

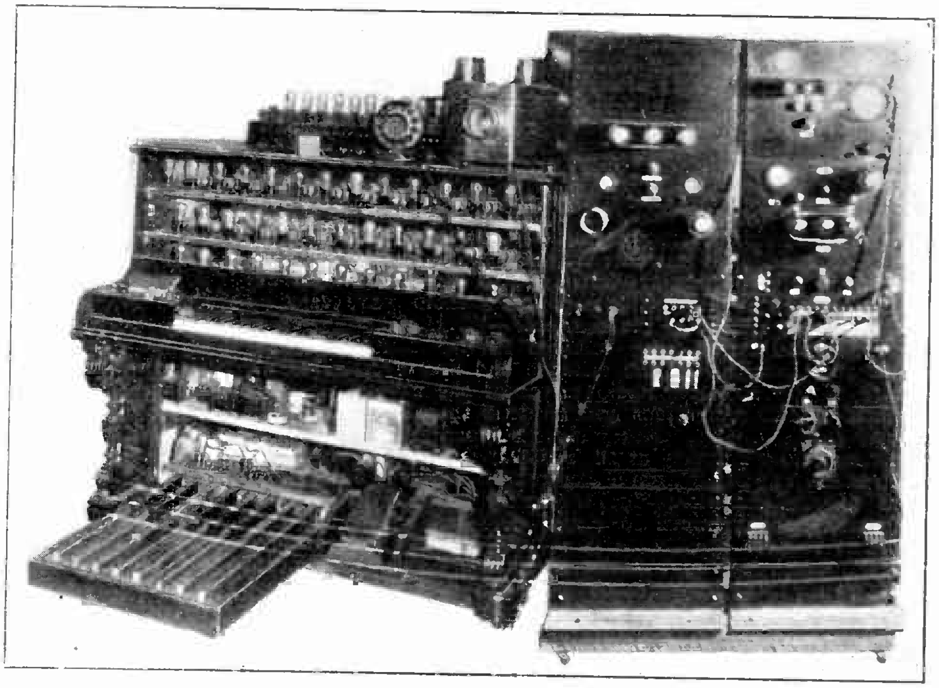
KFKB ON AIR AGAIN

The order of the court, enjoining the Federal Radio Commission from keeping KFKB, Milford, Kans., off the air pending the station's appeal from the Board's ouster due to a doctor prescribing over the air, has been obeyed by the issuance of a three-month license. This is the renewal that the Board refused to grant, as punishment for the broadcast.

WCOA ON 600 KC FULL TIME

WCOA, owned by Monumental Radio, Inc., Baltimore, Md., has been authorized by the Federal Radio Commission to use 600 kc, unlimited time.

NEW ORGAN INVENTED



AN ELECTRICAL ORGAN, JUST COMPLETED BY DR. FRANK E. MILLER, OF NEW YORK, UTILIZES RADIO TUBES AND OSCILLATORS. IT WILL PRODUCE CHORDAL MUSIC WITH A DEFINITE PITCH AND IS PLAYED ON A KEYBOARD. IT WILL COVER FROM BELOW 16 CYCLES PER SECOND TO ABOVE THE UPPER FREQUENCY LIMIT OF HEARING. ONE OSCILLATOR TUBE IS NEEDED FOR EACH TONE.

STRIKE HALTS STUDIO WORK

Chicago.

Completion of the National Broadcasting Company's studio atop the Mart Building at North Wells and Kinzie streets has been delayed by a strike of union electricians of Local No. 134.

The strike, it is said, is due to a campaign to unionize employees of radio stations, including studio employees.

The studios, when completed, will occupy nearly one-half an acre. There are to be six. They will be virtually a room within a room, as the inner studio will be separate from the building proper, and will be supported by sound insulating materials.

Summer Schedule Effected by Board

Washington.

Routine and emergency matters pertaining to the regulation of radio may be acted upon by so many members of the Federal Radio Commission as may be present in Washington during August, when that agency is in recess, under an order approved by the Commission.

The following applications will be considered:

1.—All renewal applications.

2.—Applications for modification of constructional permits, or licenses, to cover construction permits.

3.—Applications for voluntary assignments of permits.

4.—Any emergency application.

Under the above ruling the twenty-one applications for construction permits or licenses to use 50,000 watts go over until the Fall for action.

HOOVER GETS WABC PROTEST

Some of the citizens in and around Hempstead, N. Y., have become so greatly aroused over the prospect of WABC locating its proposed 50,000-watt transmitter there, that the Nassau Radio Club, its membership consisting of radioists living in the county in which Hempstead is located, sent a telegram to President Hoover, calling on him to ask the Federal Radio Commission for "a true and frank statement" concerning the likelihood of interference with other stations received by residents.

The 500-word telegram asked the President to inquire about the interference caused by "a 50,000-watt, 100 per cent. modulated broadcasting station on property owned by the Town of Hempstead, at Island Park."

The telegram was signed by Frank L. Carter, chairman. It was sent as part of the concerted move by club members to prevent the erection of the key station of the Columbia Broadcasting System in their midst.

WABC has been looking for a site for nearly a year. Rebuffed in efforts to locate in New Jersey, it sought a place on Long Island, outside the city limits, and again was unsuccessful, whereupon it negotiated for the Hempstead site, still farther out on Long Island. Terms had been agreed upon, when opposition developed. Charges were made that bribery was resorted to, but the District Attorney, after investigation, reported that these charges were unfounded.

Methods used by WABC in the attempt to obtain the Hempstead site, said the telegram, are believed to have been unfair. Also, replies by the Commission to inquiries sent by club members were said to have been "vague and indefinite."

PENNSYLVANIA SLIGHTED, REED CHIDES BOARD

Washington.

Charging that Pennsylvania has not had a square deal in the allocation of frequencies, power and time on the air, and stating that the Federal Radio Commission even admits this, Senator Reed (Rep.), of Pennsylvania, wrote a letter to the Commission, addressed to the chairman, stating that "unless the Commission is willing to take steps to correct this condition I shall feel impelled to carry the case to the President, the press and, if necessary, to Congress."

In the letter Senator Reed wrote in part:

"I would like to have a general statement from the Radio Commission with respect to broadcasting stations in Erie, Johnstown, Lancaster and Reading, Pa. These four stations in particular have endeavored from time to time to have their power increased. All four cities are important industrially and of sufficient size to deserve greater consideration than they have received.

Million Families Dissatisfied

"In the central part of the State particularly, broadcasting programs and conditions have been highly unsatisfactory for many months. There are perhaps a dozen counties which are unable at the present time to get good programs from any station. This condition is made worse by the action of the Commission in dividing the time between Station WBAL in Baltimore and a station in Hartford, Conn.

My information indicates that there are perhaps 1,000,000 or more families which, because of the Commission's discrimination against Pennsylvania, are entirely without satisfactory radio reception.

"I may say in this connection that I can see no legal or administrative justification for the persistent failure of the Commission to give Pennsylvania its proper quota of broadcasting stations and its failure to increase the power of stations in communities like those named, whose population, industrial importance and geographic location entitle them to greater consideration.

Appreciates Difficulties

"Harrisburg is another city—one of the several in the central part of the State—which has been denied proper facilities.

"In saying this, I am well aware of the difficulties which confront the Commission. I do not minimize the administrative problem presented by the effort to satisfy a continuous and, at times, unreasonable, demand for additional licenses and greater power for broadcasting stations.

WHAP GETS A VACATION

Even a broadcasting station is entitled to a two-weeks vacation, so WHAP, owned by Defenders of the Truth Society, Inc., New York City, has obtained permission of the Federal Radio Commission to suspend operation for two weeks.

WINS PLEA FOR LESS POWER

WSBC, World Battery Co., Inc., Chicago, has obtained permission of the Federal Radio Commission to reduce power from 500 watts to 100 watts. Low-level modulation will be employed and also direct crystal control.

Forum

IT is possible now to receive the elusive short waves on the walk, run or ride. It weighs 5½ pounds, uses only one stage of audio amplification and 45 volts of B batteries. It will operate a loud-speaker under good reception conditions. The batteries and other equipment weigh 14½ lbs., but can be cut down by using smaller batteries so that the total outfit will weigh about 10 lbs.

The portable short-wave outfit.

This little magic box will give any short-wave fan a thrill. It does everything that other short-wave sets do not do. It has no squeals, howls or whistles, which means it is non-oscillating. All code signals come in unheterodyned. It takes those signals that tune to a hair and spreads them out anywhere from 2 to 8 degrees, and the receiver tunes sharp at that. A .00015 tuning condenser is used. No vernier dial is necessary.

The receiver is not shielded, which means it has practically no body capacity, not even on 16 meters. It operates as well on 16 meters as it does on 180. It has picked up the ignition on certain type of aircraft two miles away. It will also pick up the telephone conversations on exposed wires that run along the railroad tracks.

The receiver is too sensitive to use in the heart of town, for it will pick up all the electrical disturbances from model T. Fords on, up to hair clippers. The stations just plop in and out as in a broadcast receiver. The sensitivity control turns smoothly and, the more you turn it, the louder the signal gets. There is a limit, though, for you run into sun static, ground static, good old fashioned static and electrical static, which is man-made. There is no end to the exploring of short waves on this magic box, for it opens the short-wave spectrum up like a good can opener opens a can.

The receiver really performs a wonderful stunt. It takes those razor-edge signals, hits them with some kind of hammer and smashes them out to a quarter or three-eighths of an inch in width on the dial so you can easily see where they come in. Then it freezes the signals up so they cannot run off every time you take a step. They can be frozen up so tight that the hand can be placed on the grid of the detector tube, which is the most sensitive part of the circuit, without the signal running off and hiding.

It can be used anywhere, providing the electrical disturbances are not too great. If the ignition is shielded, if the set is to be used on a power driven contraption, whether it is an airplane, auto, motorcycle, motorboat, canoe, bicycle or wheelchair, you can climb mountains with it, roam over the prairies or in the woods, the stations will always be at your command.

JOHN MELICHAREK,
6002 Center Street,
Houston, Texas

TELEVISION AT WMAQ TO GO ON AIR IN AUGUST

Chicago.

Television and sound are to be combined for the radio fans in Chicago next month, say operators of WMAQ, owned by the Chicago "Daily News." The transmitting equipment is now undergoing a series of tests preliminary to putting on regular programs of synchronized sound and television images.

The visual portion of the transmission will go out on the 2,800 kc channel (107.1 meters) of the experimental station W9XAP, with a power of 1,000 watts. Simultaneously the sound accompaniment will go out over the regular broadcast wave of WMAQ. Listeners provided with two receivers, one tuned to the broadcast wave and the other to 2,800 kc, will be able to receive both the sound and the vision, provided that they also have a suitable television equipment.

Scanning Details

The scanning disc revolves at 900 revolutions per minute and is run by a synchronous motor operating on the 60 cycle mains. The disc has 45 holes, arranged in three spirals of 15 holes each. Three spirals are used rather than one to reduce flicker of the picture.

