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The First and Only National Radio Weekly

Eleventh Year—533d Issue

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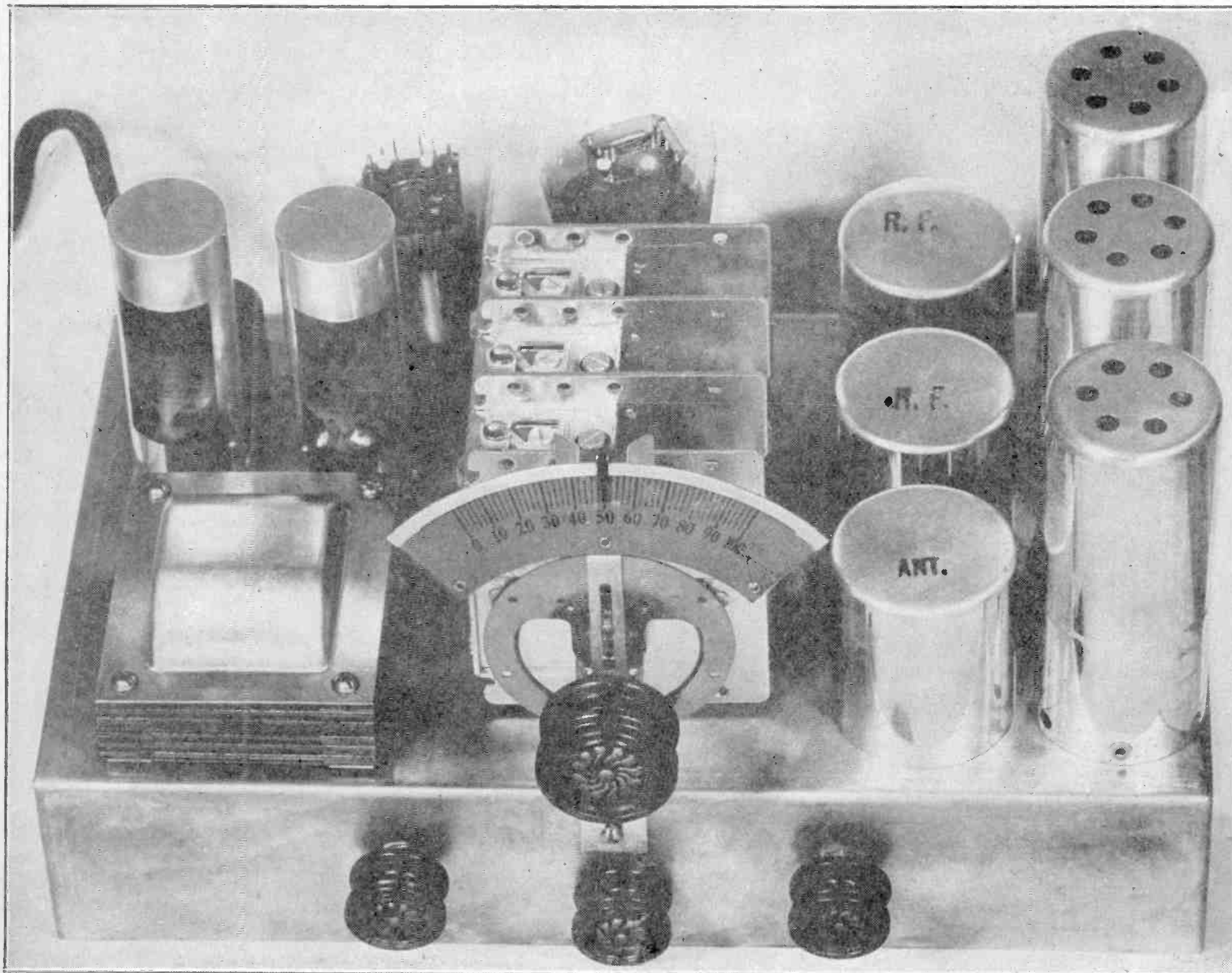

A fine arrangement of the top-chassis parts for the 627 Star Circuit. See page 5.

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RADIO WORLD

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ELEVENTH YEAR

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An 8-Tube D-C Super

Stage of T-R-F and 400 kc Intermediate

By Conrad Nissing

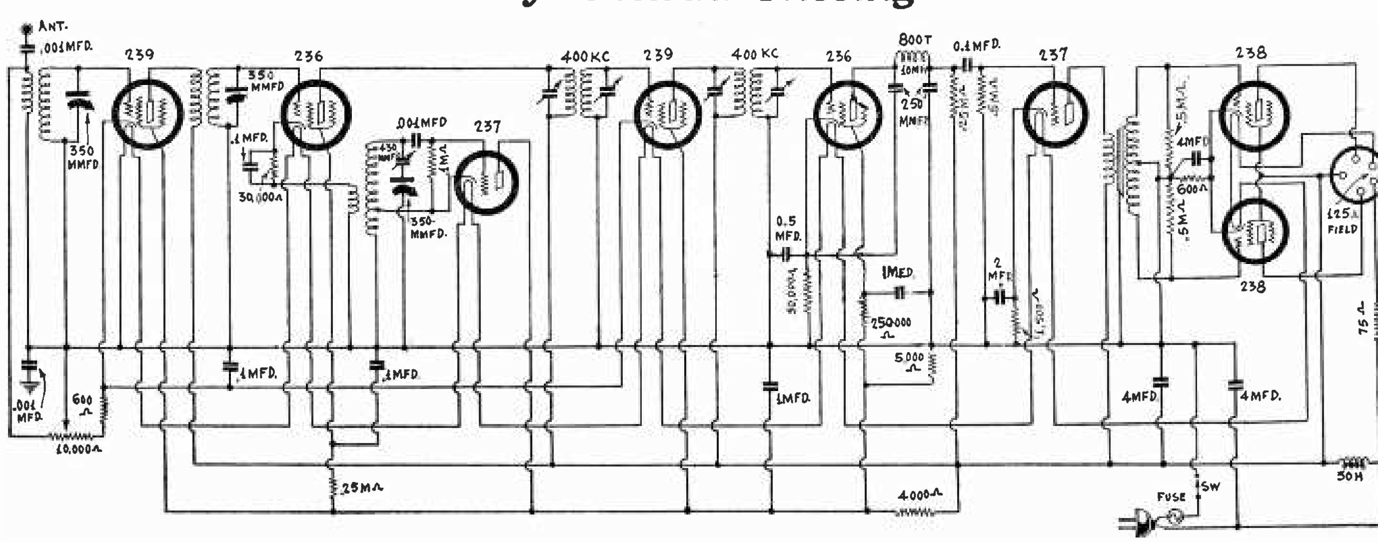


FIG. 1
The diagram of an eight-tube superheterodyne designed for operation on a 110 volt d-c line. Automobile tubes are used with heaters in series.

APPARENTLY radio has developed to the point where it knows no seasons, in so far as the type of receivers demanded is concerned, or even as to the number demanded. Receivers operated on d-c are in demand. These cannot be used as portable or as automobile sets, so they must be used by the stay-at-homes. Moreover, they must be used by city folks, for in the country, or in the small towns, there is no d-c electric service. Wherever they are used there is a constant demand for them.

The superheterodyne is well adapted for use on d-c lines, and the most practical tubes are those of the automobile series. The best combination of tubes of this series in an eight-tube superheterodyne are 239s for r-f and i-f amplifiers, 236s for detectors, 237s for the

(*Continued on next page*)

LIST OF PARTS

Coils

- Two r-f shielded midget type transformers, for 350 mmfd. tuning condensers
- One oscillator coil as described, also shielded
- Two 400 kc i-f transformers
- One 800 turns r-f choke coil, about 10 millihenries
- One push-pull input transformer
- One 30 henry choke coil

Condensers

- One three gang tuning condenser, each section 350 mmfd.
- One 350-450 mmfd. padding condenser
- Three 0.001 mfd. fixed condensers
- Three 0.1 mfd. condensers, all in one case
- One single 0.1 mfd. condenser
- Three 4 mfd. by-pass condensers
- Two 1 mfd. by-pass condensers
- One 2 mfd. by-pass condensers
- One 0.5 mfd. by-pass condenser
- Two 250 mmfd. condensers

Resistors

- Two 600 ohm bias resistors
- Two 30,000 ohm resistors
- One 100,000 ohm leak
- Three 250,000 ohm resistors
- One 1,500 ohm resistor
- Three 0.5 megohm resistors
- One 4,000 ohm resistor
- One 5,000 ohm resistor
- One 10,000 ohm potentiometer with line switch attached
- One 75 ohm 10 watt resistor

Other Requirements

- One antenna binding post
- One one ampere fuse
- Nine UY sockets
- One vernier dial
- Six grid clips
- One special 125 ohm, 0.3 ampere speaker with push-pull transformer
- One metal chassis

(*Continued from preceding page*)
oscillator and the audio frequency amplifier, and 238's in the push-pull output stage. In other words, there are two of each type of the automobile series.

The Type of Circuit

The type of circuit is that used in the automobile set which we have described under the number 631, but modified a little to meet the requirements of 110 volt d-c service. In the first place the heaters are connected in series. The first tube has its heater connected to the chassis. Then the series continues until we come to the loudspeaker socket. A 125 ohm speaker field is supposed to be used, one that has been especially designed for sets of this type. In addition to the resistance in the speaker field we need 75 ohms to take up the excess voltage. The eight tubes require a voltage of 50.4 volts and the speaker 37.5 volts. Thus if the line voltage is 110 we need a ballast of nearly 75 ohms. If the voltage is slightly higher allowance should be made for it by adding 3 1/3 ohms for each excess volt.

The oscillator used in the circuit is different from that used in the automobile set, being simpler. It is of the Hartley type and employs only two windings, with a tap on the tuned. If the form diameter is one inch and No. 32 enameled wire is used for the oscillator coil the winding should contain 85 turns, with the tap at the 38th turn from the grounded end. The pick-up winding may consist of 10 turns of the same or finer wire, and it should be placed at the ground end of the tuned winding. No separation is needed unless the pick-up is wound over the tuned winding. In that case the thickness of the insulation should be about 1/32 inch.

Choice of Grid Leak

There is a 100,000 ohm grid leak in the oscillator circuit, and a 0.001 mfd. stopping condenser. It may happen that the oscillator will block at some settings of the dial, or at all settings. This blocking will be characterized by a very high pitch squeal which does not change as the tuning condenser is turned. If this occurs a lower value leak, say 50,000 ohms, will help, or a 2,000 to 10,000 ohm resistor connected in series with the stopping condenser. If it is necessary to use less than 50,000 ohms to stop the blocking it is better to use the series resistance rather than to use a lower leak.

A comparatively low resistance leak is also used in the audio amplifier because this helps to minimize line noises. Again, in the push-pull output stage there are two half megohm grid leaks connected across the halves of the input transformer. These are particularly effective in removing high audio frequency line noises which infest d-c operated receivers. These resistances are not low enough to reduce appreciably the amplification.

Bias Resistances

Grid bias is used throughout the set except in the oscillator. The two 239 tubes are biased with a common 600 ohm bias resistance and with a portion of the volume control potentiometer. The two detectors are biased by the two 30,000 ohm resistances. The first of these is shunted by a 0.1 mfd. condenser and the second by a 0.5 mfd. A resistance of 1,500 ohms is needed for the 237 audio tube and this is shunted by a 2 mfd. condenser. In the push-pull stage a 600 ohm resistor is used for the two 238 pentodes to give them a bias of 13.5 volts. Contrary to usual practice, a large condenser of 4 mfd. is connected across this resistor. This condenser is well worth while.

The plate and screen voltages are provided for by the resistors in the voltage divider and the connection to the d-c line.

Since the values of the various components are specified there is no need of discussing them. The one thing that causes trouble in a superheterodyne is the padding of the oscillator. Hence we shall discuss that in detail. Incidentally, no good reception can be obtained unless the padding has been done right. There may be reception at the short wave end, but then nothing may come in at the other end, or there may be good reception at the high wave end, when there will be no reception at the other.

Padding Procedure

First tune the intermediate frequency transformers to 400 kc. The best way is to use a 400 kc oscillator for supplying the signal. However, it can be done without that although this will not yield a 400 kc frequency but perhaps 410, or 390, or some other frequency that will make the set work almost as well as the 400 kc. Unless the actual frequency is far off 400 kc there will be little difference in the results because we can adjust at both ends of the dial anyway. If the frequency is off slightly from 400 kc there will be a little greater deviation in the middle of the tuning band, but not serious. Still it is better to use a 400 kc oscillator than to make a close guess to 400 kc.

When tuning the intermediate with a calibrated oscillator the signal is put into the grid of the first detector and the i-f tuners adjusted for maximum signal. If the guessing process is used the set is tuned in to a broadcast station, preferably a short wave one, and then the intermediate tuners adjusted until this comes in loudest. The signal is put in at the regular antenna post.

Adjusting the Oscillator

The real padding adjustment begins after we have adjusted the intermediate frequency tuners. We shall assume that we have available a signal of 1,500 kc. Using the set as a superheterodyne, tune all the trimmers, three of them, until this signal comes in loudest, the main dial being set at about 5. If the available signal is lower than 1,500 kc, say 1,450 kc, set the main condenser at about 6 and then adjust the three trimmers.

When the trimmers have been adjusted at a short wave station do not touch them again unless a retrimming should become necessary. The series condenser, marked 430 mmfd. in the drawing, should be adjusted at the high wave end of the dial. And only this should be adjusted there.

First move the grid clip on the first detector to the grid cap of the second detector. Turn the main oscillator until a high wave station comes in loudest. A suitable station is 570 kc. Leave the dial where this station came in. Return the grid clips where they belong, that is, restore the circuit to a superheterodyne. Then without disturbing anything else, adjust the series padding condenser until the same station, 570 kc in our assumed case, comes in loudest. The circuit is then adjusted at both ends of the dial. However, it may be necessary now to retrim at the high frequency. Set the main dial where it was originally and adjust the trimmer on the oscillator only. This is the only one that needs changing, provided the adjustment was done carefully in the first place. And the oscillator trimmer should not need more than a fraction of a turn of the adjusting screw.

Indications of Padding Defects

If the padding had not been done accurately the set will not be uniformly sensitive. If it has only been adjusted at the high frequency end it will only be sensitive at that end. If it has only been adjusted at the low frequency end it will be sensitive at that end only.

Suppose the circuit is insensitive at the low frequency end. If it is not completely dead signals can be heard in the insensitive area. It may be that a station comes in at 90 when it should come in at 75. What is the most likely trouble? If it comes in at 90 more capacity is needed to bring it in than should be needed, that is, a larger proportion of the variable oscillator capacity. We may assume that the inductance is correct and also that the trimmer capacity is all right. Then there remains only one thing that might cause the trouble, the series padding condenser. Since more of the variable capacity is needed, the series condenser is evidently too small. The adjusting screw should be turned to the right. If the tuning trouble is in the opposite direction we arrive at the opposite conclusion. For example, a station that should come in at 90 may come in at 75. Then we have to open up the series condenser to make its capacity less.

A Queer Example

These conclusions are based on the fact that the oscillator determines primarily where a station comes in on the dial, and the r-f tuner determines how loud it comes in. The best adjustment is such that the r-f is tuned to the r-f signal when the oscillator is tuned to a frequency 400 kc higher than this. This relation should obtain throughout the range of the tuner, and it will if the padding adjustment has been done properly.

Two 8 tube receivers of a similar type to the one described here were made and compared side by side. One set was sensitive at the high frequency end and insensitive at the low frequency end. The other set was sensitive at the low frequency end and dead at the high frequency end. When the two sets were connected to the same batteries and the same antenna, the set that was dead part of the range came to life and was sensitive and selective throughout. The other set remained as it was before.