By a special arrangement of reflecting mirrors it is not necessary for the actors before the scanning device at the transmitter to remain within the narrow range of the lens. The operator can turn the mirrors to follow the actors wherever they may go on the stage. The equipment is also designed so that a close-up of any actor may be picked up or the full view of a group of actors, the change from one to the other being practically instantaneous.

While the scene is being televised the actors are practically in darkness, except for the light from the scanning beam, which plays upon the scene in regular and orderly sequence.

Will Present Plays

Two photo-electric cells, sixteen inches in diameter, are mounted under the ceiling of the studio, and these pick up the light reflected from the actors. The cells convert the light variations into equivalent electric current variations, which are amplified by an amplifier and then sent to the transmitter.

The equipment was designed by the Western Television Corporation, which has also developed a television and broadcast receiver assembled into a console no larger than the customary radio-phonograph combination. The Television studio, at station WMAQ, has been designed and built so as to provide for the presentation of television-radio plays, dramatic skits, and for acts depending for their entertainment value in the symmetry of motion.

New Incorporations

Willys Radio Corp.—Atty., E. I. Garver, 100 Graham Ave., Brooklyn, N. Y.

Tupper Lake Broadcasting Co., radio broadcasting—Atty., R. Hastings, Tupper Lake, N. Y.

Lester Radio Corp.—Atty., F. S. Holbrook, Rochester, N. Y.

Bressner—Radios—Atty., C. Moed, 186 Joralemon St., Brooklyn, N. Y.

Empire State Radio Merchants Association, radio expositions—Attys., Rothstein & Rothstein, 225 Broadway, New York, N. Y.

Welk Broadcasting Co., Inc., Philadelphia, Pa., broacasting station—Corporation Guarantee and Trust Co., Dover, Del.

Ray's Radio Service—Atty., H. A. Miller, Rochester, N. Y.

A THOUGHT FOR THE WEEK

THE drama is taking on a new technique. Radio dramaturgy and craftsmanship must provide for non-present listeners all the things that sight, flesh-and-blood actors, dramatic authors and skilled scenic and costume designers do for the theatregoer at our regular houses of entertainment. The dramatists, players and broadcasters are doing this so well on the air that a new school of educational and entertainment adventuring is in process of formation and already has reached a point far beyond the experimental stage—though the fullest fruition of radio dramatic accomplishment is still far off and beckons with welcoming finger.

RADIO WORLD

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.

Caution on Television

ABOUT all has been done that should have been done to impress on the public that television demonstrations are not to be taken as proud assertions of final conquest of a baffling scientific problem, but are to be regarded as so many milestones in the progress toward practical commercial television. There has been strangely little overplaying of the television hand even in the ambitious but precarious parts markets, and nobody need complain he had been fooled into believing that commercial television was here, only to ascertain on personal examination, that it was neither here nor there nor anywhere else, save in the hopeful offing. As an experimental subject it is not only interesting but thrilling, as thousands who tune in American television will attest.

Recently a play was broadcast in England, by the Baird television system, but the result, in technical histrionic achievement and in clarity of vision as well, was not deemed sufficient by the dramatic critic of the London "Times," assigned to review the showing, to warrant critical histrionic analysis. Perhaps persons in England were led to expect too much, as the reviewer seemed to think he was in for a better treat than eventuated, but on this side of the Atlantic caution on television has been driven home, and despite the roseate possibilities of this field from a stock-selling viewpoint, the oil development as an enticing bait still holds first rank in American industrial gambling.

Proof of the Treasure

RADIO'S importance may be judged by the closeness with which it is being watched by the listening public, the Government and private agencies.

The public that soon grew tired of sending in applause letters now concentrates on sending in kicks when something disliked is broadcast. The Federal Government, more exacting, wants to be sure that stations are rendering the public service to which they are dedicated by the terms of the radio law and by their very licenses, and is concerned with false and misleading advertising, and quackery in general. On the same plane of observation, but without the police power, are private organizations seeking better standards in business.

Lest the inspection be regarded as one-sided, it must be remembered that some of the stations themselves are grouped into organizations, and thus seek through mutual efforts to keep their broadcasts up to the musical and ethical standards set for themselves by themselves. Also radio trade organizations, representing manufacturers and sellers of sets, parts and equipment, establish their own code of ethics, and fix standards of advertising, for themselves no less than for the suggested use of non-members, that are higher standards than one might expect were an outside agency to write the prescription.

This guarding of a treasure is the proof of the treasure. It is more significant than the mere statement that there are 600 broadcasting stations in the United States, and that the trade will probably have a turnover for 1930-31 of $600,000,000.

Speaker on Roof Heard 25 Miles

A loudspeaker, audible over an area of twenty-five mile radius and playing orchestral music, recently startled the residents of the western sections of Berlin.

The music came from a giant speaker mounted on the roof of Siemens Experimental Laboratory in Siemenstadt.

The vibration from the speaker was so intense that it could be felt 150 feet from the diaphragm, which was made of a special alloy a sixteenth of an inch thick.

It is planned to send this speaker up on a balloon 3,000 feet in the air and thus make the music from it audible over the entire city.

Automobile Receiver Fastened to Engine

The disposition of an automobile receiver nearly always presents a problem unless the set has been designed for a given car. Since there is no room on the instrument panel or in the driver's compartment for the entire receiver, it is usually necessary to tune the receiver by some remote control arrangement, which in most cases takes the form of a flexible coupler.

Several dealers show an automobile receiver installed in a Pierce-Arrow car. The square box mounted over the engine is the receiver. It is fastened to the engine by means of brackets which hold the set in such a position that it requires only a short flexible coupler between the set and the dial on the instrument panel.

The receiver is completely shielded, being housed in a metal box, so there is no danger of picking up the noise from the high tension electrical wiring of the car.

The receiver is very compact and there is ample room for it above the engine under the hood.

Slander on Air Penalized by Bill

Baton Rouge, La.

The Louisiana House of Representatives passed by a vote of 71 to 3 a bill "to prohibit slander over, through or by means of what is commonly called 'the radio'."

The measure provides that anyone who shall falsely use, utter or publish words over, through or by means of what is commonly known as the radio, which in their common acceptance shall tend to reflect on or impeach the honesty or virtue of anyone dead or alive, he shall suffer a penalty of a fine of $100 or 30 days in jail, or both.

Clay Model Brings Correct Replacement

When Pu Kiu Feng, postmaster at Tsinghua Yuan, Peking, China, broke the stator plate of the book type condenser on his radio set he found it necessary to send to the factory for a new one.

With great thoroughness, he made a clay model of the broken part and sent it to the manufacturer with a letter requesting a new one, so that there would be no possibility of error in filling the repair order.

The model was measured and found to be an identical dimensional replica of the desired new part.

Some Circuits So Selective They Tune Out Some Audio

(*Continued from page 9*)

and spacing and with a simple receiving circuit, consisting of a coil, dry cell tube and earphones, and a chosen variable condenser, and imitate the coils shown in Fig. 3 to substantiate all that has been written here.

The more experienced experimenter who is doubtless better equipped can do a somewhat better job with a carefully tuned and adjusted local oscillator, or simple transmitter which can be so adjusted as to have the characteristics of a transmitting station several hundred miles distant.

Almost every one knows that selectivity in a radio set is roughly a function of the number of cascaded tuned circuits, but few enthusiasts would care to admit that selectivity has to fight sinister robbers, namely stage, shield and coupling losses which don't usually manifest their presence until you go "gunning" for them.

Some radio circuits are so selective to the point that a goodly portion of the broadcast wave is missing from the reproduction.

Selectivity of this order is really nothing more than a poorly (even if too carefully) designed circuit, and since most circuits are no better than their coils it necessariy follows that coil designs should be evolved that result in the set responding well at high audio frequencies, say, 6,000 to 7,000 cycles.

Fig. 4 is intended to show the novice a simple circuit arrangement to test for the maximum coupling condition that provides the greatest response in the ear phones.

This idea is subject to further extension when checking up on the response of individual stages of say a six-circuit cascade amplifier, whether it contains a band pass filter or not.

An interesting sidelight on pre-tuned filter circuits is that if the experimenter will modify the characteristics of the tuned circuits that include a tube it will be found the individual tuned stages will themselves become sufficiently good band filters and in addition one will avoid the inevitable absorption losses that cause the elusive weak signal from a distant station to be lost.

(*More on this subject next week*)

PLAY SENT OUT BY TELEVISION FROM LONDON

London.

The Baird television system was demonstrated again in co-operation with the British Broadcasting Company in a recent novelty, consisting of dual transmission of a play, "The Man with a Flower in His Mouth," written by Luigi Pirandello. A sound track was used.

The size of the received picture was 3½x5 inches and the illumination was inconstant, being good at times and only fair at other times. However, the pictures were kept well in their frames.

The demonstration was experimental. It has been known for a long time that Baird's system is a good one, and he has demonstrated that fact often. However, the transmission of the play was not undertaken because of any assumption that practical commercial television has arrived, so that a man can sit in his library and see what's going on at the pick-up point with comfort and clearness, but only to demonstrate the progress television is making toward that goal.

Close Quarters

For instance, while the size of the image was larger than that obtaining in nearly all other systems, lens magnification is used. which precludes many seeing the "show" at the same time, at any one point of reception. A solution for this would be projection on a screen. after the fashion of the movies. However, this method is beset with difficulties, some of which have been partly overcome in the United States.

Another point is the close restriction of all action, due to the limited range of the pick-up. The actors and others concerned all work within a few square yards, and must be alert to get out of one another's way.

The movements of the actors as part of the show evidently were slowed down, as they took more than ample time for gesturing, giving a slow-motion picture effect.

Show "A Curiosity"

The London "Times" assigned its play critic to review the show, but the critic ducked writing any critical review of the acting, as if the acting and results did not deserve to be dignified by a serious review by such a celebrity! He said plays by television are "a subject for men of science, as yet, and not for critics of the finer points of acting." However, from the scientific side, he said that "the difficulties overcome are many and remarkable."

He assured men of the theatre that so far as competition from televised plays is concerned, they have nothing to worry about yet, as the whole show was "a curiosity."

RADIO BOARD IN NEW QUARTERS

Washington.

The Federal Radio Commission has moved from the Interior Building to larger quarters in the National Press Building. This is its third location. When it was constituted it took quarters in the Department of Commerce Building.

BABY'S WAY

"How old is your baby?"
"Fifteen months."
"Can he turn the radio on and off?"
"No. Only on. He won't turn it off and won't let anybody else do so."

Man-Made Static Called Actionable

Tallahassee, Florida.

Fred H. Davis, State Attorney General, is of the opinion that the general law against unlawful injury by a person to his neighbor is sufficient basis for an application for an injunction in cases of the creation of electrical disturbances which interfere with radio reception, although there is no specific statute in Florida against such interference.

"Such disturbance, in my judgment," the Attorney General's opinion said, "would constitute a public nuisance against which you could obtain an injunction upon proper showing that the interference was avoidable and that a failure to stop it was due to willful or culpable negligence."

WBZ ASKS FOR 50,000 WATTS

Washington.

WBZ, at Springfield, Mass., owned and operated by the Westinghouse Electric and Manufacturing Company, has applied for a construction permit to use 50,000 watts.

Formerly a similar request was made, in conjunction with a plan to consolidate WBZ with WBZA, the sister station at Boston, which was established to bring in WBZ's synchronized programs clearly in Boston, which WBZ could not then do.

It was intended to use one high-power station, instead of the two, for overcoming the difficulty. Later the request was made for only 15,000 watts, for the consolidation, but now the company is back again with a 50,000-watt plea. The plan for consolidation is unaffected by the change in the power plea.

Nine stations now are using 50,000 watts: WBAP, WEAF, WENR, WFAA, WGY, WLW, WTAM, WTIC and KDKA.

Six holding 50,000-watt construction permits, but not yet licensed at that power, are: WABC, WLS, WOAI, KFI, KMOX and KNX.

Fifteen stations have filed applications for 50,000 watts, on which action is pending: WAPI, WBZ, WCFL, WFBM, WHAM, WHO-WOC, WOR, WOWO, WRVA, WSB, WSM, WWJ, KGO, KTNT and KWKH.

The total is thirty stations. Recently the Federal Radio Commission announced it would not issue more than twenty clear-channel licenses, instead of forty, so there are ten more applicants than vacancies.

Chaliapin Bars His Voice from Air

Buenos Aires.

Feodor Chaliapin, the Russian bass, disappointed thousands of radio listeners throughout this country who tuned in on the municipal broadcasting station with the expectation of hearing his voice from the Colon Opera House.

The singer refused to appear if his voice was to be broadcast, and for that reason the management of the opera was forced to interrupt the broadcast every time the basso went on the stage to sing, although the opera house contract with the municipality provides for municipal broadcasting of the performance.

ALL STATIONS BEING CHECKED ON PROGRAMS

Washington.

A nation-wide survey of broadcasting, to evaluate the "service to the public" of programs offered by broadcasting stations, is being made by the radio division of the Department of Commerce, at the behest of the Federal Radio Commission, according to an oral announcement at the Commission.

Every broadcasting station in the country, a total of more than 600 stations, is to be checked by the supervisors and inspectors of the radio division, pursuant to the Commission's request. It is the first survey of program merit of stations ever undertaken by a Federal agency, it was explained. Preferences of listeners through key organizations in all communities also will be solicited as a part of the project.

To Appraise All Programs

Discussing the survey, the chief of the radio division, William D. Terrell, said it will be an "appraisal of the services of all broadcasting stations to the public." An undertaking of this magnitude, he asserted, requires a considerable period of time.

"Pursuant to the Commission's request I have instructed the nine Federal radio supervisors in the field to get information along the lines suggested," said Mr. Terrell. "The radio division never before has made a program survey, but our men are just about as well qualified as any to do it."

With the results of the research, it was explained at the Commission, it is proposed to work out a system of rating stations according to program merit, according to "The United States Daily." Such a proposal was considered during the radio investigation last year of the Senate Commission on Interstate Commerce.

Four Seasonal Sections

Mr. Terrell said he was proceeding with this unprecedented canvass on the theory that it should be made in four distinct seasonal sections. Radio conditions, and, to a degree, programs, vary with the seasons, he said.

The field forces, in addition to their various other duties, now are making the "Summer survey." After the four seasonal surveys are made the findings will be collated, and stations rated in that manner, he stated.

The project is being undertaken on a "station category" basis, the official declared. Broadcasting stations, according to power and assignment, are segregated into three major classes, namely, "clear channel," "regional" and "local" stations.

Besides "tuning in" stations themselves, the supervisors and their inspectors will query chambers of commerce, boards of trade, business men's associations, boards of education and similar civic and community organizations.

LITERATURE WANTED

Alfons Jensen, 625 East 12th St., New York City.
A. B. Bayless, Room 802, 1319 F Street, N.W., Washington, D. C.
Anderson Music Company, Big Spring, Texas.
Gaston Fontaine, 290 Union Street, New Bedford, Mass.
Joseph Shiba, 2856 N. Drake Ave., Chicago, Ill.
Wesley Turpin, Orondo, Wash.
Joseph Ilardi, 988 Flushing Ave., Brooklyn, N. Y.

U. S. and Canadian Stations by Frequency

Wavelength, Call, Location, Power and Time Sharers Given

LEGEND

Please observe the following code:
* *Channel shared by United States and Canada. The Canadian stations will be found following the United States stations of the same frequency. Expression "Kw" not used for Canada.*
** *Channel exclusively assigned to Canada.*
*** *Frequency change under consideration. See "List of Impending Changes," on page 22.*
CP—Construction permit authorized.
T—Transmitter location, specially given where it differs from main studio location.
Where two powers are given, larger is for daytime use.
Time-sharers are shown in parentheses for U. S. stations.

THE list of stations by frequency published herewith was corrected up to the moment of going to press. The list includes all broadcasting stations in the United States and Canada. The reason for consolidating them is that so many Canadian stations are tuned in that a United States list would require resort to a Canadian list to make the service complete, and that Canadian list might not be at hand.

Retain this list. Tear out the pages, if necessary. Then follow RADIO WORLD from week to week and note the changes as published in the news columns. In that way you can keep your list up to date and we will have to run the full list of stations only occasionally, thus making more room for circuits.

550 KILOCYCLES, 555.6 METERS
WGR—Buffalo, N. Y. ....1 Kw.
T—Amherst, N. Y.
WKRC—Cincinnati, Ohio ....1 Kw.
KFUO—St. Louis, Mo. (KSD) ....500, 1 Kw.
KFUO—Clayton, Mo. ....500, 1 Kw.
KSD—St. Louis, Mo. (KFUO) 500
KFDY—Brookings, S. D. (KFYR) ....500, 1 Kw.
KFYR—Bismarck, N. D. (KFDY) 500
KOAC—Corvallis, Ore. ....1 Kw.

560 KILOCYCLES, 535.4 METERS
WLIT—Philadelphia, Pa. (WFI) 500
WFI—Philadelphia ....500-1 Kw.
WQAM—Miami, Fla ....1 Kw.
KFDM—Beaumont, Texas ....500, 1 Kw.
WNOX—Knoxville, Tenn. ....1 Kw., 2 Kw,
WIBO—Chicago, Ill. (WPCC, WEBW) ....1 Kw.
T—Desplaines, Ill. ....1½ Kw.
WPCC—Chicago, Ill. (WIBO, WEBW) 500
WEBW—Beloit, Wis. (WIBO, WPCC) 500
KLZ—Denver, Colo. ....1 Kw.
KTAB—Oakland, Calif. ....1 Kw.

570 KILOCYCLES, 526.0 METERS
WNYC—New York, N. Y. (WMCA) 500
WMCA—New York City (WNYC) 500
T—Hoboken, N. J.
WSYR—Syracuse, N. Y. (WMAC) 250
WMAC—Cazenovia, N. Y. (WSYR) 250
WKBN—Youngstown, O. (WEAO) 500
WEAO—Columbus, O. (WKBN) 750
WWNC—Asheville, N. C. ....1 Kw.
KGKO—Wichita Falls, Tex. 250, 500
WNAX—Yankton, S. D. ....1 Kw.
KXA—Seattle, Wash. 500
KMTR—Hollywood, Calif. 500

***580 KILOCYCLES, 516.9 METERS**
WTAG—Worcester, Mass. 250
WOBU—Charleston, W. Va. (WSAZ) 250
WSAZ—Huntington, W. Va. (WOBU) 250
KGFX—Pierre, S. D. 200
WIBW—Topeka, Kans. (KSAC) ....500, 1 Kw.
KSAC—Manhattan, Kans. (WIBW) ..500, 1 Kw.
CHMA—Edmonton, Alberta 250
CJCA—Edmonton, Alberta 500
CKUA—Edmonton, Alberta 500
CNRE—Edmonton, Alberta 500
CJBC—Toronto, Ontario 500
CJSC—Toronto, Ontario 500
CKCL—Toronto, Ontario 500
CKNC—Toronto, Ontario 500

590 KILOCYCLES, 508.2 METERS
WEEI—Boston, Mass. ....1 Kw.
T—Weymouth, Mass.
WEMC—Berrien Springs, Mich. ....1 Kw.
WCAJ—Lincoln, Nebr. (WOW) 500
WOW—Omaha, Nebr. (WCAJ) ....1 Kw.
KHQ—Spokane, Wash. (Cp. 2 Kw.) ....1 Kw.

***600 KILOCYCLES, 499.7 METERS**
WCAC—Storrs, Conn. (WGBS) 250
WCAO—Baltimore, Md. 250
WGBS—New York City (WCAC) 250
T—Astoria, L. I., N. Y. ....500, LS (Exp.)
WREC—Memphis, Tenn. (WOAN) 500
T—Whitehaven, Tenn. ....1 Kw.
WOAN—Lawrenceburg, Tenn. (WREC) 500
WMT—Waterloo, Iowa 500
KFSD—San Diego, Cal ....1 Kw., 500
CFCH—Iroquois Falls, Ontario 250
CJRW—Fleming, Saskatchewan 500
CJRM—Moose Jaw, Saskatchewan 500

610 KILOCYCLES, 491.7 METERS
WJAY—Cleveland Ohio 500
WFAN—Philadelphia, Pa. (WIP) 500
WIP—Philadelphia, Pa. WFAN) 500
WDAF—Kansas City, Mo. ....1 Kw.
KFRC—San Francisco, Calif. ....1 Kw.

620 KILOCYCLES, 483.6 METERS
WLBZ—Bangor, Maine 500
WFLA—WSUN—Clearwater, Fla. .2½ Kw., 1 Kw.
WTMJ—Milwaukee, Wis. ....1 Kw., 2½ Kw.
T—Brookfield, Wis. ....2½ Kw.
KGW—Portland, Ore. ....1 Kw.
KTAR—Phoenix, Ariz. ....1 Kw., 500

***630 KILOCYCLES, 475.9 METERS**
WMAL—Washington, D. C. 500, 250
WOS—Jefferson City, Mo. (WGBF, KFRU) 1 Kw., 500
KFRU—Columbia, Mo. (WOS, WGBS) 500
WGBF—Evansville, Ind. (WOS, KFRU) 500
CFCT—Victoria, British Columbia 500
CNRA—Moncton, New Brunswick 500
CJGX—Yorkton, Saskatchewan 500

640 KILOCYCLES, 468.5 METERS
WAIU—Columbus, Ohio 500
WOI—Ames, Iowa ....5 K
KFI—Los Angeles, Calif. ....5 Kw.

650 KILOCYCLES, 461.3 METERS
WSM—Nashville, Tenn. ....5 Kw.
KPCB—Seattle, Wash. 100

660 KILOCYCLES, 454.3 METERS
WEAF—New York City ....50 Kw.
T—Bellmore, N. Y.
WAAW—Omaha, Neb. ....500—W

670 KILOCYCLES, 447.5 METERS
WMAQ—Chicago, Ill. ....5 Kw.
T—Addison, Ill.

680 KILOCYCLES, 440.9 METERS
WPTF—Raleigh, N. C. ....1 Kw.
KFEQ—St. Joseph, Mo. ....2½ Kw.
KPO—San Francisco, Cal. ....5 Kw.