The Solution

What is the solution to this queer situation? Apparently one of the sets, that was very weak at the low frequencies and strong at the high, was not trimmed properly. It was all right at the high frequencies but the series condenser had not been adjusted right. The other set apparently would not oscillate by itself over part of the dial but was otherwise well trimmed and padded. When the two sets were together the oscillator in one made the well padded circuit work as it should.

The remedy in one case was to adjust the padding condenser. The remedy in the other case was to get the oscillator going at all settings of the variable condenser. The cause of non-oscillation was a resistor in series with the stopping condenser. A lower value, or no resistance at all, stopped it.

Earl Receivers Ordered to Drop Executive Suits

Newark, N. J.

An order was signed by Vice-Chancellor Backes directing the receivers of the Earl Radio Corporation to discontinue the suits brought against officers and directors of the company, and others, for the recovery of losses said to have been due to improper management. It was deemed that there was no likelihood of a recovery under the suit, and besides waging the suit would be expensive, whereas there is necessity for conserving the assets of the bankrupt corporation.

It is expected that a dividend will be issued to creditors. Payment will be made to creditors, some of whom have waited more than two years without receiving a cent. Another question to be decided is whether to withdraw from the suit against RCA and others for money damages due to alleged stifling of competition.

The 627's Performance

Teamwork of Parts Produces the Results

By Louis Moses
Try-Mo Radio Fair

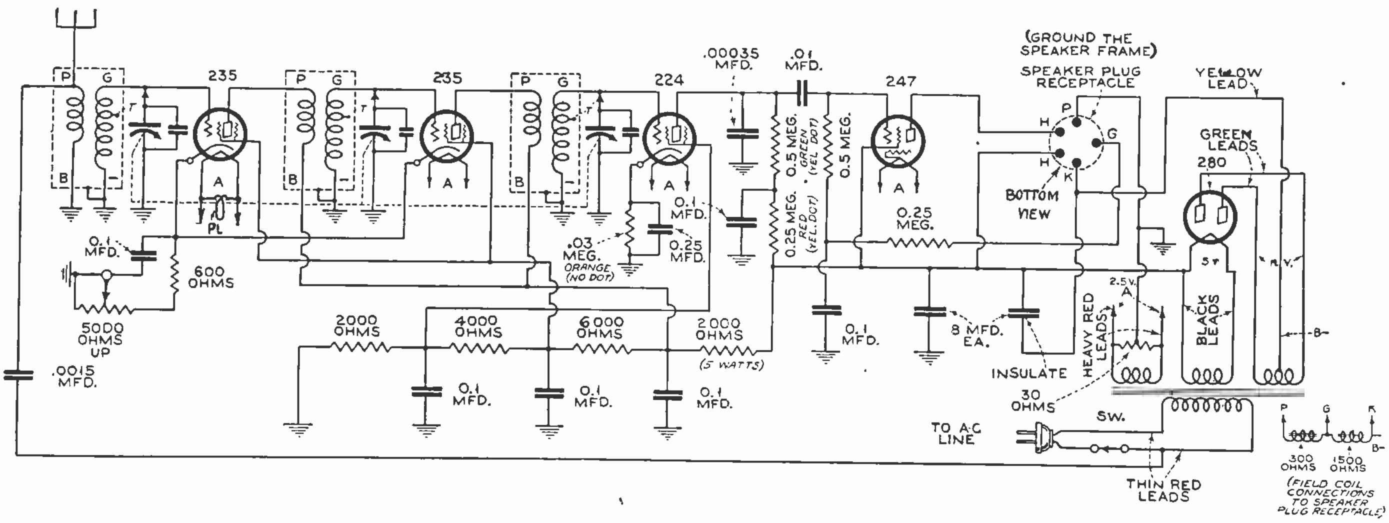


FIG. 1

Circuit diagram of the 627 Star Circuit. The series condenser connecting to the a-c line is for emergency use only, in case no outdoor aerial is available, but otherwise should be omitted.

IT often takes several months before a receiver reaches that stage of design where it may be appraised as completely satisfactory by discriminating technicians. Those months were devoted to the design of the 627 Star Circuit, the schematic diagram of which is printed herewith as Fig. 1. The circuit covers the broadcast band, and also has a switch for picking up only a small part of the secondary of the tapped coils, so that tuning from 80 to 200 meters may be enjoyed also, by throwing the coil switch. Then amateur, police calls, some relay broadcasting, television and other transmissions may be brought in.

Economy was practised in the design of the circuit, and to that end the field coil of the dynamic speaker was used for the B supply choke and also for biasing the pentode tube. If the total choke is put between B minus and ground there will be a voltage drop of about 110 volts, and with the total of 1,800 ohms in the field winding, the part between a tap and ground will give the correct bias for the pentode if the resistance is 300 ohms. Thus the choke coil or speaker field is 1,800 ohms, tapped at 300 ohms.

Speaker Connections

The most convenient way to use this system is to provide an extra socket so that a UY plug connected to the five speaker terminals may be plugged in. What prongs of the speaker receptacle socket to use for the various points can be seen from the diagram (upper right). If you have no code for the speaker you can determine the extremes of the field coil and also the 300-ohm section, or tap, with a resistance meter. The remaining terminals are those of the primary of the output transformer, normally having a resistance of about 700 ohms, but identifiable by the process of elimination as previously suggested. Reverse the connections to the output transformer, retaining that connection which renders less hum.

The filtration afforded by the field coil and two 8 mfd. condensers is adequate, and the low hum level has been the subject of comment. One of the 8 mfd. must be insulated—the one nearer B minus—but that is designated on the diagram. Remember that the cans of the condensers go to negative, in one instance to B minus, in the other to ground.

Secret Lies in Coils

However excellent the filtration may be, it is still imperative to have a sensitive and selective tuner. The audio is virtually standard—one stage of resistance coupling, with a pentode grid circuit resistor-capacity filter for hum killing.

The sensitivity is a function of the coils, really, after one assumes a good tuning condenser, a first-class shield and correct voltages and by-passing. The use of aluminum for the shields is recommended, or copper may be used if that is obtainable, which it usually is not.

So we shall investigate the coils. They are wound on 1 inch diameter tubing, with secondaries consisting of 127 turns of No. 32 enamel wire, tapped at the 30th turn from the ground end. This end is usually near the bottom of the coil, so considering the winding from the top, put on 97 turns, tap, and put on 30 turns more. The primary is wound over the secondary, near the bottom, with insulating fabric between, two or three layers preferably, and consists of 30 turns of any fine wire, if insulated, although for the antenna winding 15 turns primary may be used instead, as is true in some commercial coils. Other coils, as on ¾ inch diameter, are just as satisfactory, but have more turns, naturally.

A Screen Resistor Suggested

A fairly high screen voltage is used, but it cannot be determined accurately except by use of an electrostatic voltmeter, which few readers will have, or by a very sensitive voltmeter, say with a resistance of 10,000 ohms per volt. So, with the resistors used as specified, just accept the distribution of voltages as correct, if there are around 300 volts d-c across the final filter condenser.

One stunt that has been tried by some with approval on their part is to put a resistor of 0.5 meg. from detector screen to the joint of the two lower resistors at left horizontal, instead of bringing the screen direct to this point, as shown. The 0.1 mfd. condenser connection then, instead of being at the joint, as shown, would be moved, one side to the detector screen, other side remaining at ground. This reduces hum.

Readers who have built this circuit should try this change, as it means simply the inclusion of another resistor, and results may warrant it. The hum is reported still lower.

Widely Copied

The parts used are selected so that they provide teamwork, and the whole circuit is so simple to build and gives such excellent results that large quantities of congratulatory letters are still being received by the designer who, by the way, did all his work in Radio World's laboratories, and when the product was finished demonstrated it to the great glee of a group of engineers ordinarily quite casual about their reactions to demonstrations.

The circuit has been copied virtually all over the world, manufacturers and others seizing upon it the moment it was learned that this was an outstanding receiver. Particularly the fact that some short waves could be received won their eye, and on test it was found that sensitivity stood up on the short waves, compared to indifferent results obtained by some other switching schemes in different models they had tried.

The circuit has been reduced to blueprint form to facilitate the building of this remarkable tuned radio frequency receiver.

A 5-Tube Autodyne Superhetero
Selectivity High,
By Jack

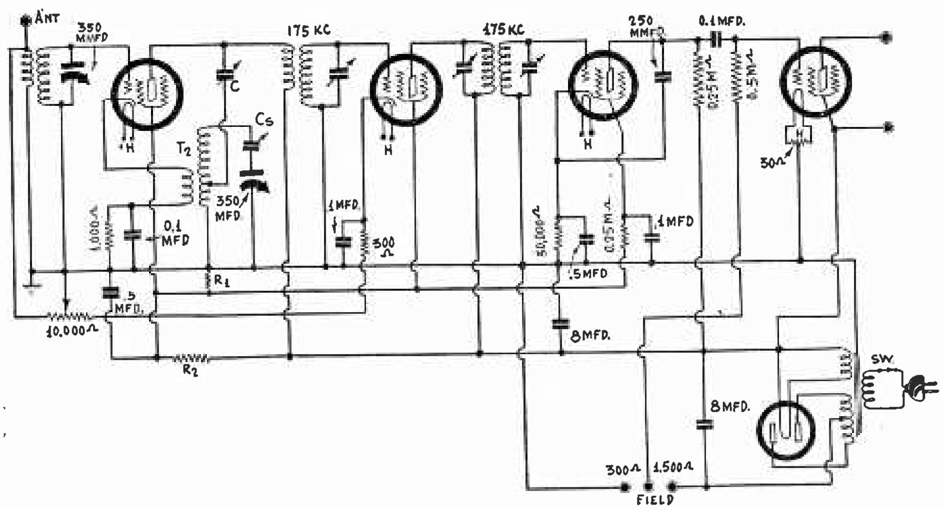


FIG. 1
The circuit of a five-tube midget superheterodyne in which the oscillator and modulator functions are combined in one tube.

LIST OF PARTS

Coils
- T1—One r-f transformer for 350 mmfd. tuning condenser, midget type.
- T2, T3—One special coil containing r-f oscillator windings and one 175 kc i-f transformer.
- T4—One 175 kc i-f transformer.
- T5—One midget power transformer.

Condensers
- One gang of two 350 mmfd. tuning condensers.
- One 700-1,000 mmfd. padding condenser.
- One unit of three 0.1 mfd. by-pass condensers.
- One 0.1 mfd. condenser.
- Two 0.5 mfd. by-pass condensers.
- One 250 mmfd. by-pass condenser.
- Two 8 mfd. electrolytic condensers.

Resistors
- One 1,000 ohm bias resistor, or higher value.
- One 300 ohm bias resistor.
- One 30,000 ohm bias resistor.
- One 0.5 megohm resistor.
- One 10,000 ohm resistor.
- One 12,000 ohm resistor.
- One 10,000 ohm potentiometer with line switch (Sw).
- One 30 ohm center-tapped resistor.

Other Requirements
- Three grid clips.
- Two binding posts.
- Five UY sockets (one for speaker.)
- One UX socket.
- One five tube midget chassis.
- One close adjustment dial.
- One special midget type loudspeaker with tapped field coil.

MIDGET SETS are getting more midgety all the time. When the seven-tube superheterodyne midget came out it seemed to be about the limit, but now receiver designers have dropped two of the tubes and made a five-tube midget superheterodyne. How have they done it? First, they have combined the oscillator and the first detector and, second, they have dropped the first radio frequency amplifier tube.

And how do these midgety sets perform? Surprisingly well! One particular model made a very favorable showing against a seven-tube set when placed side by side. Indeed, so well did the five-tube set perform that one listener asked: "Why should we use seven tubes when five tubes will give better results both in selectivity and sensitivity?"

The Five Tube Circuit

The performance was really a surprise. But whether it worked better than the seven-tube set in respect to selectivity and sensitivity it is difficult to say. The fact that it was difficult to say by listening to the performances of the two sets speaks well for the five-tube set.

The circuit of the five-tube set is shown in Fig. 1. It will be noted that there is only one radio frequency tuned circuit, and only a two-section tuning condenser is used. The key to the set lies in the combined oscillator and first detector. It will be noticed that the first tuned circuit is coupled to the grid of the tube in the usual way. The screen circuit is also connected in exactly the same way as if the tube were used only as a detector. The oscillation is obtained by putting a tuned circuit in the plate of the tube and by connecting a grid winding in the cathode circuit of the tube.

In connecting this oscillator coil the secondary terminal which goes toward ground is that which normally goes to the grid in an ordinary oscillator and the terminal that is connected to the cathode is that which ordinarily would go to ground. The grounded terminal of the tuned winding is that which would ordinarily go to the plate. These statements have nothing to do with the position of the tuning condenser or the size of the two windings but only to the arrangement of the terminals so as to make the circuit oscillate.

Oscillator Coil

The feedback is through condenser C, which is also the tuning condenser for the primary of the first i-f transformer. This condenser is not connected to the top of the tuned winding but rather to a tap lower down. There are three objects of using the tap. First, it makes the oscillation less intense and therefore prevents overloading of the oscillator tube. Second, it removes the greater part of the plate capacity from the tuned circuit and thus makes it possible to reach the necessary high frequency. Third, it removes most of the inductance of the oscillator coil from the circuit of the i-f coil.

The oscillator coil is now available for

Ultra-Wave

THE RECEPTION of ultra-short waves presents a great problem when there must be considerable amplification at the receiving end, because of inability of oscillators to remain on one frequency and also because of the ineffectiveness of amplifier tubes at such high frequencies. Theoretically, the superheterodyne offers the greatest possibility of a high amplification, but this is entirely dependent on the stability of the two oscillators, that at the transmitter and that at the receiver. If either varies in frequency by a small percentage, the difference frequency varies by a very large percentage, especially if the intermediate frequency is small compared with the signal frequency, and if the difference frequency varies by a small amount the circuit is entirely detuned and no signals are received. If the frequency change is very slow it may be possible to follow the signal by continually tuning the local oscillator, but if it is rapid, which it may be, it is not possible to follow the signal at all. The crystal oscillator at the transmitter holding the transmission frequency accurately removes one of the troubles but the trouble from the local oscillator remains. For any one frequency a crystal oscillator could also be used at the receiver and the intermediate amplifier tuned to the difference between the two frequencies. This difference can be made any convenient value. But most receivers must be adjustable to different frequencies and therefore the use of a crystal oscillator at the receiver is not practical.

Magnitude of Variation

Let us see what the possible detuning may amount to in a typical case. Suppose that the transmitter is operating on 5 meters with a crystal oscillator that is held to an accuracy of one part in a million. Since 5 meters represents a frequency of 60,000 kc the frequency varia-

dyne, A-C; Images Low, Results Surprising

Goldstein

an intermediate frequency of 175 kc. This coil has been designed very carefully for use with a 224 tube and 350 mmfd. tuning condenser. Incidentally, the oscillator coil and the first i-f transformer come in one case and partly wired so that it is only necessary to have seven leads available, one for the plate, one for B plus, one for the "hot" side of the tuning condenser, one for ground, two for the winding that goes in the cathode circuit, and one for the grid of the succeeding tube.

After the special oscillator-detector the circuit does not differ in any respect from the usual seven-tube superheterodyne. It consists of one stage of intermediate amplification, a grid biased detector, and a pentode power tube. The fifth tube in the circuit is the rectifier, which also is like the rectifier in the customary seven-tube super.

Controlling the Volume

The volume is also controlled in the same manner as it is done in the other set. That is, it is done by a combination of input voltage and amplification control. However, since we have only one high frequency amplifier before the final detector, the intermediate, we have to control the amplification in this stage. Therefore the cathode of this tube returns to the 10,000 ohm potentiometer after the lead has gone through a 300 ohm bias resistor. The other side of the potentiometer goes to the antenna in the usual way and the slider goes to ground.