690 KILOCYCLES, 434.5 METERS
CFAC, CFCN—Calgary, Alberta 500
CHCA, CJCJ, CNRC—Calgary, Alberta 500

700 KILOCYCLES, 428.3 METERS
WLW—Cincinnati, Ohio ....50 Kw.
T—Mason, Ohio

710 KILOCYCLES, 422.3 METERS
KMPC—Beverly Hills, Cal. 500
WOR—Newark, N. J. ....5 Kw.
T—Kearny, N. J.
KEJK—Beverly Hills, Calif. 500

720 KILOCYCLES, 416.4 METERS
WGN, WLIB—Chicago, Ill. ....25 Kw.
T—Elgin, Ill.

****730 KILOCYCLES, 410.7 METERS**
CHLS, CKCD—Vancouver, British Columbia 50
CKFC, CKMO—Vancouver, British Columbia ..50
CKWX—Vancouver, British Columbia 1000
CHYC—Montreal, Quebec 500
CKAC—Montreal, Quebec 1000
CNRM—Montreal, Quebec 1650

740 KILOCYCLES, 405.2 METERS
WSB—Atlanta, Ga. ....5 Kw.
KMMJ—Clay Center, Neb. ....1 Kw.

750 KILOCYCLES, 399.8 METERS
WJR—Detroit, Mich. ....5 Kw.
T—Sylvan Lake Village, Mich.

760 KILOCYCLES, 394.5 METERS
WJZ—New York, N. Y. ....30 Kw.
T—Boundbrook, N. J.
WEW—St. Louis, Mo. ....1 Kw.
KVI—Tacoma, Wash. ....1 Kw.
T—Des Moines, Wash.

770 KILOCYCLES, 389.4 METERS
KFAB—Lincoln, Nebr. (WBBM, WJBT) ..5 Kw.
WBBM, WJBT—Chicago, Ill. (KFAB) ...25 Kw.
T—Glenview, Ill.

***780 KILOCYCLES, 384.4 METERS**
WEAN—Providence, R. I. 500, 250
WTAR, WPOR—Norfolk, Va. 500
WMC—Memphis, Tenn. ....1 Kw., 500
(C. P. issued to move to Bartlett, Tenn.)
KELW—Burbank, Calif. (KTM) 500
KTM—Los Angeles, Calif. (KELW) 500
T—Santa Monica, Calif. ....1 Kw.
CKX—Brandon, Manitoba 500
CKY, CNRW—Winnipeg, Manitoba 5000

790 KILOCYCLES, 379.5 METERS
WGY—Schenectady, N. Y. ....50 Kw.
T—So. Schenectady, N. Y.
KGO—Oakland, Calif. ....7½ Kw.

800 KILOCYCLES, 374.8 METERS
WBAP—Fort Worth, Texas. ....50 Kw.
T—Grapevine, Texas (Licensed for 10 Kw. only at present)
WFAA—Dallas, Tex. (WBAP) ....5 Kw., 50 Kw.
T—Grapevine, Texas
C. P. to increase pwr. to 50 Kw.

810 KILOCYCLES, 370.2 METERS
WPCH—New York, N. Y. 500
T—Hoboken, N. J.
WCCO—Minneapolis, Minn. ....7½ Kw.
T—Anoka, Minn.

*****820 KILOCYCLES, 365.6 METERS**
WHAS—Louisville, Kentucky ....10 Kw.
T—Jeffersontown, Kentucky

830 KILOCYCLES, 361.2 METERS
WHDH—So. Boston, Mass. ....1 Kw.
T—Gloucester, Mass.
WRUF—Gainesville, Fla. ....5 Kw.
KOA—Denver, Colo. ....12½ Kw.

****840 KILOCYCLES, 356.9 METERS**
CHCT—Red Deer, Alberta 1000
CKLC—Red Deer, Alberta 1000
CFCA—Toronto, Ontario 500
CJB—Toronto, Ontario 1000
CKOW—Toronto, Ontario 500
CNRT—Toronto, Ontario 500

850 KILOCYCLES, 352.7 METERS
KWKH—Kennonwood, La. (WWL) ....10 Kw.
WWL—New Orleans, La. (KWKH) ....5 Kw.

860 KILOCYCLES, 348.6 METERS
WABC, WBOQ—New York City ....5 Kw.
T—West of Cross Bay Blvd., Queens Co.
C. P. issued to move & incr. pr. to 50 Kw.—LP
WHB—Kansas City, Mo. 500
KFQZ—Los Angeles, Calif. 250
T—Hollywood, Calif.
KMO—Tacoma, Wash. ....1 Kw., 500

870 KILOCYCLES, 344.6 METERS
WLS—Chicago, Ill. (WENR, WBCN) 5Kw., 50 Kw.
T—Crete, Ill.
WENR, WBCN—Chicago, Ill. (WLS) ....50 Kw.
T—Downers Grove, Ill.

***880 KILOCYCLES, 340.7 METERS**
WGBI—Scranton, Pa. (WQAN) 250
WCOC—Meridan, Miss. ....500, 1 Kw.
WQAN—Scranton, Pa. (WGBI) 250
WSUI—Iowa City, Iowa 500
KLX—Oakland, Calif 500
KPOF—Denver, Colo. (KFKA) 500
KFKA—Greeley, Colo. (KPOF) ....1 Kw., 500
CJCB—Sydney, N. S. 50
CHCS—Hamilton, Ontario 10
CHML—Hamilton, Ontario 50
CKOC—Hamilton, Ontario 50
CHRC—Quebec, Quebec 25
CKCI—Quebec, Quebec 22
CKCV, CNRQ—Quebec, Quebec 50

***890 KILOCYCLES, 336.9 METERS**
WJAR—Providence, R. I. 400, 250
WKAQ—San Juan, P. R. 500
WMMN—Fairmont, W. Va. 500, 250
WMAZ—Macon, Ga. (WGST) 500, 250
WGST—Atlanta, Ga. (WMAZ) 500, 250
KGJF—Little Rock, Ark. 250
WILL—Urbana, Ill. (KUSD, KFNF) 500, 250
KUSD—Vermillion, S. D. (WILL, KFNF) 750, 500
KFNF—Shenandoah, Iowa (WILL, KUSD) 1 Kw., 500
CFBO—St. John, New Brunswick 50

900 KILOCYCLES, 333.2 METERS
WMAK—Buffalo, N. Y. (WFBL) 750
T—Martinsville, N. Y.
WRDA—Buffalo, N. Y. ....1 Kw.
T—Orchard Park, N. Y. (C. P. only)
WKY—Oklahoma City, Okla. ....1 Kw.
WJAX—Jacksonville, Fla. ....1 Kw.
WLBL—Stevens Point, Wis. ....2 Kw.
KHJ—Los Angeles, Calif. ....1 Kw.
KSEI—Pocatello, Idaho 250
KGBU—Ketchikan, Alaska 500

****910 KILOCYCLES, 329.5 METERS**
CJGC—London, Ontario 500
CNRL—London, Ontario 500
CFQC—Saskatoon, Saskatchewan 500
CJHS—Saskatoon, Saskatchewan 250
CNRS—Saskatoon, Saskatchewan 500

920 KILOCYCLES, 325.9 METERS
WBSO—Wellesley Hills, Mass. 500, 250
WWJ—Detroit, Mich. ....1 Kw.
KPRC—Houston, Texas ....2½ Kw., 1 Kw.
T—Sugarland, Texas
WAAF—Chicago, Ill. 500
KOMO—Seattle, Wash. ....1 Kw.
KFEL—Denver, Colo. (KFXF) 500
KFXF—Denver, Colo. (KFEL) 500

***930 KILOCYCLES, 322.4 METERS**
WIBG—Elkins Park, Pa. 50
WDBJ—Roanoke, Va. 500, 250
WBRC—Birmingham, Ala. ....1 Kw., 500
KGBZ—York, Nebr. (KMA) ....1 Kw., 500
KMA—Shenandoah, Ia. (KGBZ) ....1 Kw., 500
KFWI—San Francisco, Cal. (KFWM) 500
KROW—Oakland, Cal. ....500, 1 Kw.
T—Richmond, Cal.
CHNS—Halifax, Nova Scotia 500
CKIC—Wolfville, Nova Scotia 50
CFRC—Kingston, Ont. 500
CKPC—Preston, Ont. 50

940 KILOCYCLES, 319.0 METERS
WAAT—Jersey City, N. J. 300
WCSH—Portland, Maine ....1 Kw., 500
WFIW—Hopkinsville, Ky. ....1 Kw.
WHA—Madison, Wis. 750
WDAY—W. Fargo, N. D. ....1 Kw.
KOIN—Portland, Ore. ....1 Kw.
T—Sylvan, Ore.
KGU—Honolulu, T. H. ....1 Kw.

950 KILOCYCLES, 315.6 METERS
WRC—Washington, D. C. 500
KMBC—Kansas City, Mo. ....1 Kw.
T. Independence, Mo.
KFWB—Hollywood, Calif. ....1 Kw.
KGHL—Billings, Mont. 500

****960 KILOCYCLES, 312.3 METERS**

CJBC—Toronto, Ontario.
CFRB—Toronto, Ontario 4000
CFCY—Charlottetown, Prince Edward Island...250
CHCK—Charlottetown, Prince Edward Island ...30
CHWC—Pilot Butte, Saskatchewan 500
CJBR—Regina, Saskatchewan 500
CHCK—Regina, Saskatchewan 500
CNRR—Regina, Saskatchewan 500

970 KILOCYCLES, 309.1 METERS

WCFL—Chicago, Ill. ....1½ Kw.
KJR—Seattle, Wash. ....5 Kw.

980 KILOCYCLES, 303.9 METERS

KDKA—Pittsburgh, Pa. ....50 Kw.
T—Wilkins Twp., Pa.
C. P. issued to move near Saxonburg, Pa.

990 KILOCYCLES, 302.8 METERS

WBZ—Springfield, Mass (WBZA) ....15 Kw.
T—E. Springfield, Mass.
WBZA—Boston, Mass. (WBZ) 500

1000 KILOCYCLES, 299.8 METERS

WHO—Des Moines, Ia. (WOC)..............5 Kw.
WOC—Davenport, Ia. (WHO) ....5 Kw.
KFVD—Culver City, Calif. 250

***1010 KILOCYCLES, 296.9 METERS**

WQAO, WPAP—New York, N. Y. (WHN, WRNY) 250
T—Cliffside, N. J.
WHN—New York, N. Y. (WQAO, WPAP, WRNY) 250
WRNY—New York, N. Y. (WQAO, WPAP, WHN) 250
T—Coytesville, N. J.
KGGF—Picher, Okla. (WNAD) 500
WNAD—Norman, Okla. (KGGF) 500
WIS—Columbia, S. C. ....1 Kw., 500
(C. P. only)
CKCR—Waterloo, Ont. 50
CFLC—Prescott, Ont. 50
CKSH—St. Hyacinthe, Que. 50
KQW—San Jose, Calif. 500

*****1020 KILOCYCLES, 293.9 METERS**

WRAX—Philadelphia, Pa. 250
KYW, KFKX—Chicago, Ill. ....10 Kw.
T—Bloomingdale, Ill.