Most of the values necessary are specified on the diagram, but some of them are not. Transformer T1 is a regular antenna coupler wound for a 350 mmfd. tuning condenser. T2 is the special oscillator coil referred to, and C is the variable condenser tuning the primary of the 175 kc transformer, which is built into the dual transformer. Cs is the series padding condenser in the oscillator, which for 175 kc i-f and 350 mmfd. tuning condenser should have a range between 700 and 1,000 mmfd. The correct value is approximately 800 mmfd.

The Voltage Divider

The other values not specified are the resistances in the voltage divider. In order to get high gain it is advisable to make the screen voltage high, say 100 volts. This should be the drop in R1. If we select a resistance of 10,000 ohms we have a bleeder current of 10 milliamperes. The voltage across the entire voltage divider is about 260 volts so the drop in R2 should be 170 volts. This will be obtained with a resistance of about 12,000 ohms. Hence that should be the value of R2.

The bias resistance for the oscillator-detector tube specified is 1,000 ohms, but values as high as 10,000 ohms may be used. If the resistance is too high, however, the tube will not oscillate. The value to use is the highest that will not stop oscillation, provided it does not exceed 30,000 ohms.

The power transformer is a regular midget set type. It contains one 5 volt winding for the 280 rectifier, one 2.5 volt winding for the heaters of the amplifier and detector tubes, and one high voltage, center-tapped winding for the plates of the rectifier. This winding should be such that it maintains a voltage of about 370 volts across the filter. One hundred volts are dropped in the loudspeaker field. The transformer is standard for midget sets.

Midget receivers of this type are mounted on very small chassis and in corresponding small cabinets. One feature of a construction which reduces the size is the mounting of the electrolytic filter condensers directly on the loudspeaker. They occupy a space that would be empty if not used for this purpose. Thus the room on the chassis that is ordinarily taken up by the filter condensers can be used for mounting other parts and the entire assembly can be reduced in size. The field coil is used for filter choke and its total resistance should be 1,800 ohms with a tap at 300 ohms. If the proper speaker is obtained the condensers will be attached and the two 8 mfd. electrolytics in the list of parts will not be needed.

Solutions

tion may amount to 60 cycles per second. This is not a great deviation and we can neglect it. But the local oscillator cannot be crystal operated and about the best stability that we can assume for a vacuum tube oscillator of the usual type is one part in a 1,000. If we assume an intermediate frequency of 600 kc we should set the local oscillator to 60,600 kc to get the 60,000 kc signal. But the local oscillator may change by one part in a 1,000. Hence it may change to 60,539.4 kc. The difference frequency will then become 539.4 kc and the ratio of the difference frequency to the intermediate frequency will become 539.4/600, or 0.9. This is a considerable detuning. It is the same as if we set a radio frequency tuner at 539.4 kc and expected to get 600 kc.

If the intermediate tuner has a selectivity comparable to the selectivity of a fairly good broadcast set the signal will be entirely tuned out. As the local oscillator swings back and forth the difference frequency may swing between 539.4 and 660.6 kc. At times the signal will come through but most of the time it will be suppressed.

A New Suggestion

A new suggestion has come from Germany along this line which in theory seems to offer a good solution but which in practice is subject to many difficulties. The suggestion is that the transmitter send out two waves differing by a suitable amount which would be the intermediate frequency. One of these waves would be modulated by the signal to be transmitted and the other would be unmodulated.

These two waves could be controlled by two different crystals, or even by the same crystal, and could be held to a high degree of accuracy. In fact, they could be held without great trouble to a constant difference even if the two frequencies varied. If the difference were held constant there would be no variation of the intermediate frequency at the receiver and all should be well. But reception obtained on this scheme would demand that both frequencies were received at the receiving point in phase and in nearly equal magnitude. If the phase varied that would be equivalent to a variation in the difference frequency and we would not have gained anything. A variation in phase might result from selective fading. The same phenomenon might also cause one to fade out entirely when it would not be possible to receive. The defense against change of phase and fading is that at the short waves where the system would be used these difficulties are relatively unimportant, for the two waves would be received on the earth wave only.

Another Objection

Another difficulty is that both components would be weak at the receiver and we would not get the benefit of the gain obtained by supplying a strong local oscillation. The intensity of the beat signal between two different frequencies is proportional to the product of the intensities of the two, in a square law detector, which would be used in this case. Since both components are weak the product of the two would be still weaker. We would need a great deal of amplification in the receiver to compensate for the loss. This may possibly make circuit noises so great that no clear reception could be obtained.

Suppose the unmodulated wave were received and made to control the frequency of the local oscillator by the zero beat method, the local oscillation could be built up before applying it to the local detector. If the beat is held at zero automatically, the difficulty would be overcome. It is well known that a feeble impulse will control the oscillation of an oscillator over a certain band. Thus if the local oscillator tried to go off the proper frequency, the weak impulse from the transmitter would pull it back. The range of control is not wide but it is possible that the local oscillator can be made stable enough, and sensitive enough to control, that the beat would remain zero for long periods.

Using Stable Oscillators

By taking special precautions it is possible to make a vacuum tube oscillator that is stable to one part in 10,000, or even better. If an oscillator of this type is used the possible frequency fluctuation will be reduced to one-tenth of its former value. Instead of having a possible detuning of 60.6 kc we would have a detuning of only 6.06 kc. This would not detune the circuit entirely even if it were very selective. In an ordinary tuner the diminution in the signal would hardly be noticeable, at least not unless the frequency fluctuated so rapidly that the beat frequency would fall in the audible range. This is most unlikely.

A 7-TUBE SHORT-WAVE SUPE BEAT WI

By Einar

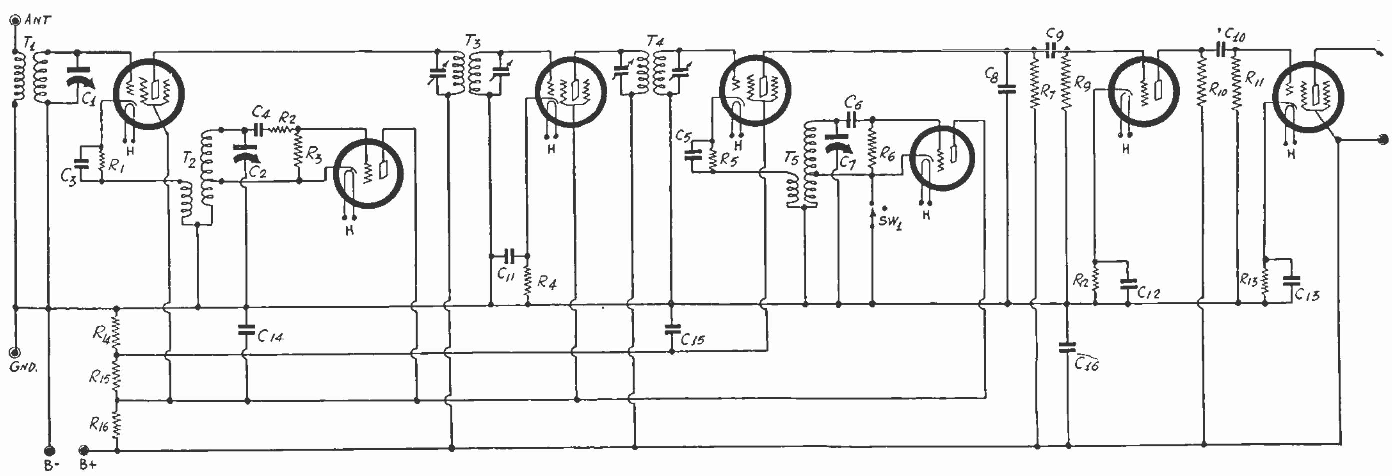


FIG. 1

A seven tube short wave receiver of the superheterodyne type that may be adapted to either d-c or battery operation. Plug-in coils are used to change wave band.

A SHORT-WAVE receiver which has been designed for reception of modulated waves only will receive a very small fraction of the total short-wave stations operating within the range of that receiver because there are many more stations operating on interrupted continuous waves. Of course, those who do not read code do not care whether their sets can bring it in or not, but there are many who do and find a great deal of pleasure in listening in. It does not require much of a change in a receiver to make it bring in code as well as modulated signals, only the addition of an oscillator. We shall describe a short-wave set that will bring in either code or modulated waves, and the circuit will be of the superheterodyne type.

While it is possible to build a good receiver of this type with switches for changing from one wave band to another, better results can usually be obtained with plug-in coils. Hence we shall use this type of coils in the set.

Type of Tubes

It is desirable to use steady voltages for operating a short-wave set, especially one of the regenerating or oscillating type, in order to minimize hum. However, it is also desirable to use heater tubes because of the greater flexibility of these tubes in respect to circuit arrangements. Also the circuit should be economical to operate. For these reasons we decide to use automobile type tubes in the circuit.

The diagram of the receiver is given in Fig. 1. It consists of a first detector with tuned input, an oscillator, an intermediate frequency amplifier coupled to the detector with a doubly tuned i-f transformer, a second detector of the grid bias type and coupled to the i-f amplifier with another doubly tuned i-f transformer, an oscillator i-f frequency, and intermediate a-f amplifier, and finally a power amplifier of the 238 type.

The tubes in order are: 236, 237, 239, 236, 237, 237, and 238.

It is recommended that the two intermediate frequency transformers T3 and T4 be tuned to 465 kc. Transformers of this type, nominally rated at 450 kc, are available, which can easily be tuned to 465 kc. The plug-in coils T1 and T2 will be designed for this intermediate frequency.

LIST OF PARTS

Coils

T1—One set of plug-in short wave coils as described.
T2—One set of plug-in oscillator coils as described.
T3, T4—Two 465 kc intermediate frequency transformers, doubly tuned.
T5—One i-f oscillator coil as described.

Condensers

C1, C2—Two 140 mmfd. tuning condensers.
C3, C11, C14, C15—Four 0.1 mfd. by-pass condensers.
C4, C6—Two 0.001 mfd. condensers.
C5—One 0.25 mfd. condenser.
C7—One adjustable condenser about 100 mmfd.
C8—One 0.00025 mfd. condenser.
C9, C10—Two 0.006 or larger condensers.
C12, C13—Two 1 mfd. condensers.
C16—One 4 mfd. by-pass condenser.

Resistors

R1, R5—Two 30,000 ohm resistors.
R2—One 5,000 to 10,000 ohm resistor (sometimes not needed.)
R3, R6—Two 100,000 ohm grid leaks.
R4—One 5,000 ohm variable resistor for volume control.
R7, R10—Two 250,000 ohm plate resistors.
R9, R11—Two 500,000 ohm grid leaks.
R12—One 10,000 ohm bias resistor.
R13—One 1,200 ohm bias resistor.
R14—One 1,000 ohm resistor.
R15, R16—Two 2,000 ohm resistors.

Other Requirements

Sw1—One single pole, double throw switch.
Six binding posts.
Four grid clips.
Eight UY sockets.
One UX socket.
Two dials.
One B supply, an A supply, and a speaker.
One chassis.

Power Supply

All the heaters should be connected in parallel if the filament voltage source is a 6 volt storage battery. This is the best source of filament power for this set. However, it may be that some will prefer to use a 110 volt d-c line. To adapt the circuit to this the heaters should be connected in series and one terminal of one heater should be connected to the chassis. If the heaters are operated in this way a ballast resistance of 220 ohms and 25-watt rating should be connected in the series before connecting to the other side of the d-c line.

The plate voltage supply should preferably be a 135 volt dry cell battery, which may be connected between the B minus and B plus terminals. A switch should be

Tube Choice in

[Here are some more data on the all-wave set by Axel Peterson, supplementing last week's article.]

The rectifier is an 82, the new mercury vapor tube, which should be in a perforated shield. Also in this shield, which should be grounded, are two radio frequency chokes, of no less than 1 millihenry inductance. The 300-turn commercial values having an inductance of about 1.3 millihenries and are suitable, provided the type that will stand the current.

The 20-ohm potentiometers are for hum adjustment, while the 16 mfd. in the B filter and the B choke (150 ohms d-c resistance, 30 henries) keep the hum level low at the rectifier filter output, and besides two 8 mfd. condensers are used at points where they reduce feedback, which includes hum, while the third, across the biasing section for the driver (750 ohms) has a hum increase effect, but only because it favors low-note response, and hum is in this region. Quality is served by a

RHETERODYNE; TH CARRIER AIDS IN TUNING

Andrews

provided to open the B supply circuit for otherwise current will flow through the bleeder resistance when the set is not in use. In case the circuit is operated on a 110 volt d-c line a 30 henry choke coil should be inserted between the positive side of the line and B plus and a 4 mfd. condenser should be connected from each side of the choke to ground.

The Oscillators

The two oscillators in the circuit are identical in so far as the connections are concerned. They differ only in the values of the coils and the condensers, except that in one a resistance R2 is used. This condenser may or may not be necessary. Condensers C4 and C6 should be 0.001 mfd. each and the grid leaks R3 and R6 100,000 ohms each. C2 should be a condenser of 140 mmfd. maximum capacity and C7 should be an adjustable condenser of the same type as those used for tuning the intermediate transformers T3 and T4.

Transformers T5 in the second oscillator should be one of the type as T3 and T4. The windings should be connected in series aiding and the juncture of the two should be connected to the cathode of the tube. The series aiding connection can be determined by inspection because it is that which makes the two in the same direction. The inductance of the two coils will add, and a small amount of inductance will be added due to the mutual inductance between them. Hence if T5 is to be tuned to about the same frequency as either of the windings in the i-f transformers, C7 should be set at slightly less than half the capacity of that used in each of the i-f windings. If the tuning condenser cannot be set at so low a value it is necessary to use a smaller condenser or else to remove some turns from the two coils connected in series.

R-F Oscillator Coils

The small pick-up winding on the form of T5 can be placed between the other

All-Wave Set

large capacity to reduce the impedance here. As for the tubes, two have been discussed in general. The oscillator is a 56, because it is a good oscillator and is recommended for this use. The modulator or first detector is a 58 because cross-talk and cross-modulation are reduced, and regeneration and volume can be partly controlled by the screen voltage adjustment. This amounts to about the same thing as bias adjustment for volume control, more usually recommended. However, an extra volume control, one that will really control volume over a wide range, rather than merely control regeneration, is necessary, and is found in the 50,000-ohm potentiometer.

The 58 is used for the two intermediate frequency amplifiers, the 56 for second detector or demodulator, and the diode (made up of a 56), as automatic volume control. The 46 as driver and again two 46's as Class B output tubes have been discussed.

two coils. It need only be about 25 turns.

The r-f oscillator coils should be wound on forms fitting UY, or five-contact, sockets. Each should consist of two windings, one with a tap near the center. The table given below gives the number of turns on each winding, the size of wire, on the location of the tap on the assumptions that the tuning condenser has a capacity of 150 mmfd. including the stray capacity, and a minimum capacity of 30 mmfd., and wound on a diameter of 1.25 inches. The coverage is from 1,500 kc up to about 25,000 kc.

The r-f transformer T1 should be wound on form fitted with UX bases so that they cannot be inserted in the socket for the oscillator. No harm would result if an interchange were made but it is just as well to have a distinctive means of identifying the coils. The diameter of the forms should be 1.25 inches, the same size as the oscillator. The tuning condenser C1 for the r-f coils should have the same maximum capacity as the oscillator coil, namely 150 mmfd. This means a condenser rated at 140 mmfd. In the table giving the oscillator winding data the data for the r-f coils are also given.

Winding Data

	R-F		Oscillator			
Coil	N1	N2	N3	N4	N5	Wire
A	12	54	5	37	17	No. 26 enam.
B	4	21	4	18.5	9	No. 22 enam.
C	2	8.5	2	7.5	4	No. 18 enam.
D	1	3.5	1	3.5	1.75	No. 14 enam.