****1030 KILOCYCLES, 291.1 METERS**

CJOR—Sea Island, B. C. 50
CNRV—Vancouver, B. C. 500
CFCF—Montreal, Que 1650

*****1040 KILOCYCLES, 288.3 METERS**

WKEN—Buffalo, N. Y. ....1 Kw.
T—Grand Island, N. Y.
WKAR—East Lansing, Mich. ....1 Kw.
KTHS—Hot Springs National Park, Ark. (KRLD) ....10 Kw.
KRLD—Dallas, Tex. (KTHS) ....10 Kw.

1050 KILOCYCLES, 285.5 METERS

KFKB—Milford, Kansas ....5 Kw.
KNX—Hollywood, Calif. ....50 Kw., 5 Kw.
T—Los Angeles, Calif.

1060 KILOCYCLES, 282.8 METERS

WBAL—Baltimore, Md. (WTIC) ....10 Kw.
T—Glen Morris, Md.
WTIC—Hartford, Conn. (WBAL) ....50 Kw.
T—Avon, Conn.
WJAG—Norfolk, Neb. ....1 Kw.
KWJJ—Portland, Ore. 500

*****1070 KILOCYCLES, 280.2 METERS**

WAAT—Jersey City, N. J. 300
(Day until 6 PM. but not after sunset at Cleveland, O.)
WTAM—Cleveland, Ohio ....50 Kw.
T—Brocksville Village, O.
WCAZ—Carthage, Ill. 50
WDZ—Tuscola, Ill. 100
KJBS—San Francisco, Calif 100

*****1080 KILOCYCLES, 277.6 METERS**

WBT—Charlotte, N. C. ....5 Kw.
WCBD—Zion, Ill. (WMBI) ....5 Kw.
WMBI—Chicago, Ill. (WCBD) ....5 Kw.
T—Addison, Ill.

*****1090 KILOCYCLES, 275.1 METERS**

KMOX, KFQA—St. Louis, Mo. ....50 Kw., 5 Kw.
T—Kirkwood, Mo.

1100 KILOCYCLES, 272.6 METERS

WPG—Atlantic City, N. J. (WLWL) ....5 Kw.
WLWL—New York City (WPG) ....5 Kw.
T—Kearny, N. J.
(6 P.M. to 8 P.M.)
KGDM—Stockton, Calif. 250, 50
(C. P. to incr. pwr. to 250 W—D)

*****1110 KILOCYCLES, 270.1 METERS**

WRVA—Richmond, Va. ....5 Kw.
T—Mechanicsville, Va.
KSOO—Sioux Falls, S. D. ....2 Kw.

***1120 KILOCYCLES, 267.7 METERS**

WDEL—Wilmington, Del. 350, 250
WDBO—Orlando, Fla. 500
WTAW—College Station, Tex. (KTRH) 500
KTRH (formerly KUT)—Austin, Texas.. (WTAW) (C. P. only).....................500
WISN—Milwaukee, Wis. (WHAD) 250
WHAD—Milwaukee, Wis. (WISN) 250
KFSG—Los Angeles, Calif. (KMIC)............500
KRSC—Seattle, Wash. 50
KFID—Spokane, Wash. 100
KMIC—Inglewood, Calif. (KFSG) 500
CHGS—Sunnyside, Prince Edward Island.......25
CJOC—Lethbridge, Alberta 50
CJRX—Middlechurch, Manitoba...............2000
CFJC—Kamloops, British Columbia.............15

*****1130 KILOCYCLES, 265.3 MTEERS**

WOV—New York City ....1 Kw.
T—Secaucus, N. J.
Daytime to 6 P.M.
WJJD—Mooseheart, Ill. ....20 Kw.
KSL—Salt Lake City, Utah ....5 Kw.

*****1140 KILOCYCLES, 263.0 METERS**

WAPI—Birmingham, Ala. (KVOO) ....5 Kw.
KVOO—Tulsa, Okla. (WAPI) ....5 Kw.

*****1150 KILOCYCLES, 260.7 METERS**

WHAM—Rochester, N. Y. ....5 Kw.
T—Victor Township

*****1160 KILOCYCLES, 258.5 METERS**

WWVA—Wheeling, W. Va. (WOWO)........5Kw.
WOWO—Ft. Wayne, Ind. (WWVA)........10 Kw.

*****1170 KILOCYCLES, 256.3 METERS**

WCAU—Philadelphia, Pa. ....10 Kw.
T—Byberry, Pa.
KTNT—Muscatine, Iowa ....5 Kw.

*****1180 KILOCYCLES, 254.1 METERS**

WDGY—Minneapolis, Minn. (WHDI).........1 Kw.
WHDI—Minneapolis, Minn. (WDGY)..........500
KEX—Portland, Ore. (KOB) ....5 Kw.
KOB—State College, N. M. (KEX) ....20 Kw.

1190 KILOCYCLES, 252.0 METERS

WICC—Bridgeport, Conn. 500
T—Easton, Conn.
WOAI—San Antonio, Tex. ....5 Kw.
C. P. issued to increase power to 50 Kw.

***1200 KILOCYCLES, 249.9 METERS**

WABI—Bangor, Maine 100
WNBX—Springfield, Vt. (WCAX) 10
WCAX—Burlington, Vt. (WNBX) 100
WORC—Worcester, Mass. 100
T—Auburn, Mass.
WIBX—Utica, N. Y. 300, 100
WFBE—Cincinnati, Ohio 100
WHBC—Canton, Ohio (WNBO) 10
(Sundays)
WLAP—Louisville, Ky. 30
WLBG—Petersburg, Va. 250, 100
T—Ettrick, Va.
WNBO—Silver Haven, Pa. 100
Sundays only.
WEHC—Emory, Va. 100
WCOD—Harrisburg, Pa. (WKJC) 100
WKJC—Lancaster, Pa. (WCOD) 100
WNBW—Carbondale, Pa. 10
KMLB—Monroe, La. Cp. only.....................50
WABZ—New Orleans, La. (WJBW)............100
WJBW—New Orleans, La. (WABZ) 30
WBBZ—Ponca City, Okla. 100
WFBC—Knoxville, Tenn. 50
WRBL—Columbus, Ga. 50
(C. P. only)
KBTM—Paragould, Ark. 100
KGHI—Little Rock, Ark..........................100
WJBC—LaSalle, Ill. (WJBL) 100
WJBL—Decatur, Ill. (WJBC) 100
WWAE—Hammond, Ind. (WRAF) 100
WRAF—Laporte, Ind. (WWAE) 100
KFJB—Marshalltown, Ia. 250, 100
KGCU—Mandan, N. D. 100
WCAT—Rapid City, S. D. 100
KGDY—Oldham, S. D. 15
KFWF—St. Louis, Mo. (WMAY, WIL).........100
KGDE—Fergus Falls, Minn. 100, 50
KGFK—Hallock, Minn. 50
WCLO—Kenosha, Wis. 100
WHBY—Green Bay, Wis. 100
T—West De Pere, Wis.
WIL—St. Louis, Mo. (KFWF, WMAY)....250, 100
WMAY—St. Louis, Mo. (KFWF, WIL)...250, 100
KGFJ—Los Angeles, Calif. 100
KXO—El Centro, Calif. 100
KSMR—Santa Maria, Calif. 100
KWG—Stockton, Calif. 100
KGEK—Yuma, Colo. (KGEW) 50
KGEW—Ft. Morgan, Colo. (KGEK) 100
KFHA—Gunnison, Colo. 50
KVOS—Bellingham, Wash. 100
KGHI—Little Rock, Ark. 100
KGY—Lacey, Wash. 50, 10

***1210 KILOCYCLES, 247.8 METERS**

WJBI—Redbank, N. J. (WCOH, WGBB)....100
WGBB—Freeport, N. Y. (WCOH, WJBI)......100
WCOH—Yonkers, N. Y. (WJBI, WGBB)......100
T—Greenville, N. Y.
WOCL—Jamestown, N. Y. 25
WLCI—Ithaca, N. Y. 50
WPAW—Pawtucket, R. I. (WDWF, WLSI)....100
WDWF, WLSI—Providence, R. I. (WPAW).100
T—Cranston, R. I.
WMRJ—Jamaica, N. Y. 10
WMAN—Columbus, Ohio 50
WJW—Mansfield, Ohio 100
WALR—Cambridge, Ohio 100
WBAX—Wilkes-Barre, Pa. (WJBU)............100
T—Plains Twp., Pa.
WJBU—Lewisburg, Pa. (WBAX) 100
WMBG—Richmond, Va. 100
WBBL—Richmond, Va. (WMBG) 100
WSIX—Springfield, Tenn. 100
WRBU—Gastonia, N. C. 100
WJBY—Gadsden, Ala. 50
(C. P. only)
KGMP—Elk City, Okla. 100
WRBQ—Greenville, Miss. 250, 100
WGCM—Gulfport, Miss. 100
T—Mississippi City, Miss.
Now Licensed.
KWEA—Shreveport, La. 100
KDLR—Devils Lake, N. D. 100
KGCR—Watertown, S. D. 100
KFOR—Lincoln, Nebr. 250, 100
WHBU—Anderson, Ind. 100
KFVS—Cape Girardeau, Mo. (WEBQ) 100
WEBQ—Harrisburg, Ill. (KFVS)...............100
WSBC—Chicago, Ill. (WEDC, WCRW)........100
WCRW—Chicago, Ill. (WEDC, WSBC).........100
KGNO—Dodge City, Kansas 100
(C. P. only)
WEDC—Chicago, Ill. (WSBC, WCRW).........100
WCBS—Springfield, Ill. (WTAX) 100
WTAX—Streator, Ill. (WCBS) 50
WHBF—Rock Island, Ill. 100
WIBA—Madison, Wis. 100
WOMT—Manitowoc, Wis. 100
KMJ—Fresno, Calif. 100
KFXM—San Bernardino, Calif. (KPPC)........100
KDFN—Casper, Wyo. 100
KPPC—Pasadena, Calif. (KFXM) 50
CHWK—Chilliwack, British Columbia 5
CFNB—Frederickton, New Brunswick 50
CFCO—Chatham, Ontario 50
CKMC—Cobalt, Ontario 15
CKPC—Preston, Ontario 50

1220 KILOCYCLES, 245.8 METERS

WCAD—Canton, N. Y. 500
WDAE—Tampa, Fla. ....1 Kw.
WCAE—Pittsburgh, Pa. ....1 Kw.
WREN—Lawrence, Kans. (KFKU) ......1 Kw.
KFKU—Lawrence, Kans. (WREN) ....1 Kw.
KWSC—Pullman, Wash. ....2 Kw., 500

1230 KILOCYCLES, 243.8 METERS

WNAC, WBIS—Boston, Mass. (T. Quincy, Mass.) ....1 Kw.
WPSC—State College, Pa. 500
WSBT—South Bend, Ind. (WFBM) 500
WFBM—Indianapolis, Ind. (WSBT) ....1 Kw.
KGGM—Albuquerque, N. M. 500, 250
KYA—San Francisco, Calif. ....1 Kw.
KFQD—Anchorage, Alaska 100

1240 KILOCYCLES, 241.8 METERS

WGHP—Detroit, Mich. ....1 Kw.
KTAT—Fort Worth, Texas (WACO)........1 Kw.
T—Birdsville, Texas
WACO—Waco, Texas (KSAT) ....1 Kw.

1250 KILOCYCLES, 239.9 METERS

WGCP—Newark, N. J. (WODA, WAAM) 250
KFMX—Northfield, Minn. ....1 Kw.
WODA—Paterson, N. J. (WGCP, WAAM) 1 Kw.
WAAM—Newark, N. J. (WODA, WGCP) 1 Kw., 2 Kw.
WDSU—New Orleans, La. ....1Kw.
WLB, WGMS—Minneapolis, Minn. (WRHM, KFMX, WCAL) ....1 Kw., 50
(C. P. to move locally and increase power to 1 Kw.
WRHM—Minneapolis, Minn. (WLB, KFMX, WCAL) ....1 Kw.
T—Fridly, Minn.
KFMX—Northfield, Minn. (WLB, WRHM, WCAL) ....1 Kw.
WCAL—Northfield, Minn. (WLB, WRHM, KFMX) ....1 Kw.
KFOX—Long Beach, Calif. ....1 Kw.
KIDO—Boise, Idaho ....1 Kw.

1260 KILOCYCLES, 238.0 METERS

WLBW—Oil City, Pa. ....1 Kw., 500
KWWG—Brownsville, Texas (KRGV).......500
WTOC—Savannah, Ga. 500
KRGV—Harlingen, Texas (KWWG)............500
KOIL—Council Bluffs, Ia. ....1 Kw.
KVOA—Tucson, Arizona 500

1270 KILOCYCLES, 236.1 METERS

WEAI—Ithaca, N. Y. 500
WFBR—Baltimore, Md. 250
WASH—Grand Rapids, Mich. (WOOD)........500
WOOD—Grand Rapids, Mich. (WASH) 500
T—Furnwood.
WJDX—Jackson, Miss. ....1 Kw., 500
KWLC—Decorah, Iowa (KGCA)................100
KGCA—Decorah, Iowa (KWLC)..................50
KTW—Seattle, Wash. (KOL) ....1 Kw.
KOL—Seattle, Wash. (KTW) ....1 Kw.
KFUM—Colorado Springs, Colo.............1 Kw.

1280 KILOCYCLES, 234.2 METERS

WCAM—Camden, N. J. (WOAX, WCAP).....500
WCAP—Asbury Park, N. J. (WCAM, WOAX) 500
WOAX—Trenton, N. J. (WCAM, WCAP).....500
WDOD—Chattanooga, Tenn. ....2½ Kw., 1 Kw.
WRR—Dallas, Tex. 500
KFBB—Great Falls, Montana (KGIR).......1 Kw.
WRR—Dallas, Tex. 500

1290 KILOCYCLES, 232.4 METERS

WNBZ—Saranac Lake, N. Y......................50
WJAS—Pittsburgh, Pa. ....1 Kw.
T—North Fayette Twp., Pa.
KTSA—San Antonio, Texas (KFUL) 2 Kw., 1 Kw.
KFUL—Galveston, Texas (KTSA) 500
KLCN—Blytheville, Ark. 50
WEBC—Superior, Wis. ....2½ Kw., 1 Kw.
(C. P. to incr. pr. to 2½ Kw., L. S.)
KDYL—Salt Lake City, Utah ....1 Kw.

1300 KILOCYCLES, 230.6 METERS

WBBR—Rossville, N. Y. (WHAP, WEVD, WHAZ) ....1 Kw.
T—Staten Island.
WHAP—New York, N. Y. (WBBR, WEVD, WHAZ) ....1 Kw.
T—Carlstadt, N. J.
WEVD—New York, N. Y. (WBBR, WHAP, WHAZ) 500
T—Forest Hills, N. Y.
WHAZ—Troy, N. Y. (WBBR, WHAP, WEVD) 500
WIOD, WMBF—Miami Beach, Fla.........1 Kw.
KFH—Wichita, Kansas (WOQ) ....1 Kw.
WOQ—Kansas City, Mo. (KFH) ....1 Kw.
KGEF—Los Angeles, Calif. (KTBI) ....1 Kw.
KTBI—Los Angeles, Calif. (KGEF)............750
KFJR—Portland, Oregon (KTBR) 500
KTBR—Portland, Oregon (KFJR) 500

1310 KILOCYCLES, 288.9 METERS

WKAV—Laconia, N. H. 100
WEBR—Buffalo, N. Y. 200, 100
WMBO—Auburn, N. Y. 100
WNBH—New Bedford, Mass. 100
WOL—Washington, D. C. 100
WGH—Newport News, Va. 100
WRK—Hamilton, Ohio 100
WAGM—Royal Oak, Mich. 50
WFDF—Flint, Michigan 100
WHAT—Phiadelphia, Pa. (WFKD)............100
WFKD—Philadelphia, Pa. (WHAT)...............50
WJAC—Johnstown, Pa. (WFBG) 100
WFBG—Altoona, Pa. (WJAC) 100
WRAW—Reading, Pa. (WCAL) 100
WGAL—Lancaster, Pa. (WRAW) 100, 15
(C. P. to 100 watts)
WSAJ—Grove City, Pa. 100
WBRE—Wilkes-Barre, Pa. 100
WKBC—Birmingham, Ala. 100
WRBI—Tifton, Ga. 20
WOBT—Union City, Tenn. 250, 100
WNBJ—Knoxville, Tenn. 50
KRMD—Shreveport, La. (KTSL) 50
KTSL—Shreveport, La. (KRMD)................100
T—Cedar Grove, La.
WSJS—Winston-Salem, N. C. 100
(C. P. only)
WCSC—Charleston, S. C. 250, 100
(C. P. only)
KFPM—Greenville, Texas 15
KTSM—El Paso, Texas (WDAH) 100
WDAH—El Paso, Texas (KTSM) 100
KFPL—Dublin, Texas 100
KFXR—Oklahoma City, Oklahoma 100
WKBS—Galesburg, Ill. 100
WCLS—Joliet, Ill. (WKBB).......................100
WKBB—Joliet, Ill. (WCLS) 100
KWCR—Cedar Rapids, Iowa (KFGQ, KFJY)..100
KFJY—Fort Dodge, Iowa (KFGQ, KWCR)..100
KFGQ—Boone, Iowa (KWCR, KFJY)...........100
KGFW—Ravenna, Nebr. 100
WBOW—Terre Haute, Ind. 100
WJAK—Marion, Ind. (WLBC) 50
WLBC—Muncie, Ind. (WJAK) 50
KGBX—St. Joseph, Missouri 100
(Does not operate when WOQ operates)
WIBU—Poynette, Wis. 100
KFIU—Juneau, Alaska 10
KFBK—Sacramento, Calif. 100

KGRJ—Jerome, Ariz. 100
(C. P. only)
KGCX—Wolf Point, Mont. 250, 100
KGEZ—Kalispell, Mont. 100
KFUP—Denver, Colo. (KFXJ) 100
KFXJ—Edgewater, Colo. (KFUP) 50
KMED—Medford, Ore. 50
KXRO—Aberdeen, Wash. 75
KIT—Yakima, Wash. 50

1320 KILOCYCLES, 277.1 METERS

WADC—Tallmadge, Ohio ....1 Kw.
WSMB—New Orleans, La. 500
KGIQ—Twin Falls, Idaho (KID) 250
KGHF—Pueblo, Colo. 500, 250
KGMB—Honolulu, Hawaii 500
KID—Idaho Falls, Idaho (KGIQ)......500, 250

1330 KILOCYCLES, 225.4 METERS

WDRC—New Haven, Conn. 500
WSAI—Cincinnati, Ohio 500
T—Mason, Ohio
WTAQ—Eau Claire, Wis. (KSCJ) ....1 Kw.
T—Township of Washington, Wis.
KSCJ—Sioux City, Iowa (WTAQ) ..2½ Kw., 1 Kw.
KGB—San Diego, Calif. 250

1340 KILOCYCLES, 223.7 METERS

WSPD—Toledo, Ohio ....1 Kw., 500
KFPY—Spokane, Wash. ....1 Kw., 500

1350 KILOCYCLES, 222.1 METERS

WBNY—New York, N. Y. (WMSG, WCDA, WKBQ) 250
WMSG—New York, N. Y. (WBNY, WCDA, WKBQ) 250
WCDA—New York City (WBNY, WMSG, WKBQ) 250
T—Cliffside Park, N. J.
WKBQ—New York City (WBNY, WMSG, WCDA) 250
KWK—St. Louis, Mo. ....1 Kw.

1360 KILOCYCLES, 220.4 METERS

WFBL—Syracuse, N. Y. ....1 Kw.
WQBC—Vicksburg, Miss. 300
WJKS—Gary, Ind. (WGES)..............500, 1250
WGES—Chicago, Ill. (WJKS).........500, 1 Kw.
KGIR—Butte, Mont. (KFBB)....................500
KGER—Long Beach, Calif. (KPSN)..1 Kw., 250
KPSN—Pasadena, Calif. (KGER)............1 Kw.