Which Coils Are Which

In the table N1 is the primary of the r-f transformer, N2 is the secondary, N3 is the pick-up winding on the oscillator, N4 is the tuned winding of the oscillator, and N5 is that part of N4 which is between the tap and the ground connection.

Turns are given to the nearest half-turn, except in one case. Deviations made necessary by the terminal arrangement on the form are permissible. It is suggested that the terminals be connected as near as possible to conform with the pins. That is, the grid end of N2 should go to the grid pin, the ground end to F minus, the antenna end to the plate pin, and the ground end to F plus. On the oscillator the tap should go to the K pin, the grid end to the grid pin, and the ground end of N4 to the plate. This leaves the two heater pins for the pick-up winding.

Placing of Windings

The primary and the pick-up windings can be placed below the respective tuned windings. There need be no separation between them. However, for the smaller coils it is well to leave a space of from 1/4 to 1/2 inch, the larger distance between used for the smaller coils.

The heavier wire sizes will be too thick for the holes in the pins. Hence a special arrangement will have to be made to make the connections. The heaviest wire that can be put through should be used between the base pins and the heavier wire of the coils. It is also possible to enlarge the holes in the pins by drilling out.

The pick-up winding in any case can be wound with fine wire that is easy to handle. The tap can also be made of fine wire, which can be run so that it is not necessary to bring the heavy wire down to the pin at all. One way that has proved satisfactory is to drill a hole in the form where the tap is to be and then bring a loop of fine wire through the hole and over the heavy wire and then down to the pin. Both the heavy wire and the tap wire should be cleaned off in a spot and a little solder applied. This can be done so neatly that the main winding is not appreciably distorted.

Tuning Condensers

Separate tuning condensers should be used for best results, because it is not practical to pad the oscillator for all the tuning bands. If the tuning condensers were ganged it would be necessary to have a large trimmer on the r-f condenser, and this would be an extra control. It is just as well to have the controls on the main condensers. At least one of the dials, that on the oscillator condenser, should be of the vernier type.

The two intermediate frequency transformers should be tuned exactly to 465 kc, or to some frequency close to that value. This can be done without the aid of an oscillator because it does not matter whether the frequency has any particular value just so long as all the four circuits are tuned to the same frequency. If a signal is tuned in the i-f transformers can be tuned by ear for loudest volume.

The Second Oscillator

After the intermediate frequency transformers have been tuned the intermediate frequency oscillator should be adjusted to nearly the same frequency by adjusting C7. This can be done by the heterodyne method when either a modulated or a code signal is being received. First tune in the signal for loudest volume with the i-f oscillator stopped. Then start the oscillator and adjust until the heterodyne heard has a value of about 500 cycles, or any other frequency that can be heard well. This done, the circuit is ready for the reception of interrupted continuous waves. It is not necessary to adjust either the i-f transformers or the i-f oscillator further. In tuning in a code signal it is only necessary to tune the two tuning condensers until the heterodyne is loudest. There may be two settings of C2 which will bring in the code, but one of them should be slightly louder than the other—considerably louder if the i-f amplifier is sharply tuned.

Stopping I-F Oscillator

A switch Sw1 is provided for stopping and starting the intermediate frequency oscillator. When the switch is in the position indicated the tickler portion of the tuned coil is short-circuited and no oscillation can take place. When it is thrown to the right the tickler is effective and the circuit oscillates.

Detector-Amplifier Tube

Also Useful for Automatic Volume Control

By C. W. J. Ferris

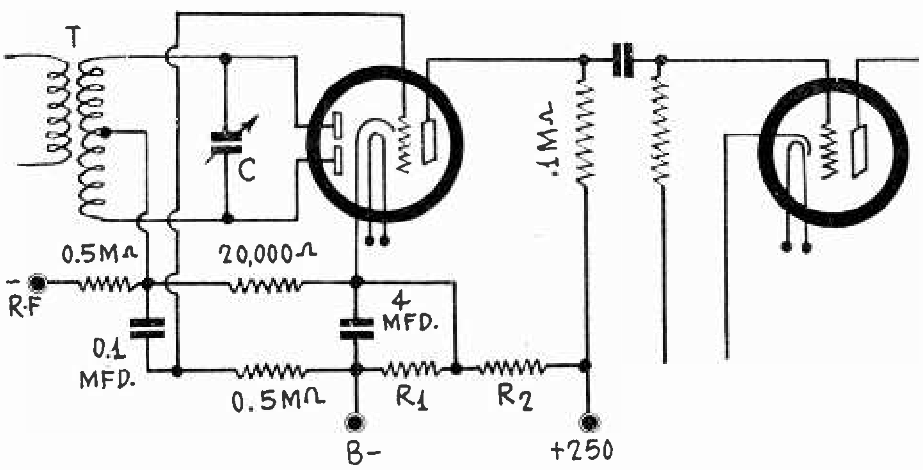


FIG. 1

This diagram shows a possible connection of the duplex diode and amplifier tube in a full-wave rectifier, resistance coupled amplifier and automatic volume control.

THERE is considerable talk these days about the debut of a new tube, one that combines amplification and diode detection. Nothing official is known about the tube and no confirmation of the report can be obtained from any of the tube manufacturers. If, indeed, there is substance behind the persistent reports, the announcement of the tube is being withheld for some reason, possibly for further development.

The tube, according to the reports, is of the heater type and requires a voltage of 2.5 volts and a current of one ampere, which is in line with the new series of tubes just announced. Further, the tube is supposed to have two plates, symmetrically placed with respect to the cathode. These two plates, together with the cathode, will permit the use of the tube as a diode detector in full-wave detection by dividing the input voltage symmetrically between the plates, in respect to the cathode, or as a half-wave diode detector by using either plate separately or the two connected in parallel. Another use of the tube is as an automatic volume control, in which case one of the plates may be used for half-wave detection and one for the automatic volume control. There are also many other combinations possible. Indeed, whether the plates are connected in parallel or are used in the full-wave connection automatic volume control is possible. These conclusions are based on the reported electrical and mechanical characteristics of the tube.

Use as Amplifier

The tube also contains a grid and a third plate, arranged as in the ordinary triode amplifier with respect to the cathode. Thus the tube can be used as a voltage amplifier simultaneously with detection. The cathode is arranged so that the two functions are entirely independent of each other, except for such external connections as may be made.

Thus in one small tube we shall have a detector, a voltage amplifier, and an automatic volume control, if and when the tube is issued.

The reported new tube has low internal resistance in the conductive direction so that a resistance of only 20,000 ohms will give virtually linear detection. Thus the detected signal will be relatively free from harmonic distortion and the signal as impressed on the grid of the tube will be of good quality. The plate-cathode of the amplifier part of the tube has a comparatively low resistance and requires a load resistance about 100,000 ohms in case resistance coupling is used between the special tube and the power tubes. With this there should be a voltage gain of about 8.

It is also possible to use transformer coupling between the triode part of the tube and the succeeding tube, the low plate resistance and the moderate amplification factor making this practicable. Thus if we have a transformer with a step-up ratio we can get a still greater gain out of the tube and the coupler.

Typical Circuit

In Fig. 1 we show a circuit which could be used with such a tube. This has been drawn on the basis of the reported characteristics of the tube. We show it merely to illustrate the principle. However, if and when the tube does come out, the circuit can be followed in assembling a detector-amplifier that will also work as an automatic volume control.

The radio frequency transformer T is a regular transformer with a center-tapped secondary. The tuning condenser C tunes the entire primary. If it is necessary to ground any part of this condenser a double condenser should be used with the common rotors tied together and grounded. If the transformer is for intermediate frequency coupling the condenser may be the regular tuning condenser in the transformer, grounding being unnecessary.

The center tap of the secondary is connected to the negative end of the 20,000-ohm load resistance and the two extreme terminals of the coil are connected to the diode plates. The positive end of the load resistance is of course connected to the cathode, for the cathode makes it positive.

As a signal voltage is impressed on the tuned circuit a rectified current flows around the circuit and sets up a voltage drop across the load resistance. This drop contains both carrier and modulation frequencies but the carrier frequency current is removed with the by-pass condensers. A stopping condenser of 0.1 mfd. is connected between the negative end of the load resistance and a 0.5 megohm grid leak and the grid of the tube. A voltage at the modulation frequency is thus transferred to the amplifier portion of the tube. The 20,000-ohm load resistance, the 0.1 mfd. condenser, and the 0.5 megohm resistor are the regular elements in a resistor coupler.

Grid Bias on Amplifier

The grid bias for the amplifier is obtained from a voltage drop in the voltage divider, that is, from the drop in R1. The value of this resistor, of course, depends on the current that flows in the divider. The resistor is by-passed with a 4 mfd. condenser to prevent degenerative feedback. The voltage drop in R1 should be about 20 volts, according to the reported characteristics of the tube. Self bias could also be used on the tube but that is not so good as the method illustrated.

In the plate circuit of the tube is a 100,000-ohm resistor and the usual stopping condenser and grid leak. A plate voltage of 250 volts is used in the plate circuit. This voltage is used on all the new tubes.

For automatic volume control the drop in the load resistance is used. The grids of the controlled tubes are returned to the negative end of the load resistance through a 0.5 megohm resistor. The 0.1 mfd. condenser serves in part to produce the time delay necessary to prevent the control bias from varying with the carrier, or with the modulation frequencies. If additional filtering is necessary it can be put in at the left of the terminal marked R-F, that is, near the controlled tubes. The object of the time delay is to make the potential at the R-F terminal vary with slow changes in signal level, or slow changes in the potential drop across the load resistor, and not at carrier or audio frequencies. The variation in the potential at the R-F terminal, of course, is with respect to B minus, or with respect to ground, if the two differ.

Terminal Arrangement

The tube requires a six-pin socket and a grid clip. On the base of the tube there would be two terminals for the heater, three for the plates, one for the cathode. The grid is brought out at the top.

The circuit in Fig. 1 is just one of the many possible arrangements of the various elements. From one point of view it is the best. The detection is full-wave and the circuit is balanced with respect to ground at the carrier frequency. Because of this balance there will be no carrier current component in the plate circuit of the tube and therefore the need for a by-pass condenser across the load resistance of the amplifier is obviated. However, if perfect balance is not brought about, the condenser is necessary. It is not difficult to balance the circuit at a fixed frequency, such as is used in a superheterodyne, but it is difficult in an r-f circuit where the frequency varies. Hence when the detector is used in an r-f detector the by-pass condenser should be used just as if the detector were of the ordinary type.

One disadvantage of full-wave detection is that the output is not quite so large as when a half-wave rectifier is used, due to the fact that the input voltage to the rectifier is divided in two. The balancing out of most of the carrier in the full-wave rectifier is a compensation for this disadvantage.

Transformers for the 46

Step-down Push-Pull Device Required

*[In a pamphlet, "Technical Discussion on the application of the Type 46 Tube" (Laboratory Series, No. UL-1, Second Issue), RCA Radiotron, Inc., and E. T. Cunningham, Inc., give the transformer requirements for the Class B power stage, particularly for the special push-pull input transformer. The pamphlet is reprinted by us substantially complete as to text, in two instalments. The first was printed last week, the second and final one follows.—*EDITOR.]

SUPPOSE the transformer efficiency q is 80% (peak power efficiency). The available peak grid power is $(0.80 \times 2.15) = 1.72$ watts. On curves we find for $E_B = 300$ volts and peak grid power of 1.72 watts the plate load of the class B tubes should be 1,110 ohms per tube. This means the load from plate to plate should be $(4 \times 1{,}110) = 4440.$ ohms. The power output curve (not reprinted herewith) shows the power output from the two tubes is 15.7 watts.

Resistance Equivalent

On the curve for peak a-c grid resistance we read 1,390 ohms. This is an instantaneous resistance value corresponding to the ratio of the maximum peak grid voltage to the maximum peak grid current. The equivalent resistances of the transformer losses should be added to the peak grid resistance to get the total load effective on the driver.

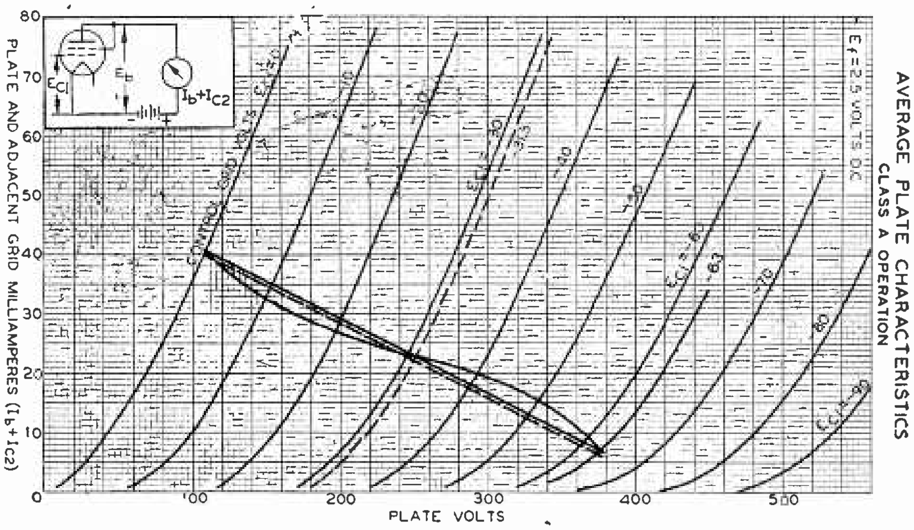
The resistance equivalent of the transformer losses is represented by a T-network having primary and secondary resistances as the series arms and the equivalent core loss resistance as the shunt arm.

Since the secondary load consists of the grid of one tube and alternates from one-half of the secondary winding to the other half on alternate half cycles, it is only necessary to consider the relations between primary and one-half of the secondary.

The secondary copper resistance (one-half) is represented by r_2. The core loss equivalent resistance in one-half of the secondary circuit is R'_o. The primary copper resistance equivalent in one-half of the secondary circuit is r_1'.

(The leakage reactance should be small enough to be negligible. The primary inductance should be as high as that for a transformer working into no load, as the grid resistance is high for small signals.)

The combined resistance of the transformer and the peak grid resistance of the tube should be reflected into the driver plate circuit as the peak plate load of the driver tube. The transformer turns ratio is the square root of the ratio of driver peak plate load resistance to the resistance equivalent of transformer losses and peak grid resistance.



Class A amplifier curves for the 46, showing plate current and plate voltage.

Mathematical Presentation

For the example here the assumed transformer efficiency q equals 80 per cent. Considering the transformer losses distributed, so that (1) copper losses equal core losses, and (2) primary copper loss equals secondary copper loss, the power losses will be 10 per cent. in the core, 5 per cent. in the primary winding, and 5 per cent. in the secondary winding.

The secondary winding resistance should be

$$r_2 = R_g\left(\frac{1-q}{4q}\right) = 1390 \times .0625 = 87.9 \text{ ohms (one side}$$

The equivalent core loss resistance reflected in the secondary circuit should be

$$R_o' = R_g\left[\frac{(3q+1)^2}{8q\ (1-q)}\right] = 1390 \times 9.05 = 12{,}500 \text{ ohms}$$

The primary resistance reflected in the secondary circuit should be

$$r_1' = R_g\left[\left(\frac{1-q}{4q}\right)\left(\frac{3q+1}{3+q}\right)\right]$$

$$= 1390 \times .05 = 69.5 \text{ ohms}$$

The combined resistance of grid plus transformer losses would be

$$\left[\left(\frac{(R_g + r_2)\ R_o'}{R_g + r_2 + R_o'}\right) + r_1'\right] =$$

$$\left[\frac{(1390 + 87)\ 12{,}550}{1390 + 87 + 12{,}550} + 69.5\right]$$

$= 1{,}389.5$ ohms—equivalent in one-half of the secondary circuit.

The Transformer turns ratio from primary to one-half of the secondary should be

$$N_o = \sqrt{\frac{8000}{1389.5}} = 2.40$$

The resistance of the primary should be

$$(69.5 \times 2.4^2) = 400 \text{ ohms}$$

The core loss equivalent resistance in the primary circuit should be

$$(12{,}550 \times 2.4^2 = 72{,}300 \text{ ohms.}$$

Optimum Driver Operating Conditions

Type	*Plate Voltage*	*Bias Voltage*	*Peak Plate Load** Ohms*	*Peak Power Output*** Watts*
1-27	200	—15	23000	0.50
1-27	250	—21	21000	0.92
1-45	250	—50	8000	2.50
1-46	200	—24	9000	1.15
2.27*	250	—21	16000	2.00
1-46	250	—33	8000	2.15
2-45*	250	—50	16000	5.0
2-46*	250	—33	15000	4.5

**Push-pull.*
***Maximum peak a-c plate voltage divided by maximum peak a-c plate current.*
****Maximum peak a-c plate voltage times maximum peak a-c plate current.*

Westinghouse Unites Broadcasting Activities

Pittsburgh.

The creation of a Radio Broadcasting Department is announced by J. S. Tritle, vice-president and general manager of the Westinghouse Electric & Manufacturing Company.

The new department will consolidate all radio broadcasting and associated activities of the Westinghouse Company. Before the grouping of the various radio functions into the new department such activities were split among several other departments and bureaus of the Westinghouse Company. Walter Evans has been appointed manager of the new department.

The Westinghouse stations are KDKA, Pittsburgh; WBZ, Boston; WBZA Springfield, Mass.; KYW and KFKX, Chicago.

Rule of Resistance

Sent's resistors give an effective resistance equal to their sum. Parallel resistors yield a resistance equal to the reciprocal of the sum of the reciprocals.

Electron - Coupled Oscillation fo

of I

By Herm

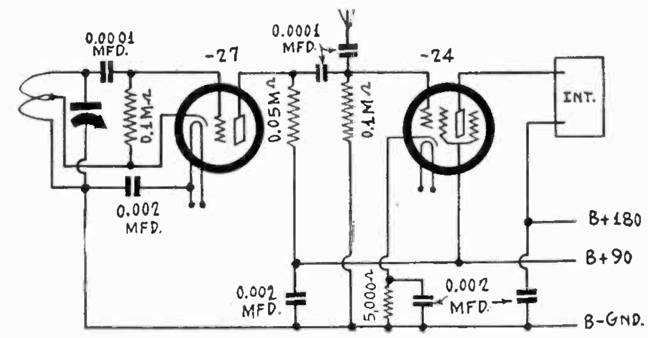


FIG. 1
A modified Hartley oscillator for ultra frequencies, with plate circuit coupled to a modulator. The frequency stability was good, but not good enough.

In recent months there was published in these columns a series of articles about the Mystery Circuit, so-called because two diagrams were printed in separate issues and readers asked to speculate as to what they were. Some hints were given. It was surprising—or should I say it was not surprising—the number of readers who analyzed the circuit correctly.

The idea was as follows: A superheterodyne receiver, to cover any selected frequencies of signal, say from 20,000 to 500 kc (about 15 to 600 meters), without plug-in coils, coil-switching or any other operation except simple tuning.

The execution was to be in this manner: The input to the modulator, of the various signal frequencies, would be untuned, or a series of choke coils used in the grid circuit for semi-tuning, requiring no switching or other manipulation. Against these input frequencies would beat the local oscillator, range 20,500 to 40,000 kc. The only circuit manually tuned would be this local oscillator. The intermediate frequency would be 20,000 kc. Subtract the intermediate frequency from the frequency range of the local oscillator and you get the values of signal frequencies previously specified for the extremes.

A Second Local Oscillator

Incidentally, it was admitted that the intermediate channel at 20,000 kc could not consist of any vast number of stages, and also that the selectivity at this intermediate frequency would be low. However, after this channel had been sharpened as well as possible, the output would be mixed with a fixed oscillating frequency, to lower the modulated frequency to a range in which amplification could be readily obtained in great amount, and selectivity to boot, almost without limit. Let us assume the second so-called intermediate frequency would be 465 kc. Then the second local oscillator—not manually controlled, remember—would simply generate 20,465 kc, or at least would generate it, even if not so simply.

The rest of the circuit would be standard. Even the latest tubes could be used, and a Class B amplifier, if desired.

It was considered important to do some work first on the high frequency local oscillator, really an ultra frequency oscillator. It was feared that oscillation would readily make strange exits at this frequency, but it was surprising to find that the first attempt yielded an oscillator that did its work well at all points on the dial, a '27 tube being used, while the coil consisted of a single turn, and the condenser 0.00015 mfd.

Coil Used

The wire was 3/8 inch diameter hollow copper tubing, wound with one end four inches from the other, no form being used, of course, one end of the coil connected to the grid condenser right near the tuning condenser, and the other to ground. The oscillator was of the modified Hartley type (Fig. 1), and when the plate voltage was high enough, say, no less than 90 volts, oscillation was plentiful.

It was not practical to do much coupling to the grid coil, otherwise the oscillation would stop. However, the plate circuit could stand anything, and so the plate circuit of the oscillator was paralleled with the grid circuit of the modulator, with a resistor as the grid load. This worked out all right as to wide choice of degrees of coupling (effected by different values of stopping condenser from plate to grid), but the frequency stability was not of a very high order. This was true even though the grid circuit was stabilized as best circumstances permitted, and the plate circuit itself was non-reactive. The stability was favorable, compared to that of many other types of oscillators, particularly those without the stabilized grid circuit, but it was not good enough for the present purposes, where, as an extreme example, a change of 1 per cent. in frequency would make a difference of 400 kc, or almost half the width of the broadcast band. Under the best condition 1 per cent. would mean a difference of about 200 kc. These are considerable absolute values, despite the low percentage of error.

Also it was noticed that the losses build up at the high frequencies, not sufficiently to stop oscillation but sufficiently

Mixer for 200

By Hooc

Some experiments with superheterodynes to cover from 200 to 2000 meters have not turned out so well, there being trouble principally in the oscillator, due to high minimum capacity preventing frequency coverage desired, and also to failure of oscillation over some portions of the longer wave tuning. The high capacity may be due to the switch used to pick up two different coils or taps on one coil, to the placement of some parts too close to a metal chassis, to poor shape factor of the oscillator coil, to excess distributed capacity in the long-wave section of the oscillator coil, to failure to stabilize the oscillator and perhaps to some other causes. The net result is usually due to a combination of all the factors mentioned, and in addition is due indirectly to the choice of the intermediate frequency.

Frequencies to Cover

The habit has been to select a low intermediate frequency. One tried was 90 kc, but it did not work out so well. Others have tried 115 kc with more or less success.

It is proposed that the intermediate frequency instead be shifted above the highest broadcast frequency, somewhere between 1550 and 1600 kc or thereabouts, the reason being that the oscillator padding becomes simpler and the promise of better all-around results is held forth.

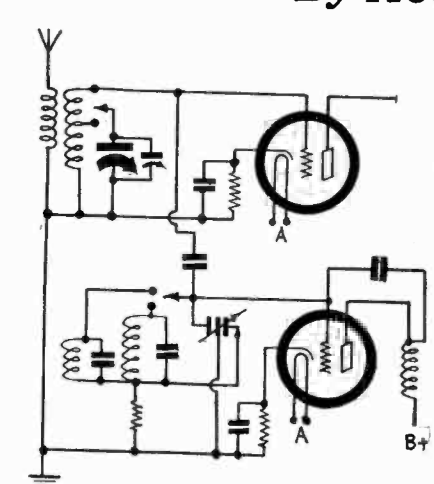


FIG. 1

If the intermediate frequency is assumed to be 1600 kc, and the signal frequencies, at extremes, 1500 and 150 kc, then the oscillator could tune from 1750 to 3100 kc, a ratio of less than 3-to-1, and therefore the entirety could be covered by one combination of tuning condenser and

Stability
requency in the Mystery Circuit
n Bernard

to attenuate the generation, as compared to frequencies of around 5,000 kc. for instance. Since the local oscillator is concerned only with ultra frequencies there will be an accompanying feebleness, which suggested the inclusion of a stage of amplification.

New Attempt Made

Fig. 2 shows the circuit of the new arrangement, with a two-gang 0.00035 mfd. condenser so used that the sectional capacities are in series, and the condenser capacity range is from about 10 to about 175 mmfd., except that the means of introducing oscillation is omitted. It is true, of course, circuit conditions will impose other minimum capacities, so from 40 to 205 mmfd. may be expected, a capacity ratio of about 5-to-1 or frequency ratio of somewhat less than 2.3-to-1, which is more than we need.

The oscillator and amplification stage are fashioned after the stabilized oscillator described by J. B. Dow of the Bureau of Engineering, Navy Department, in the December, 1931, issue of "Proceedings" of the Institute of Radio Engineers, utilizing electron coupling. This is a very loose form of coupling between oscillator and amplifier. The cathode emits electrons, which bombard the plate, but the screen also draws electrons, and the coupling arises from the fact that both screen and plate are common to the electron stream or so-called space current.

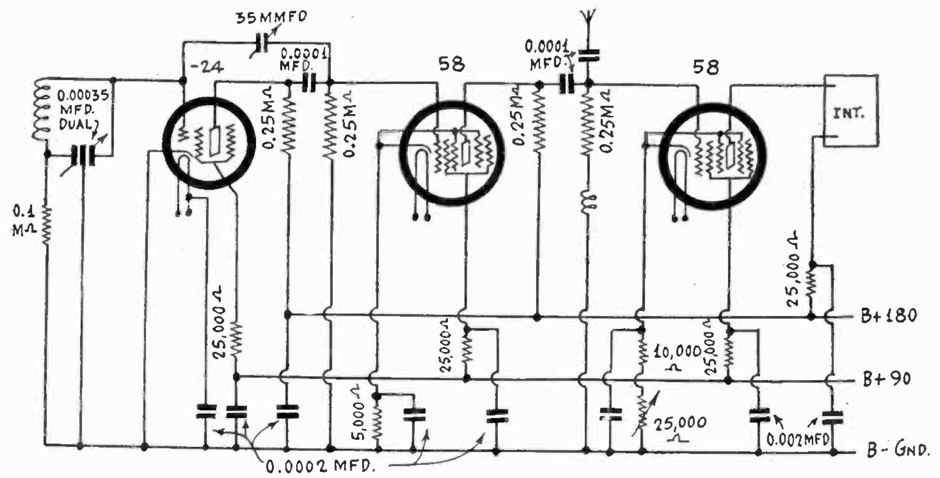


FIG. 2
A Colpitt oscillator for ultra frequencies, with a stage of electron-coupled amplification feeding into the modulator (at right).

A crystal-controlled oscillator was available at 5,000 kc, which required a different coil for the tested oscillator, and the frequency of the tested oscillator held well, but for various frequencies within the actual band of use, roughly 20,000 to 40,000 kc, there was nothing like a crystal controlled circuit to go by, as the harmonics of 5,000 kc became weak and confusing and opportunity to use the crystal type was not prolonged. However, two independent oscillators of frequency-stabilized types were set up, one of them Fig. 2 without the third tube, and the two tuned to zero beat. This beat was held for fifteen minutes as a test. The result was no sound, so either the frequencies did not change, or, if they did change, both changed at the same time and to exactly the same extent in the same direction.

Tube-Removal Test

Then the voltages of the Fig. 2 oscillator tube were changed considerably, different orders of biasing used, as well as equivalent changes (in plate and screen voltage and current), but zero beat still held. Finally the tested oscillator's tube heater voltage supply was shut off, and still no sound. Always when an oscillator is unstable as to frequency, hence is not immune from changes of voltages affecting frequency, when the heater voltage is taken off a rising or falling pitch is heard. Zero beat stops. Something is heard and the sound goes on. Of course the tube finally stops oscillating, because there is no cathode emission. Only with the heater type tubes will this test hold, since for some seconds after the heater voltage is shut off they still function as amplifiers, detectors or oscillators.

For Fig. 2 the single turn of wire may still be used, but no center tap is present. The oscillator should be a '24, because of the position of the screen around the plate, both outside and inside. Neutralization of the capacity may be effected by removing the plate voltage, retaining the screen voltage and setting a small condenser so that no alternating current flows in the screen circuit. A thermomilliammeter is watched until the current is zero.

Providing Oscillation

The circuit as diagrammed is not an oscillator, for means of introducing the oscillation must be provided. The screen current is to be fed back, and this may be done inductively, if desired, or from screen to control grid a condenser of 0.002 mfd. or thereabouts may be used.

o 2000 Meters
Astrakan

coil, no switching of any kind, no plugging in, nothing but tuning. However, it is advisable indeed to tune the modulator, and when that is done a frequency ratio of 10-to-1 must obtain, which is impractical with any single coil and condenser, for the maximum capacity of the condenser would have to be a hundred times as great as the minimum, or, to take into account the stray or distributed minimum capacities, the entirety—tube, coil and condenser—would have to give a capacity variation from 40 to 4000 mmfd.

To avoid this confusion and difficulty, and dodge a perplexity that is almost laughable, the oscillator coil system may consist of two separate inductances, while across each is an equalizing condenser, set to afford what amounts to band-spanning, a form of padding not commonly met in oscillators for the low signal frequencies under discussion.

How It's Done

By suitable choice of tuning capacity for the modulator and selection of a tap on the secondary a ratio frequency 10-to-1 could be obtained there, as that would require a little lower ratio than 3.2-to-1, which is practical with 0.000375 or 0.0005 mfd. condensers of good make. So the tuning, in frequencies, would be from 1500 to about 468 kc, for the lesser modulator inductance, and from 470 kc to 150 kc, approximately, for the total secondary.

Taking these frequencies, and knowing the intermediate frequency, we find what the oscillator frequencies should be by adding the signal frequencies, at the extremes, to the intermediate frequency. Thus, in one instance, the oscillator would have to tune from 3100 to 2068 kc, and the other from 2170 to 1750 kc. By selection of the proper parallel capacities and the inductances across which these are placed the coverage can be accomplished.

However, the shapes of the tuning curves will differ, and therefore single control will not be effective without the aid of a parallel manual trimmer, which can be included, of course, and will be most effective on the broadcast band, and least on the long waves, in a relative sense.

Thus the problem may be solved, and a good oscillator coil used. A three-gang condenser may be utilized for tuning, with two of the sections effectively in series for oscillator tuning, using the oscillator designed by Colpitt. This facilitates coil switching, as only one connection need be shifted in the oscillator, as well as one in the modulator, whereas most oscillator switching systems have to do with two changes for the oscillator and a third for the modulator.

Radio University

A QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by subscribing for RADIO WORLD for one year (52 issues) at $6, without any other premium.

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

Self Bias in Class B Amplifier

IF THE 247 tube is used as a Class B amplifier what should the grid bias be? How much resistance is needed if the tubes are to be self biased?—A. B. S., New Brunswick, N. J.

The grid bias should be approximately twice as much as the bias needed for Class A service. Since this tube requires a bias of 16.5 volts in Class A service it would require 33 volts for Class B service. The bias should be adjusted until the plate current is very nearly zero, say one-half milliampere. Self bias should not be used. Bias should be obtained either with batteries or with a drop in the voltage divider where the drop is caused by a current large enough compared with the sum of the currents of the two 247 tubes at the operating point. And even then there should be a very large condenser across the bias resistance. This is necessary to reduce as much as possible the degenerative feed back.