1370 KILOCYCLES, 218.8 METERS

WRDO—Augusta, Maine. CP. only............100
WQDM—St. Albans, Vermont (C.P. only)........5
WSVS—Buffalo, N. Y. 50
WPOE—Patchogue, N. Y....................100
WCBM—Baltimore, Md. 250, 100
WHBD—Mt. Orab, Ohio....................100
WHDF—Calumet, Mich....................250, 100
(C. P. to increase power to 250)
WBGF—Glens Falls, N. Y. CP. only............50
WLEY—Lexington, Mass. 100
WJBK—Ypsilanti, Mich. (WIBM)..............50
WIBM—Jackson, Mich. (WJBK)..............100
WRAK—Williamsport, Pa. 50
WELK—Philadelphia, Pa. 250, 100
WFDV—Rome, Ga. 100
WRBJ—Hattiesburg, Miss. 10
WHBQ—Memphis, Tenn. 100
WRBT—Wilmington, N. C....................100
KGFG—Oklahoma City, Okla. (KCRC).........100
KFJZ—Fort Worth, Texas....................100
KCRC—Enid, Oklahoma (KGFG)........250, 100
WMBR—Tampa, Florida....................100
KGCI—San Antonio, Texas (KONO)............100
KONO—San Antonio, Texas (KGCI)............100
KGKL—San Angelo, Texas....................100
KFLX—Galveston, Texas 100
WGL—Ft. Wayne, Indiana 100
WBTM—Danville, Virginia (WLVA)............100
(C. P. only)
WLVA—Lynchburg, Virginia (WBTM)........100
(C. P. only)
KGDA—Dell Rapids, S. D....................50
C. P. to move to Mitchell, S. D.
KFJM—Grand Forks, N. D....................100
KWKC—Kansas City, Missouri....................100
WRJN—Racine, Wisconsin 100
KGAR—Tucson, Arizona....................250, 100
(C. P. to incr. pr. to 250)
KOH—Reno, Nevada 100
KRE—Berkeley, California 100
KZM—Hayward, Calif. 100
KLO—Ogden, Utah 200, 100
KOOS—Marshfield, Ore....................100
KFBL—Everett, Wash. (KVL)....................50
KVL—Seattle, Wash. (KFBL)....................100
KFJI—Astoria, Ore. 100
KGFL—Raton, N. M....................50

1380 KILOCYCLES, 217.3 METERS

WSMK—Dayton, Ohio. (KQV)....................200
KQV—Pittsburgh, Pa. (WSMK)....................500
KSO—Clarinda, Ia. (WKBH) 500
WKBH—LaCrosse, Wis. (KSO) ....1 Kw.

1390 KILOCYCLES, 215.7 METERS

WHK—Cleveland, Ohio. T—Village of Seven Hills ....1 Kw.
KLRA—Little Rock, Ark. (KUOA)..........1 Kw.
KUOA—Fayetteville, Ark. (KLRA) ....1 Kw.
KOY—Phoenix, Ariz. 500

1400 KILOCYCLES, 214.2 METERS

WCGU—Brooklyn, N. Y. (WSGH-WSDA, WLTH, WBBC) 500
WSGH-WSDA—Brooklyn, N. Y. (WCGU, WLTH, WBBC) 500
WLTH—Brooklyn, N. Y. (WCGU, WSGH. WSDA, WBBC) 500
WBBC—Brooklyn, N. Y. (WCGU, WSGH-WSDA, WLTH) 500
KOCW—Chickasha, Okla. 250, 500
WCMA—Culver, Ind. (WBAA, WKBF) 500
WKBF—Indianapolis, Ind. (WBAA, WCMA)..500
WBAA—W. Lafayette, Ind. (WCMA, WKBF) 500

1410 KILOCYCLES, 212.6 METERS

WBCM—Bay City, Mich. Hampton Twp., Mich. 500
WLEX—Lexington, Mass. 100
KGRS—Amarillo, Texas (WDAG)............1 Kw.
WMAF—South Dartmouth, Mass. (WLEX, WSSH) 500
WODX—Mobile, Ala. (WSFA)....................500
T—Springhill, Ala.
WSFA—Montgomery, Ala. (WODX)..........500
(C. P. only)
WRBX—Roanoke, Va. 250
WSSH—Boston, Mass. (WLEX, WMAF)......500
WDAG—Amarillo, Texas (KGRS) 250
KFLV—Rockford, Ill. (WHBL) ....500, 1 Kw.
WHBL—Sheboygan, Wis. (KFLV)............500

1420 KILOCYCLES, 211.1 METERS

WELL—Battle Creek, Mich. 50
WHDL—Tupper Lake, N. Y....................10
WTBO—Cumberland, Md. 100, 50
WILM—Wilmington, Del. 100
WEDH—Erie, Pa. 30
WMBC—Detroit, Mich. 250, 100
WKBP—Battle Creek, Mich. 50
WHIS—Bluefield, W. Va. 100
WPAD—Peducah, Ky. 100
WIBR—Steubenville, Ohio 50
WFDW—Talladega, Ala. 100
(C. P. only)
WJBO—New Orleans, La. 100
KTAP—San Antonio, Tex. 100
KTUE—Houston, Texas 100
KFYO—Abilene, Texas 250, 100
WSPA—Spartansburg, N. C. 250, 100
(C. P. only)
KICK—Red Oak, Iowa....................100
WIAS—Ottumwa, Iowa 100
WLBF—Kansas City, Kans. 100
WMBH—Joplin, Mo. 250, 100
KLPM—Minot, N. D. 100
WEHS—Evanston, Ill. (WKBI, WHFC)........100
WHFC—Cicero, Ill. (WKBI, WEHS)...........100
WKBI—Chicago, Ill. (WHFC, WEHS)..........50
KFIZ—Fon du Lac, Wis. 100
KFXY—Flagstaff, Ariz. 100
KGIX—Las Vegas, Nev. 100
(C. P. only)
KFQU—Holy City, Calif. (KGGC)..............100
KFXD—Jerome, Idaho 50
KGFF—Alva, Okla. 100
KGIW—Trinidad, Colo. 100
KGKX—Sandpoint, Idaho 100
KGGC—San Francisco, Calif. (KFQU)..........50
KBPS—Portland, Ore. 100
KXL—Portland, Oregon (KFIF)................100
KFIF—Portland, Oregon (KXL) 100
KORE—Eugene, Ore. 100
KFQW—Seattle, Wash. 100

1430 KILOCYCLES, 209.7 METERS

WHP—Harrisburg, Pa. (WBAK, WCAH)......500
T—Lemoyne, Pa.
WBAK—Harrisburg, Pa. (WHP, WCAH) ....1 Kw., 500
WCAH—Columbus, Ohio (WHP, WBAK).....500
C. P. to incr. pr. to 1 Kw.
WGBC—Memphis, Tenn. (WNBR) 500
KGNF—North Platte, Nebraska 500
(C. P. only)
WNBR—Memphis, Tenn. (WGBC)............500
KECA—Los Angeles, Calif. ....1 Kw.
WOKO—Poughkeepsie, N. Y. (WHEC-WABO).500

1440 KILOCYCLES, 208.2 METERS

T—Mt. Beacon, N. Y.
WCBA—Allentown, Pa. (WSAN)..............250
WSAN—Allentown, Pa. (WCBA) 250
WNRC—Greensboro, N. C. 500
WTAD—Quincy, Ill. (WMBD) 500
WMBD—Peoria Hgts., Ill. (WTAD)....1 Kw., 500
KLS—Oakland, Calif. 250

1450 KILOCYCLES, 206.8 METERS

WBMS—Hackensack, N. J. (See Note)..........250
WHOM—Jersey City, N. J. (WBMS, WNJ, WKBO) 250
WNJ—Newark, N. J....................250
WKBO—Jersey City, N. J....................250
WSAR—Fall River, Mass. 250
(Note: WBMS, WNJ, WIBS and WKBO divide time with each other)
WCSO—Springfield, Ohio (WFJC) 500
WFJC—Akron, Ohio (WCSO) 500
WTFI—Toccoa, Ga. 500
KTBS—Shreveport, La. ....1 Kw.

1460 KILOCYCLES, 205.4 METERS

WJSV—Mt. Vernon Hills, Va. ....10 Kw.
KSTP—St. Paul, Minn. ....10 Kw.

1470 KILOCYCLES, 204.0 METERS

WTNT—Nashville, Tenn (WLAC)...........5 Kw.
WLAC—Nashville Tenn. ....5 Kw.
KGA—Spokane, Wash. ....5 Kw.

1480 KILOCYCLES, 202.6 METERS

WKBW—Buffalo, N. Y....................5 Kw.
T—Amherst, N. Y.
KFJF—Oklahoma City, Okla. ....5 Kw.

1490 KILOCYCLES, 201.2 METERS

WFBL—Syracuse, N. Y....................1 Kw.
(Also operates ½ time with 750 w. on 900 kc.)
WCHI—
T—Deerfield, Ill. ....5 Kw.
WCKY—Covington, Ky. ....5 Kw.
WTNT—Nashville, Tenn. (WLAC)..........5 Kw.
T—Crescent Springs, Ky.
WLAC—Nashville, Tenn. (WTNT)...........5 Kw.
WORD—Chicago, Ill (WJAZ, WCHI, WCKY) ....5 Kw.
KPWF—Westminster, Calif. ....5 to 10 Kw.
(C. P. only)
WJAC—Mt. Prospect, Ill. (WORD, WCKY, WCHI) ....5 Kw.

1500 KILOCYCLES, 199.9 METERS

WMBA—Newport, R. I....................100
WLOE—Boston, Mass (WMES)..........250, 100
T—Chelsea, Mass.
WMES—Boston, Mass. (WLOE) 50
WBBS—Boston, Mass. 50
WNBF—Binghamton, N. Y. 100, 50
(C. P. to incr. pr. to 100 w.)
WMBQ—Brooklyn, N. Y. (WLBX, WCLB, WWRL) 100
WCLB—Long Beach, N. Y. (WLBX, WMBQ, WWRL) 100
WLBX—Long Island City, N. Y. (WMBQ) WCLB, WWRL) 100
WWRL—Woodside, N. Y. (WMBQ, WLBX, WCLB) 100
WKBZ—Ludington, Mich. 50
WMPC—Lapeer, Mich. 100
WPEN—Philadelphia, Pa. 250, 100
WMBJ—Penntownship, Pa. 100
WODY—Tupelo, Miss. CP. only................100
WOPI—Bristol, Tenn. 100
WRDY—Augusta, Ga. CP. only....................100
KGKY—Scottsbluff, Nebr. 100
(C. P. only)
KGFI—Corpus Christi, Tex. 100
KUT—Austin, Texas 100
KGKB—Brownwood, Texas 100
KTLC—Houston, Texas 100
WKBV—Connersville, Ind. 150, 100
KPJM—Prescott, Ariz. 100
KVEP—Portland, Ore. 15
KDB—Santa Barbara, Calif. 100
KREG—Santa Ana, Calif. 100
KUJ—Long View, Wash. 100
(½ time)
KGMD—Roswell, N. M....................100
(C. P. only)
KGIZ—Grant City, Mo. 50
(C. P. only)
KPG—Wenatchee, Wash. 50
KGEP—Const. permit issued to move to Moorhead, Minn., and change frequency from 1200 to..............1500 Kc.