* * *

Heterodyning Between Stations

SOMETIME next month the Federal Radio Commision will require that all broadcast stations stay within less than 50 cycles of the assigned frequency. It is said that this will allow a maximum heterodyne between the carriers of 100 cycles per second. Is that right, and if so, why? Why is not the maximum heterodyne possible 50 cycles per second?—F. R. W., Omaha, Neb.

It is correct. If one station is 50 cycles higher than the assigned frequency and the other on the same wave is 50 cycles less than the frequency, the possible beat is 100 cycles. The probability that a station is higher than the assigned frequency is just the same as the probability that it is less. Of course, it may be that both stations are off in the same direction. Then the heterodyne is the difference between the two deviations. For example, one may be 5 cycles higher and the other 15 cycles higher than the assigned frequency. The beat would then be 10 cycles per second.

* * *

Inductance of a Loop

I HAVE in mind constructing a loop measuring 20 inches on each side. That is, it will be a square. The tuning condenser will be 350 mmfd. and the tuned circuit is to cover the broadcast band. How many turns of wire should I use? I have for the purpose No. 20 copper wire.—W. H. C., Camden, N. J.

The computation of inductance of a loop is a long and tedious manipulation of figures. However, the inductance of one turn of the loop you describe will be 2.656 microhenries. If the turns are close together so that the coupling between any two turns is unity, the inductance of the loop will be proportional to the square of the number of turns. Hence the turns required on this assumption is obtained by dividing the inductance required by the inductance of one turn and extracting the square root of the ratio. The inductance needed for a 350 mmfd. condenser is 245 microhenries. Therefore the number of turns should be 9.6. Since the turns will be spread out a little the coupling between any two turns will not be unity and therefore a few more turns will be needed. Just how many more will depend on the spacing of the turns. If the spacing is greater than the diameter of the wire the inductance will be much less than it should be. If we make is a circular loop having a radius such that the wire in one turn is the same as the length of wire in one turn of the square loop and if we space the turns so that the axial length is 3.58 inches, the number of turns needed is 16. The greater part of the change was due to the spreading of the turns and not to the changing of the shape of the coil. The best way to determine the number of turns needed is to put one more than enough turns and then reduce them until the condenser when set at maximum reaches 540 kc., or slightly below 550 kc.

* * *

Obtaining Selectivity Mechanically

PLEASE suggest a dial with so fine adjustment that I can separate broadcast stations which now interfere. I can hear local stations when I listen to DX even if they are separated as much as 50 kc. If I had a better dial I would be able to separate them but I have not been able to locate one that will do the work.—W. G. L., Rochester, N. Y.

You never will find a dial that will do the trick. What you need is a new set that is selective enough. From what you say you have no selectivity worthy of the name. If you first get a set that will separate stations operating 10 kc. apart, then you might be ready for a new dial just to make tuning a little easier. Of course, the new dial will not help the selectivity. High selectivity in a receiver is one thing; a close adjustment dial is something else entirely.

* * *

Beat Between Stations

IN YOUR May 14th, 1932, issue you state: "The new 50 cycle rule will confine beat notes to a maximum of 100 cycles between stations assigned to the same wave." What would be the effect on this, if both carriers were modulated 100 per cent by different program, the listener being near one station? What if both carriers were modulated 50 per cent?—A. H. Marsh, Santa Barbara, Calif.

If the carrier from the remote station can be received at all, there will be a 100 cycle note heard in the receiver, provided it is designed so that it can bring out such a low frequency strongly. This would be heard regardless of the degree of modulation of the two carriers. There is no relation between the percentage modulation and the frequency difference between the two carriers. If both are modulated 100 per cent the signals of both at the receiver would be strong. If both are modulated 50 per cent both will be about half as strong. But the ratio of the strengths of the two would be the same in either case. The local station would undoubtedly drown out the distant station. If the modulation on the local station should be zero some time when that on the other had some value, it is possible that the distant station could be heard, and it would be heard twice as loud if it were modulated 100 per cent as if it were modulated 50 per cent. Straight line detection is assumed. But the beat note would be heard as a 100 cycle tone regardless of the modulation of either or both. And the 100 cycle note could be heard long before any of the modulation from the distance station could be heard.

* * *

Leak Value in Detector

WHAT VALUE of grid leak would you recommend in a regenerative short wave receiver for best all-around results? I have noticed that the ease with which the regeneration can be controlled depends on the value.—F. W. K., Amarillo, Tex.

A grid leak of 2 megohms is entirely satisfactory, although many prefer to use much higher values. If you use a high value the detecting efficiency on the low notes will be greater but the high notes will be weaker. The regeneration control can be obtained without changing the grid leak. One way of controlling the regeneration is to control the filament current, another is to control the plate voltage, and still another is to change the number of turns on the tickler. You should have at least two controls because one will not cover satisfactorily the entire tuning range. If you find that the circuit snaps in and out of oscillation reduce the tickler turns, or the plate voltage, or the filament current.

* * *

Heising Modulation System

WHAT IS the distinguishing feature of the Heising modulation system? In what manner does it modulate?—D. B. F., Wheeling, W. Va.

In the Heising modulation system the plate voltage is varied by the modulator, or what amounts to the same thing, the plate circuit resistance is varied. In the usual Heising modulator the plates of the oscillator and modulator tubes are tied together and an audio frequency choke is connected between these plates and the source of steady voltage.

* * *

Phase Difference in Audio Amplifier

IN A RESISTANCE coupled amplifier using a 227 tube having a plate resistance of 20,000 ohms, a load resistance of 250,000 ohms, a stopping condenser of 0.1 mfd., and a grid leak of 0.5 megohm, what is the phase difference at 100 cycles per second between the input voltages of the tube in question and the next?—W. H. G., Wilmington, Del.

It is a little over 181 degrees. If there had been no stopping condenser it would have been 180 degrees.

* * *

Regeneration in Intermediate Amplifier

WOULD IT be practical to introduce regeneration in the intermediate frequency amplifier to make the set more sensitive? If so, what kind of coupling should be used between the plate circuit and the grid circuit?—S. G., New York, N. Y.

Regeneration has been used successfully in intermediate frequency amplifiers. The coupling may be by the ordinary tickler coil or the circuit may be arranged in the form of a Hartley oscillator. Of course, it is necessary to adjust the feed back so that the circuit will not oscillate. In using regeneration there is danger of getting a too high selectivity. The fact is that many intermediate frequency amplifiers are regenerative though not intentionally made so. There is usually sufficient stray coupling to set oscillation going when the i-f circuits are all in tune with the same frequency and in most cases it is necessary to do something about it. The easiest way to stop it is to detune.

STATION SPARKS

By Alice Remsen

The Great Outdoors

For Artells Dickson

WABC, Mondays 10:00 a.m., Wednesdays 10:15 a.m., and Saturdays 9:45 a.m.

Oh, give me a bright and sunny sky
And a white road under my feet,
I wouldn't trade my great outdoors
For a house on a city street.
An open road is the home for me,
And I range it far and wide,
With a book to read, a pipe to smoke,
And my old dog by my side.

With a loaf of bread and a hunk o' cheese,
I can pause at a spring to drink.
Oh, there's nothing like an open road
To make a body think.
There's always a friendly hedgerow
For shelter in case of rain,
There's always a chance of forgetting
The millstones of barter and gain.

There's always a friendly adventure
Waiting just 'round the bend,
And Fate never tells us beforehand
Just where that adventure will end.
Oh, the open road is the only road
For a body to travel in peace;
And the great outdoors is my only home,
'Til my traveling days shall cease.

—*A. R.*

* * *

AND IF YOU LISTEN IN TO Artells Dickson, you, too, will be yearning for the great outdoors, after hearing him sing. He's fine; you'll like him.

* * *

News of the Studios

WABC

June 13th will be gala night with the "Evening in Paris" broadcast. Such well-known radio stars as The Boswell Sisters, Lanny Ross, Singing Sam, Col. Stoopnagle and Bud and Kate Smith will supplement the regular program. Following the program a dinner will be served at the Berkshire Hotel for the artists, radio editors and guests.

Bourjois will not be off the air prior to its change in program, but will open for the summer on June 20th, with a fifteen-minute period of dance music by Howard Lanin's orchestra and vocal selections by Alice Remsen, on Monday nights at 9:45.

* * *

The Wrigley programs, "Myrt and Marge" and "The Lone Wolf Tribe," are scheduled to return to the air on August 29th. In the meantime both programs will play vaudeville and personal appearance tours through the summer.

* * *

Columbia is planning to use its Chicago talent and studios more frequently during the summer months. Nine new programs are scheduled to emanate from the Windy City. "Romance," featuring Frank Westphal and his orchestra, with Jack Brooks as tenor soloist, has already been inaugurated. June 7th saw "Snapshots" take the air; memory pictures in song, featuring the Chicagoans Quartet. June 1st brought Freddy Rose to the attention of New York listeners in a song novelty program. "The Grab Bag" is already pouring out a radio variety show each Friday, and on Saturday two programs will be heard, commencing the latter part of June. Look in your local papers for the programs and time of presentation.

* * *

NBC

Among accomplished child actresses on the air is Florence Baker, who plays Sarah Browning in the Stebbins Boys sketches, which are broadcast over an NBC-WJZ network, under the sponsorship of Swift and Company. Florence is a dark-eyed, curly-haired girl of fourteen who began her radio career at the age of eight in the Lady Next Door program. She had had no previous stage experience, but it didn't take her long to develop into a radio personality. Among her important roles was that of Marjorie Jones in the NBC presentation of Booth Tarkington's "Penrod."

* * *

The sprightly-witted Ray Perkins will inaugurate a new series of programs early this summer, details of which will be published in a forthcoming issue of this paper. Here, in my humble opinion, is one of the brightest and best of radio's funny men—never too subtle, yet intelligently interesting, with a pleasing personality and a great way of putting over a song.

* * *

Good-looking Smith Ballew looked down at me from his six-feet-something the other afternoon at Lindy's and tendered the information that he was opening at the Pavilon Royale and will be broadcasting again soon. This is good news to me, for Smith, who, by the way, is one of the most modest band leaders in this dizzy business, always has a fine band, great for dancing and he also sings better than the average leader.

* * *

WOR

Tom Terris, the vagabond adventurer, who is presenting a series of broadcasts over WOR for the United States Steamship Lines, has traveled all over the world, even though he is still a young man. He has visited Moscow, Constantinople, Malta, Jerusalem, the whole of Egypt, the Upper Nile as far as Khartoum; Persia, Siam, all of India and Indo-China, Japan, China, New Guinea, the Cannibal Islands, Africa, South, North, East and West, and innumerable other remote spots.

* * *

A German girl who hasn't been in this country very long, but long enough to know what's what in radio, according to Nilson of WOR's engineering department, picked that station's "Gems of Opera" and the "Perole String Quartet" as her favorite programs a short time ago. She said: "Mine favorites iss Germs of Opera undt dat Paralyse String Quartet."

* * *

Sidelights

MARIA CARDINALE is an expert chauffeur and drives her own car; she can change a tire and monkey with the engine's "innards" in the most approved fashion. . . . IRVING KAUFMAN was once with a circus. . . . MABEL JACKSON is an expert pianist, organist and saxophone player and taught music long before she discovered her voice. . . . BEN POLLACK once worked as a draftsman. . . . ANN LEAF has moved to such a large apartment that she is thinking of putting a bell around her neck in order to find herself. . . . JOE SANDERS was born in Thayer, Kansas. . . . DAVEY ROSE collects steam engines—models, of course. . . . MURIEL POLLOCK is a great friend of Amelia Earhart Putnam and her hubby; among Muriel's most treasured possessions are several intimately signed photographs of the great aviatrix. . . . ART JARRET is a nice-looking boy, but he'll have to go some to grow as handsome as his dad. . . . Proof that summer is definitely here may be gathered from the conversation overheard at WABC between SAM LANIN, MAX SMOLEN, FREDDIE RICH, AL NEWMAN, ARNOLD BRILLHEART and a few other hard-working musicians,—nothing but golf, golf and then again golf. . . . ALEXANDER HAAS was born in the glorious city of Budapest, Hungaria, on July 3rd, 1886. . . . Two of the three PEBECO PLAYBOYS have collaborated on a song called "Bananas," that is going to be a hit; George Marlo publishes it. . . . LEONARD JOY is composing. . . . THEODORE WEBB was born in Winnipeg of an English father and a Scotch mother. . . . ROSARIO BOURDON was born in Montreal. . . . RICHARD MAXWELL, NBC tenor, used to sing bass in the Glee Club at Kenyon College.

* * *

Answers to Correspondents

ZELVA CUNNINGHAM, San Jose, Calif.—A biography of Bing Crosby was run in this department in our issue of Oct. 10th, 1931. However, I am running it again at the request of several readers, including yourself. You may hear Mr. Crosby from Los Angeles, Cal., on Wednesdays and Saturdays, through Station KHJ. See local papers for time of program.

E. GERRARD, Long Island City, N. Y.—Glad you recognized my voice. Shall be on that program again some time in the near future.

* * *

Biographical Brevities

More About Bing Crosby

The Crosbys named him Harry L., but he has been Bing for all but three of his twenty-eight years. Acquired the nickname from his fondness for Indian and cowboy games, wherein he could and did shout "Bing, bing, bing" from morning till night, with redskins by the hundred biting the Tacoma dust.

Attended college at Gonzaga in Seattle. Too light for football except freshman squad, but got on the Varsity baseball team. Edited school papers, being afflicted with the writing bee, the virus of which still hangs on. Imagines he could earn his living as an author if only his voice would let him, but he can't turn down all that money. Started singing professionally while still in Gonzola. Income wasn't sufficient to support him, so he clerked in a law office, but jurisprudence lost out when an offer came from a Los Angeles booking office.

Since 1926 has appeared in theatres throughout this country, Mexico and Canada. Never has been abroad but wants to go there; has a special urge to see Lichtenstein and Andorra.

Started getting raves for his work while entertaining at Cocoanut Grove, Los Angeles. California syndicate and magazine writers discovered him about the same time that his records became best sellers. Has worked for four recording companies; also has made plenty of talking shorts, good ones, too, and has appeared on countless radio programs, but is still nervous when approaching a microphone.

Golf is his favorite sport; cares in a big way for the radio work of the Boswell Sisters; thinks his wife, Dixie Lee, is the best girl ever; drives a car like nobody's business, although the traffic cops make it theirs; never has been able to get enough summonses to paper a room but is still hopeful. Reads a lot. Taste in clothes runs to browns and blues. Has played drums but doesn't think he's very good at them.

Is five feet, nine inches tall, weighs 165, has blue eyes, brown hair and is tanned. Has a very husky speaking voice that is quite fascinating. Is extremely serious about his work and usually rehearses five times the length of a program for each broadcast.

* * *

If you would care to know something of your favorite radio artists, drop a line to the conductor of this page. Address: Miss Alice Remsen, care Radio World, *145 W. 45th St., New York City.*

BEAM OF LIGHT FROM DIRIGIBLE CARRIES VOICES

Schenectady, N. Y.

The new transmitter of WGY recently was put into service on a signal from the U. S. N. dirigible Los Angeles, aloft about a mile away. A modulated light beam was used.

The ceremonies were heard by millions over a National Broadcasting System chain.

Voice communication from the ship to a fixed land receiver was maintained over the beam of light directed at a 30-inch concave mirror target. As long as the light beam hit the target, communication was maintained. Often there was a break due to failure to hit the target. Expert marksmanship was required to hold the target 2500 feet away for the fifteen minutes of the event, during which the ship circled at a rate of thirty miles per hour.

Developed by Taylor

The system of light transmission of sound was developed by John Bellamy Taylor of the General Electric Company. Mr. Taylor, aboard the dirigible, directed the broadcast. In this system the light source is a standard automobile headlight operated on a 6-volt battery. Between the light source and a converging lens is a delicately-suspended mirror 0.017 inch square. Sound waves directed to this mirror cause it to vibrate and to vary the amount of light in the beam. Some sluggishness of the mirror's movement was suggested by the attenuation of high audio frequencies.

At the concave mirror a super-sensitive photo-electric tube catches the variations in light and sets up an electrical current in correspondence to the variations. These electrical impulses were transmitted by line from the target to the transmitter and thus to the stations of the network and were later translated into sound at the loudspeakers.

The light itself was visible to observers but there was no visible evidence of a beam. In earlier tests at Lakehurst the mirror target picked up the light when the dirigible was two miles away, the greatest distance yet recorded by Mr. Taylor's system.

Works in Daylight, Too

Light transmission is equally efficient in daylight with the same equipment.

A gun sight beside the light beam enables the operator to train the beam to the mirror target. In the broadcast Lieut. Benjamin May, of the dirigible personnel, sighted the target.

Chester H. Lang, of the General Electric Company, aboard the dirigible, described the method by which communication was carried on and explained that he would literally blow one transmitter off the air and blow another one on. At the first blast of a whistle operators at WGY's old transmitter shut off the current. The second blast, however, was carried to a thyratron tube, one of the newer developments of General Electric and this tube, operating as a relay, tripped the new transmitter into service.

The response to the whistle was so fast that listeners tuned to WGY heard the final whistle notes as the transmitter came into service. John Young, announcer, acted aboard the Los Angeles and introduced Commander F. T. Berry, who spoke briefly and in praise of the light-beam system of communication.

WNYC Gets Stay; Would Keep 570 kc

Washington.

An order was obtained from the District of Columbia Court of Appeals by WNYC, the municipal station in New York City, staying the execution of decree issued by the Federal Radio Commission assigning WMCA and WPCH, both in New York City and both controlled by the same company, to 570 kc, the frequency WNYC formerly shared with WMCA. WNYC was given WPCH's former frequency, 810 kc, by the Commission.

The refusal of the Commission to move WBCM, Bay City, Mich., from 1410 to 940 kc, on the ground that interference would result, particularly to WHA, Madison, Wis., WFIW, Hopkinsville, Ky., WCSH, Portland, Me., and WWJ, Detroit, Mich., was upheld by the court.

CROOKS LISTEN, POLICE LAMENT

Washington.

The effectiveness of police radio is being hampered by criminals who listen in, and profit by what they hear, police of six large cities complained to the Federal Radio Commission. The criminals use the information to their own advantage, and thus the system is turned to a detriment to the police departments in their work of crime detection and catching offenders.

The Commission let it be known that more and more persons listen to police broadcasts, including principally honest citizens with short-wave sets, adapters or converters, but that the greatest growth of the listening audience is among criminals.

There is no law against listening, but it is a penal offense to tell what you hear —$5,000 fine or five years in prison or both being the penalty.

New 50-Cycle Rule In Effect June 22d

On Wednesday, June 22nd, the new rule of the Federal Radio Commission compelling broadcasting stations to stick to their assigned frequencies to plus or minus 50 cycles, instead of the present 500 cycles, goes into effect. This would confine heterodyne interference to 100 cycles at most, a frequency not audible in most receivers.

The stations have had a year's advance notice and have been required to install approved frequency monitors. Four makes of monitors have been approved.

Winchell Back Soon; Police Cases to be Aired

A new Lucky Strike Dance Hour series featuring Bert Lahr, clowning Broadway comedian; Walter Winchell, purveyor of breezy gossip and up-to-the-second news; Walter O'Keefe, celebrated night club and musical comedy master of ceremonies; dramatizations of actual criminal cases from the files of the New York City Police Department; and the world's leading dance orchestras, will be inaugurated over a nationwide NBC-WEAF network about the middle of this month.

U.S. BROADCAST ON LONG WAVES BEING STUDIED

By HAROLD A. LAFOUNT
Federal Radio Commissioner

The European broadcasting interests, through their common agency, the International Broadcasting Union, propose to extend the broadcasting band from 160 to 285 kilocycles, from 370 to 460 kilocycles, and to add on 10 kilocycles to the lower end of the present broadcasting band, making it run from 540 to 1500 kilocycles.

Considering the matter from a practical standpoint, it would appear that of these proposals, the extension from 370 to 460 kilocycles had the least chance of success, involving as it does the moving and reallocation of large groups of commercial, mobile, and land stations. The maritime and aviation interests in Europe are as much against such a proposal as the same interests are in this country, and they feel that such proposals make it impossible to provide adequate space for the safeguarding of these highly important safety-of-life services which can be handled in no other way except by radio.

Called a Logical Extension

The proposal for the extension of the so-called long-wave European broadcasting band from 160 to 285 kilocycles in Europe, however, has a somewhat different aspect and it appears that if increased facilities are necessary in Europe, it would be a logical extension of their present long-wave band. In America we have an entirely different situation. Our broadcasting band has always been confined to within the limits of 550 to 1500 kilocycles, and it is significant that within this single band the United States has practically as many broadcasting stations operating on 10 kilocycles separation as all the rest of the world put together.

Specifically, the so-called long-wave band which is used in Europe for broadcasting is used in this country for point-to-point services by the Army, Navy, and the Department of Commerce, and, by the widespread radiobeacon service developed for the use of aviation by the Bureau of Standards and the Airways Division of the Department of Commerce. These stations provide a service to aircraft which the aviation transport companies have grown to accept as essential to their daily passenger, mail, and cargo flights. Through thick, rainy, foggy weather, these planes are able to fly because of the radiobeacon.

Study Being Made

Unfortunately, at the present time, little data have been available concerning the relative value of long and medium waves for broadcasting on the North American continent.

Such a study has just been instituted. At a meeting called by the Federal Radio Commission in Washington to consider the proposals of other nations concerning the allocation of frequencies, a committee headed by the Chief Engineer of the Federal Radio Commission was appointed to collect such data and, if possible, make a recommendation concerning the use of long waves for broadcasting on the North American continent. The results of the study to be made by this committee will be of importance to the broadcasting industry in this country and, as a matter of fact, may affect the whole future of radio in America.

LEGAL RELIEF FOR THE TRADE IS PROPOSED

Chicago.

Speaking for Radio Manufacturers Association, Inc., as a body, John W. Van Allen, its general counsel, outlined to the members official recommendations for the remedy of legal obstructions, as follows:

(1)—The removal of the restriction now imposed by the Clayton Act so that a manufacturer will be legally able to fix the price of his commodity, not including understandings and agreements with his competitors, but including the maintenance of different discounts among intermediate distributors.

(2)—Trade associations, now legally empowered to collect statistics on the industry and disseminate them to members, should not be restricted against advising members as to the best course of conduct in the light of such statistics, just as stocks and bonds are at present subject to any kind of comment without law violation. Power of trade associations to regulate prices is not asked.

(3)—That the Federal Court assume jurisdiction over the administration of patents now held by the radio pool that is being sued by the Government for illegal monopoly and restraint of trade, and that the present licenses granted to manufacturers be confirmed, and future issues of licenses be under court control, lest there be more licensees than the market will stand. If necessary, that a Congressional act be passed empowering the court to assume these powers, for general protection of the industry, no matter whether the Government wins or loses its anti-trust suit. Otherwise, if the Government wins, the patent ownerships will be scattered, and the licensees' present protection placed in jeopardy.

(4)—Any new copyright act should embody relief from arbitrary or oppressive terms or denial of permission to use on reasonable terms, although no specific recommendation regarding copyright law is made.

New Incorporations

George H. Field, New York City, radio broadcasting—Atty., J. Klepner, 207 West 29th St., New York City.

H. & H. Electric and Radio Co., Bronx, New York City, contracting—Attys., Brauer and Elkin, 225 Broadway, New York City.

Kempton Products Corp., New York, N. Y., electric apparatus—Atty., N. Goodman, 11 West 42nd St., New York City.

Aeon Electric, New York City, electrical work—Atty., S. Moreland, Jr., Rockville Center, N. Y.

Hubert Service Co., Queens, L. I., N. Y., electrical appliances—Atty., S. Moanfeldt, 1,450 Broadway, New York City.

Everlast Refrigeration Corp., Bronx, New York City—Atty., B. Berenstein, 11 West 42nd St., New York City.

BANKRUPTCY PROCEEDINGS

Petitions Filed Against

East Side Music Co., Inc., radios, 172 Fifth Ave., New York City. By Colonial Radio Distributors.

Receivers Appointed

The Irving Trust Co. was designated in the following case: Redifone Corp. of America, radios, 72 Cortlandt St., New York City.

CAPITAL INCREASES

Preferred Electric and Wire Corp., Manhattan, $20,000 to $30,000.

CAPITAL REDUCTIONS

Radio Music Co., Manhattan, $6,265,050 to 650.

DISSOLUTIONS

C. G. Radio Co., Brooklyn, N. Y.
Splitdorf Electrical Co., New Jersey.

Tradiograms

By J. Murray Barron

Cortlandt Street

Nowhere in this country or anywhere else can there be found in any one section of any one city the number of radio retail stores as are located in downtown Manhattan. While a number of these stores are just a few steps off Cortlandt Street, all are considered in the Cortlandt Street district. To be more exact, out of possibly sixty retail stores in this district, approximately 60 per cent. are actually on the street, the balance on cross streets, as Greenwich and Washington Streets.

In addition to these stores and in the same district are a number of retail radio establishments above the ground floor.

From this one can more readily understand what a large buying public must visit this district to warrant such a number of radio retail establishments, and what a wide and varied choice of radio merchandise is carried in stock. Here truly is radio buying a real pleasure for the serviceman and experimenter. The hard-to-find gadget or part can surely be found in this district.

For the most part these establishments are well organized and systematized, and no effort or money spared to attract the buying public, hence departments are well laid out, merchandise stocked and windows attractively dressed, with frequent changes and trimmings, so every week new ideas, merchandise, and often special sales are in order. The stores have their own followings, but naturally the more progressive and aggressive are sought out and do the biggest business. For the most part they are all a pretty good crowd and aid in their way to make the street a national radio thoroughfare. To visitors, Cortlandt Street is a trip worthwhile.

* * *

Try-Mo Radio Fair, 85 Cortlandt Street, N. Y. City, is attracting considerable attention with a special window display of a five-tube radio receiver. It is a completed model. Parts for building it are the main attraction. There is also a very simplified blueprint incorporated in the display.

* * *

Aerovox Wireless Corporation, 70 Washington Street, Brooklyn, N. Y., announces change in name to Aerovox Corporation.

* * *

Radio Surplus Co., 179 Greenwich Street, N. Y. City, has completed a radio bargain basement. It is well laid out and stocked with a large variety of small and replacement parts. A unique idea is the price tags, which makes shopping much easier.

* * *

Warner Radio Co., 170 Greenwich Street, N. Y. City, has been featuring a fine display in its windows of Silver-Marshall receivers. There is also an unusual window trimming, showing small radio parts.

* * *

Neon Radio Co., 176 Greenwich Street, N. Y. City, has arranged for public inspection a very complete assortment of midget radio receivers. For the experimenter and serviceman there is an excellent display of small parts, converters, etc.

Literature Wanted

John B. Woodyard, Albany, Ohio.
Sylvester Deming (portable button microphone combined with telegraphone for recording ordinary speech) Box 493, Pleasantville, N. Y.
Eugene Loeb, Medford, Wisc.
F. E. Kauffman, Jr., 1202 Avenham Ave., Roanoke, Va.
Charles Fowler, McComas, W. Va.
Charles R. Pearce, 2-2 Macdonald Dormitory, 15th Street, Troy, N. Y.

BAND SPANNING IS FEATURED IN "PRO" RECEIVER

A high frequency receiver for 1.5 to 20 megacycles, having a sensitivity of better than ½ microvolt per meter, has just been developed in the laboratories of the Hammarlund Manufacturing Company, Inc., 424 West 33rd Street, New York City.

An eight tube a-c operated superheterodyne, this new model is known as the Comet "Pro" and incorporates such features as "band spread" tuning at any frequency within the range of the receiver, an intermediate oscillator for CW code reception and for phone station finding, outlet for humless headphone operation, loudspeaker connection, vernier controls, etc. The receiver has a ⅛" black crackle finished aluminum panel and is housed in a brown mahogany cabinet 20½" long, 9½" high, and 13" deep.

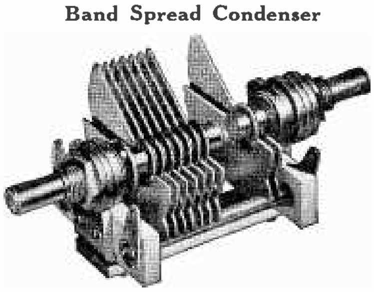
Statistics on Selectivity, Sensitivity

The selectivity is such that the over-all response curve averages only 30 kc. wide at 10,000 times input. The sensitivity is so high and the receiver noise level so low that under test in a prominent laboratory it was found possible to read a CW code signal at 20 words a minute (single transmission) when the input to the receiver was only 1/40th microvolt per meter.

The receiver uses three 227's, two as oscillators and one as an audio, two 235's in the intermediate frequency channel, two 224's as detectors, and a 280 fullwave rectifier. A 227 is used in a resistance coupled AF stage to provide clean and humless headphone signals. On all but the very weakest signals sufficient output is obtained to operate a loudspeaker at moderate volume.

Interchangeable plug-in coils are used to shift from one frequency range to another. Two coils, one oscillator and one wavelength, constitute a set and each set of coils covers a frequency range of approximately two to one. The coils are wound on extruded Isolantite forms 1½" in diameter and plug into special extruded Isolantite sockets with double grip clips, insuring reliable electrical connection with consequent freedom from noise due to variation in resistance.

Band Spread Condenser



To assist amateurs in constructing short-wave receivers having band spread tuning, Hammarlund has produced a new type "band spread" midget condenser.

Two sections are provided in the condenser, one having a capacity of 100 mmfd., the other a capacity of 35 mmfd. Each section may be individually tuned by its own shaft. Tuning to the center of the desired band is accomplished by the high capacity section, the low capacity section then being used for "spreading the band" and so greatly simplifying tuning within the limits of the band.

A THOUGHT FOR THE WEEK

HOW ABOUT A SPECIAL MOO SET? It seems that cows give more milk when they listen to a radio set while they are being milked. A farmer writes to Station WLS to the effect that his cows positively produce a greater quantity of the lacteal fluid when he puts his set in the barn —and especially when organ music is on the program. He is honest enough to say that he hasn't been able to decide whether or not the quality of the milk is improved by this method. He's going to find out, though. Thus radio again demonstrates its economic worth. And, by the way: What of hen consciousness? Is there such a thing? Let the farmer and scientist—also the cow and hen—work together and see what happens. The possibilities are rather interesting.

RADIO WORLD

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

The First and Only National Radio Weekly

Eleventh 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, managing editor and business manager; J. E. Anderson, technical editor; J. Murray Barron, advertising manager.

Tax Crooks to End Police Wave Prying

Police chiefs of six large cities complain to the Federal Radio Commission that crooks eavesdrop on police radio messages and put the system to their own use instead of being victimized by it. Police departments should tax the crooks for this service, instead of the public.

* * *

Big chains want to buy more stations, but the stations they want to buy would like to know what the chains intend to use for money.

* * *

Including some longer waves in the American broadcast band is under investigation, but we can tell right now what the set manufacturers will say about it, and also listeners who now have receivers that can't even get the present stations.

* * *

Rush of real comedians to the ether shows how tough are the times in the show business.

* * *

Radio manufacturers want the restriction against price-fixing lifted, but it would be more important if the public restriction against set-buying were lifted instead.