List of Impending Changes, Not Yet in Effect

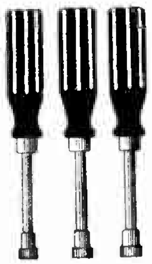
[Stations marked (***) on list by Frequencies are under consideration for change in frequencies as follows:]

Station Location	Present kc.	Proposed kc.
WHAS—Louisville, Kentucky	820	1020
KYW—Chicago, Illinois	1020	1140
KTHS—Hot Springs, Arkansas.. } KRLD—Dallas, Texas }	1040	1070
WTAM—Cleveland, Ohio	1070	1080
WBT—Charlotte, North Carolina	1080	1040
KMOX—St. Louis, Missouri	1090	1110
WRVA—Richmond, Virginia	1110	1150
WHEC-WABO—Rochester, N. Y. (WOKO)		500
WAPI—Birmingham, Alabama	1140	1130
KVOO—Tulsa, Oklahoma	1140	1130
WHAM—Rochester, N. Y.	1150	1160
WOWO—Fort Wayne, Indiana	1160	1180
WWVA—Wheeling, West Virginia	1160	1180
WCAU—Philadelphia, Pa.	1170	820
KOB—State College, New Mexico	1180	1170
KEX—Portland, Oregon	1180	1170
WMBI—Chicago, Illinois	1080	1040

Following Proposed Changes Involve Limited Time and Day Transmission:

Station Location	Present kc.	Proposed kc.
WCBD—Zion City, Illinois	1080	1040
WHDI—Minneapolis, Minn.	1180	1170
WDGY—Minneapolis, Minn.	1180	1170
WJJD—Mooseheart, Illinois	1130	1090
WKEN—Grand Island, N. Y.	1040	1160
WKAR—Lansing, Michigan	1040	830
WCAZ—Carthage, Illinois } WDZ—Tuscola, Illinois }	1070	No Change
KTNT—Muscatine, Iowa	1170	1160
KSL—Salt Lake City, Utah	1130	1090

Set of SOCKET WRENCHES *FREE!*



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224	65c	280	50c
226	50c	281	60c

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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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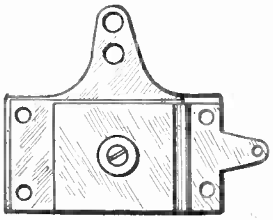
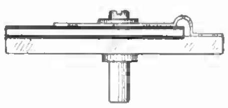
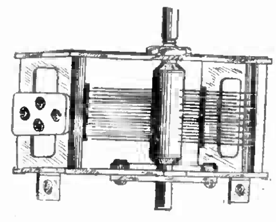




CAT. EQ-100 AT 35¢

The most precise and rugged equalizing condenser made, with 20 mmfd. minimum and 100 mmfd. maximum, for equalizing the capacity where gang condensers are used that are not provided with built-in trimmers. Turning the screw alters the position of the moving plate, hence the capacity. Cross-section reveals special threaded brass bushing into which screw turns, hence you can not strip the thread. Useful in all circuits where trimming capacity of 100 mmfd. or less is specified. Maximum capacity stamped on

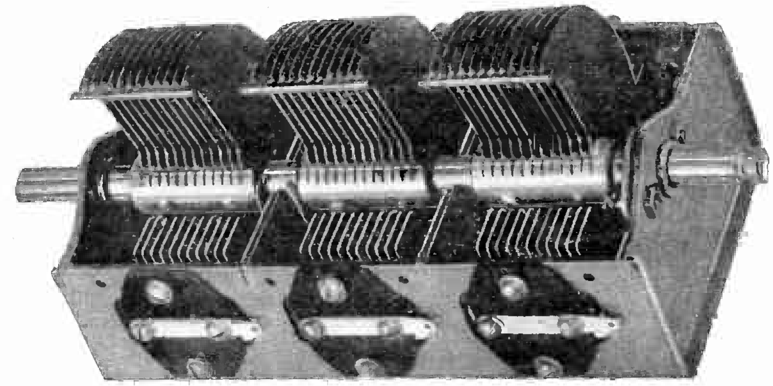
SINGLE .00035



CAT. KH-3 AT 85¢

A single .00035 mfd. condenser with nonremovable shaft, having shaft extension front and back, hence useful for ganging with drum dial or any other dial. Shaft is ¼ inch diameter, and its length may be extended ⅝ inch by use of Cat. XS-4. Brackets built in enable direct sub-panel mounting, or may be plied off easily. Front panel mounting is practical by removing two small screws and replacing with two 3/34 screws ¾ inch long. Condenser made by Scovill Mfg. Co.

THREE-GANG SCOVILL .0005 MFD.



One of the finest, strongest and best gang condensers ever made is this three-gang unit, each section of full .0005 mfd. capacity, with a modified straight frequency line characteristic. The net weight of this condenser is 3¼ lbs. Cat. SC-3G—5 at $4.80.

HERE is a three-gang condenser of most superior design and workmanship, with an accuracy of at least 99¼ per cent. at any setting — rugged beyond anything you've ever seen. Solid brass plates perfectly aligned and protected to the fullest extent against any displacement except the rotation for tuning. It has both side and bottom mounting facilities. Shaft is ⅜ inch diameter and extends at front and back, so two of these three-gangs may be used with a single drum dial for single tuning control. For use of this condenser with any dial of ¼" diameter bore, use Cat. XS-8, one for each three-gang. Tension adjusters shown at right, either side of shaft.

SALIENT FEATURES OF THE CONDENSER

(1)—Three equal sections of .0005 mfd. capacity each.
(2)—Modified straight line frequency shape of plates, so-called midline.
(3)—Sturdy steel frame with rigid steel shields between adjacent sections. These shields minimize electric coupling between sections.
(4)—The frame and the rotor are electrically connected at the two bearings and again with two sturdy springs, thus insuring positive, low resistance contact at all times.
(5)—Both the rotor and the stator plates are accurately spaced and the rotor plates are accurately centered between stator plates.
(6)—Two spring stoppers prevent jarring when the plates are brought into full mesh.
(7)—The rotor turns as desired, the tension being adjustable by set-screw at end.
(8)—The shaft is of steel and is ⅜ inch in diameter.
(9)—Each set of stator plates is mounted with two screws at each side of insulators, which in turn are mounted with two screws to the frame. Thus the stator plates cannot turn sidewise with respect to the rotor plates. This insures permanence of capacity and prevents any possible short circuit.
(10)—Each stator section is provided with two soldering lugs so that connection can be made to either side.
(11)—The thick brass plates and the generous proportions of the frame insure low resistance.
(12)—Provision made for independent attachment of a trimmer to each section.
(13)—The steel frame is sprayed to match the brass plates.
(14)—The condenser, made by America's largest condenser manufacturer, is one of the best and sturdiest ever made, assuredly a precise instrument.

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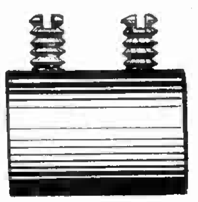
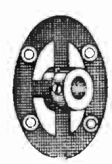


CAT. RL-3 AT 12¢

For coupling two ¼ inch diameter shafts, either coil shaft and condenser shaft, or two condenser shafts, a coupling link is used. This may be of the rigid type, all metal, where the linked units are not to be insulated. The rigid link, Cat. RL-3, has two set-screws, one to engage each shaft, and is particularly serviceable where a grounded metal chassis is used, as the returns then need no insulation.



CAT. FL-4 at 30¢

Flexible insulated coupler for uniting coil or condenser shafts of ¼ inch diameter. Provides option of insulated circuits

EXTENSION SHAFTS, TWO SIZES

CAT. XS-4 AT 10¢

Here is a handy aid to salvaging condensers and coils that have ¼" diameter shafts not long enough for your purpose. Fits on ¼" shaft and provides ⅝" extension, still at ¼". Hence both the extension shaft and the bore or opening are ¼" diameter. Order Cat. XS-4.

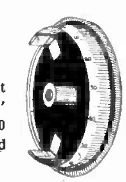
For condensers with ⅜" diameter shaft, to accommodate to dials that take ¼" shaft, order Cat. XS-8 at 15c.

.00035 TWO-GANG

A two-gang condenser, like the single type, KHS-3, but consisting of two sections on one frame, is Cat. KHD-3, also made by Scovill. The same mounting facilities are provided. There is a shield between the respective sections. The tuning characteristic is modified straight frequency line. Order Cat. KHD-3 at $1.70.

DRUM DIAL

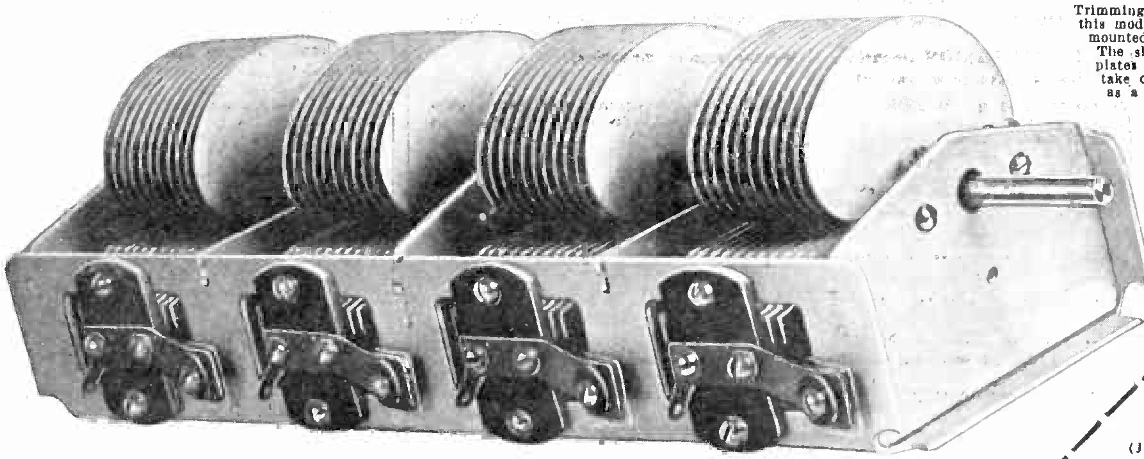
CAT DD-O-100 @ $1.50



A suitable drum dial of direct drive type is obtainable for ¼" shafts or ⅜" shafts, and with 0-100 scales. An escutcheon is furnished with each dial.

FOUR-GANG .00035 MFD. WITH TRIMMERS BUILT IN

Trimming condensers are built into this model. The condenser may be mounted on bottom or on side. The shaft is removable, also the plates are removable, so you can take out one section and operate as a three-gang.



Four-gang .00035 mfd. with trimmers built in. Shaft and rotor blades removable. Steel frame and shaft aluminum plates. Adjustable tension at rear. Overall length, 11 inches. Weight, 3½ lbs. Cat. SPL-4G-3 $3.95.

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Tuning condensers for short waves, especially suitable for mixer circuits and short-wave adapters. These condensers are .00015 mfd. (150 microfarads) in capacity. They are suitable for use with any plug-in coils. Order Cat. SW-S-150 @ $1.50. To provide regeneration from plate to grid return, for circuits calling for this, use .00025 mfd. Order Cat. SW-S-250 @ $1.50.

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☐ Cat. XS-8 @ 15c
☐ Cat. KHD-3 @ $1.70
☐ Cat. RL-3 @ 12c
☐ Cat. DD-0-100 @ $1.50
☐ Cat. EQ-100 @ 35c
☐ Cat. SC-3 G-5 @ $4.80
☐ Cat. SPL-4 G-3 @ $3.95
☐ Cat. FL-4 @ 30c
☐ Cat. SW-S-150
☐ Cat. SW-S-250

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