* * *

A moratorium against any more new tubes until after the debt payments by foreign countries are resumed should be President Hoover's next proposal.

* * *

However, the embarrassment over new tubes isn't so terrific, seeing as it's impossible to get any.

* * *

Listeners are being organized to protest against the overdose of advertising sales talks on the air. All the sponsors need do is withdraw, and the battle will be lost to both sides.

Current Technical Publications

Titles of Principal Articles in Radio Press

SERVICE (May)

The Triple-Twin Tube, by G. M. Reed.
The Type 46 Tube.
Oscillator Computations.
Test Data on the G-2-S Duodiode Detector.
Atwater-Kent Auto Supers.
Majestic Model 110 Auto Radio.
Majestic Model 10 Short-Wave Converter.
Atwater-Kent Model 93 Short-Wave Converter.

* * *

RADIO ENGINEERING (May)

A Chronological History of Electrical Communication—Telegraph.
Telephone and Radio (continued). This instalment covers developments in 1850 to 1853.
Radio Test Methods and Equipment, by William F. Diehl.
Sources of Light for Television, by A. Ernest Lyle.
The Application of Permeability Tuning to Broadcast Receivers, by R. H. Langley.
Radio Dissemination of the National Standard of Frequency, by J. H. Dellinger and E. L. Hull.
Further Description and Characteristics of the Wunderlich Tube, by Frederick E. Terman.
Loudspeakers with Independent Control Added to Radio Receivers, by W. L. Parsons.
Frequency Control Monitor for Broadcast Stations.
Progress in Radio Tubes.

* * *

Journal of the Institute of Radio Service Men (May)

The Design and Performance of Electro-Dynamic Loudspeakers, by Benj. Olney.
Automobile Radio "B" Eliminators, by Paul E. Gerst.
Radio Receiver Measurements, by George H. Scheer, Jr.

SUPPRESSORS FOR CAR SETS

In automobile installations it is usually but not always necessary to use spark suppressors.

Short-Wave Club

The following is a list of new members:

Samuel Buzin, 206 Powell St., Brooklyn, N. Y.
Riccard Andrews, Box 74, Gruver, Iowa.
Roger Lines, Box 101, Gruver, Iowa.
Henry I. Leinbach, 304 Juniper St., Quakertown, Penna.
Henry Flores, 812 W. Mo. St., El Paso, Texas.
J. L. Boswell, 706 Everett St., Portland, Ore.
Frank M. Pontius, 2911-11th Ave., Los Angeles, Calif.
Gentry Philpott, 6564 Delor, St. Louis, Mo.
Joe G. Kuly, 1194 E. 80th St., Cleveland, Ohio.
Robert C. Watson, 1 Smith Street, Riverside, R. I.
Merle Radke, 1922-9th Ave., Seattle, Wash.

TWO BIG CHAINS WOULD BUY UP KPO AND WJSV

Washington.

That the chains find it profitable to acquire ownership of powerful broadcasting stations is indicated by the fact that both the National Broadcasting Company and the Columbia Broadcasting System are seeking to win the approval of the Federal Radio Commission for the addition of one powerful station to each chain.

NBC wants the license of KPO, San Francisco, owned by Hale Bros. Stores Inc. and the Chronicle Publishing Company, on 680 kc., 5,000 watts, transferred to it, under a contract of purchase tentatively entered into with the present owners. A construction permit to increase the power to 50,000 watts is part of the bargain, this permit having been granted to KPO some months back.

Whole Board to Hear Cases

CBS would add WJSV, Alexandria, Va., at present owned by Station WJSV, Inc., to the list of stations CBS owns. The frequency is 1460 kc and the power is 10,000 watts.

The entire Commission will hear both cases, as the subject of the growing power of chains is one of outstanding importance.

An examiner of the Commission's staff recommended increased power and time for WHDL, Tupper Lake, N. Y., now 100 watts, recommended for 500 watts.

The application of KMJ, Fresno, Calif., to change to 580 kc from its present 1210 kc, with power increase from 100 to 500 watts, was recommended by an examiner. Also increased time but decreased power were recommended for KVOA, Tucson, Ariz., now on half time, 500 watts. Full time, 250 watts, was the recommendation.

WCFL Seeks Full Time

The American Federation of Labor asked unlimited time for its station, WCFL, Chicago, and an increase to 5,000 watts. It now has limited time 1,500 watts.

WORC-WEPS, Worcester, Mass., asked more power and a change in frequency. At present unlimited time, 100 watts, are allowed on 1200 kc, but unlimited time, 500 watts and 1350 kc were requested.

Plenty of Business Yet

The radio industry is headed for steadily increasing business and is no more near the saturation point than the automobile industry was in 1921, J. Clarke Coit, former president of Radio Manufacturers Association Inc., asserted.

"During the depression of 1921 an intimate friend of mine, who was an automobile manufacturer, concluded that the saturation point in automobile sales and use had been reached. So he disposed of his business. To the analytical mind of 1932 his decision of 1921 was silly, just as silly as an opinion of some that the saturation point in radio has been reached in 1932 would be to the analytical mind of 1942.

"Ten years from now the man who goes out of radio this year because he thinks that the radio industry is through and has reached its saturation point will look just as silly as my automobile friend looks today to those who have made millions and millions of dollars since he figured that that industry was through.

STATIONS BY FREQUENCIES

United States, Canadian, Newfoundland, Cuban and Mexican Transmitters Listed

Corrected to June 1st, 1932

The stations listed herewith are in the order of frequencies, with equivalent wavelengths given. The call, location, owner, and power are stated. The location is that of the main studio, for United States stations. If the transmitter is located elsewhere it is indicated additionally, preceded by T. The power given is the licensed maximum. Some stations use maximum power in daytime only. These are identified by an asterisk after the power figure (*). Usually in such cases the night power is half the day power. CP means construction permit, license expected.

—EDITOR.

540 KILOCYCLES—555.6 METERS

CKWO—Windsor, Ont., Can.; Essex Bdcsters Lmt. 5 KW.

550 KILOCYCLES—545.1 METERS

WGR—Buffalo, N. Y.; T—Amherst, N. Y.; Buffalo Broadcasting Corporation; 1 KW.
WKRC—Cincinnati, Ohio; WKRC (Inc.); 1 KW.
KFUO—St. Louis, Mo.; Concordia Theo. Sem.; 1 KW.*
KSD—St. Louis, Mo.; Pulitzer Publishing Co.; 500 W.
KFDY, Brookings, S. Dak.; South Dakota State College, 1 KW.*
KFYR—Bismarck, N. Dak.; Meyer Broadcasting Co., 2½ KW.*
KOAC—Corvallis, Oreg.; Oregon State Agricultural College, 1 KW.

560 KILOCYCLES—535.4 METERS

WLIT—Philadelphia, Pa.; Lit Bros.; 500 W.
WFI—Philadelphia, Pa.; Strawbridge & Clothier; 500 W.
WQAM—Miami, Fla.; Miami Broadcasting Co.; 1 KW.
KFDM—Beaumont, Tex.; Magnolia Petroleum Co.; 1 KW.*
WNOX—Knoxville, Tenn.; WNOX, Inc.; 2 KW.*
WIBO—Chicago, Ill.; T—Des Plaines, Ill.; Nelson Bros. Bond & Mortgage Co.; 1½ KW.*
WPCC—Chicago, Ill.; North Shore Church; 500 W.
KLZ—Denver, Colo.; Reynolds Radio Co. (Inc.), 1 KW.
KTAB—San Francisco, Calif.; T—Oakland, Calif.; The Associated Broadcasters (Inc.), 1 KW.

570 KILOCYCLES—526.0 METERS

WNYC—New York N. Y.; City of N. Y.; 500 W.
WMCA—New York, N. Y.; T—Hoboken, N. J.; Knickerbocker Broadcasting Co. (Inc.); 500 W.
WSYR-WMAC—Syracuse N. Y.; Clive B. Meredith; 250 W.
WKBN—Youngstown, Ohio; WKBN Broadcasting Corp.; 500 W.
WEAO—Columbus, Ohio; Ohio State University; 750 W.
WWNC—Asheville, N. C.; Citizen Broadcasting Co.; 1 KW.
KGKO—Wichita Falls, Tex.; Wichita Falls Broadcasting Co., Inc.; 500 W.*
WNAX—Yankton, S. Dak.; The House of Gurney (Inc.); 1 KW.
KMTR—Los Angeles, Calif.; KMTR Radio Corporation; 500 W.
KVI—Tacoma, Wash.; Puget Sound Bdcg Co.; 500 W.

580 KILOCYCLES—516.9 METERS

WTAG—Worcester, Mass.; Worcester Telegram Publishing Co. (Inc.), 250 W.
WOBU—Charleston, W. Va.; WOBU (Inc.), 250 W.
WSAZ—Huntington, W. Va.; WSAZ (Inc.); 250 W.
WIBW—Topeka, Kans.; Topeka Broadcasting Association (Inc.), 1 KW.
KSAC—Manhattan, Kans.; Kansas State Agricultural College; 1 KW.*
KMJ—Fresno, Calif.; Jas. McClatchy Co.; 500 W.; C. P. only: see 1210 KC.
CFCY—Charlottetown, Prince Edward Island, Canada; Island Broadcasting Co., Ltd.; 500 W.
CHMA—Edmonton, Alberta, Can.; Christian & Missionary Alliance, 250 W.
CKCL—Toronto, Ontario, Can.; Dominion Battery Co., Ltd.; 500 W. (Uses call CFCL on Sundays), 500 W.
CKUA—Edmonton, Alberta, Can.; University of Alberta; 500 W.

590 KILOCYCLES—508.2 METERS

WGCM—Gulfport, Miss.; T—Mississippi City, Miss.; Great Southern Land Co.; 1 KW.
WEEI—Boston, Mass.; T—Weymouth, Mass.; Edison Electric Illuminating Co. of Boston; 1 KW.
WKZO—Berrien Springs, Mich.; WKZO (Inc.); 1 KW.
WCAJ—Lincoln, Nebr.; Nebraska Wesleyan University; 500 W.
WOW—Omaha, Nebr.; Woodmen of the World Life Insurance Association; 1 KW.
KHQ—Spokane, Wash.; Louis Wasmer (Inc.), 2 KW.*
CMW—Havana Cuba; Columbus Commercial & Radio Co.; 1400 W.

595 KILOCYCLES—503.9 METERS

CJGC—London, Ontario, Can.; T—Strathburn, Ontario, Can.; London Free Press & Ptg. Co., Ltd.; 5 KW.
CNRL—London, Ontario, Can.; T—Strathburn, Ontario, Can. (Uses Transmitter of CJGC); Canadian National Railways; 5 KW.

600 KILOCYCLES—499.7 METERS

WICC—Bridgeport, Conn.; T—Easton, Conn.; Bridgeport Broadcasting Station (Inc.); 250 W.
WCAC—Storrs, Conn.; Connecticut Agricultural College; 250 W.
WCAO—Baltimore, Md.; Monumental Radio (Inc.), 250 W.
WREC—Memphis, Tenn.; T—Whitehaven, Tenn.; WREC (Inc.), 1 KW.*
WMT—Waterloo, Iowa; Waterloo Broadcasting Co.; 500 W.
KFSD—San Diego, Calif.; Airfan Radio Corporation (Ltd.); 1 KW.*
CNRO—Ottawa, Ontario, Can.; Canadian National Railways; 500 W.

610 KILOCYCLES—491.5 METERS

WJAY—Cleveland, Ohio; Cleveland Radio Broadcasting Corporation; 500 W.
WIP—Philadelphia, Pa.; Gimbel Brothers (Inc.); 500 W.
WDAF—Kansas City, Mo.; Kansas City Star Co.; 1 KW.
KFRC—San Francisco, Calif.; Don Lee (Inc.); 1 KW.
WFAN—Philadelphia, Pa.; Keystone Broadcasting Co.; 500 W.
XETR—Mexico, D. F.; Cia Difusora Mexicana, S. A.; 2½ KW.

620 KILOCYCLES—483.6 METERS

WLBZ—Bangor, Me.; Maine Broadcasting Co. (Inc.); 500 W.
WFLA-WSUN—Clearwater, Fla.; Clearwater Chamber of Commerce and St. Petersburg Chamber of Commerce; 2½ KW.*
WTMJ—Milwaukee, Wis.; T—Brookfield, Wis.; The Journal Co. (Milwaukee Journal), 2½ KW.*
KGW—Portland, Oreg.; Oregonian Publishing Co.; 1 KW.
KTAR—Phoeniz, Ariz.; KTAR Broadcasting Co.; 1 KW.*

630 KILOCYCLES—475.9 METERS

KGFX—Pierre, S. D.; Dana McNeil; 200 W.
WMAL—Washington, D. C.; M. A. Leese Radio Corp.; 500 W.*
WOS—Jefferson City, Mo.; Missouri State Marketing Bureau, 500 W.
KFRU—Columbia, Mo.; Stevens College; 500 W.
WGBF—Evansville, Ind.; Evansville on the Air (Inc.); 500 W.

630 KILOCYCLES—475.9 METERS (Continued)

CFCT—Victoria, British Columbia; Victoria Broadcasting Asso.; 50 W.
CJGX—Winnipeg, Manitoba; T—Yorkton, Saskatchewan; Winnipeg Grain Exchange; 500 W.
CHCS—Hamilton, Ont., Can.; T—Fruitland; Spectator; 1 KW.*
CKOC—Hamilton, Ont., Can.; T—Fruitland; Wentworth Bdcg Co.; 1 KW.*
CKTB—St. Catherine's, Ont., Can.; T—Fruitland; Taylor & Bate, St.; 1 KW.*
CNRA—Moncton, New Brunswick; Canadian National Railways; 500 W.
CMCJ—Havana, Cuba; Rafael Rodriquez; 250 W.
XETA—Veracruz, Ver., Mex.; Manuel Espinosa Tagle; 500 W.
XETF—Veracruz, Ver., Mex.; Manuel Angel Fernandez; 500 W.
CMQ—Havana, Cuba; Jose Fernandez; 250 W.

640 KILOCYCLES—468.5 METERS

WAIU—Columbus, Ohio; Associated Radiocasting Corp.; 500 W.
WOI—Ames, Iowa; Iowa State College of Agriculture and Mechanic Arts; 5 KW.
KFI—Los Angeles, Calif.; Earle C. Anthony (Inc.), 50 KW.

645 KILOCYCLES—464.8 METERS

CHRC—Quebec, Quebec, Can.; CHRC, Ltd.; 100 W.
CKCI—Quebec, Quebec, Can. (Uses transmitter of CHRC); Le Soleil, Inc.; 100 W.
CKCR—Waterloo, Ontario, Can.; Wm. C. Mitchel & Gilbert Liddle, 100 W.

650 KILOCYCLES—461.3 METERS

WSM—Nashville, Tenn.; National Life & Accident Insurance Co.; 5 KW.
KPCB—Seattle, Wash.; Queen City Broadcasting Co.; 100 W.

660 KILOCYCLES—454.3 METERS

WEAF—New York, N. Y.; T—Belmore, N. Y.; National Broadcasting Co. (Inc.); 50 KW.
WTIC—Hartford, Conn.; Travelers Broadcasting Service, Inc.; 5 KW.
WAAW—Omaha, Nebr.; Omaha Grain Exchange; 500 W.
CMCO—Havana, Cuba; J. L. Stowers; 250 W.
CMDC—Havana, Cuba; Juan Fernandex de Castro; 500 W.

665 KILOCYCLES—450.9 METERS

CHWK—Chilliwack, British Columbia, Can.; Chilliwack Broadcasting Co., Ltd.; 100 W.
CJRM—Moose Jaw, Saskatchewan; T—old city Moose Jaw, Can.; James Richardson & Sons, Ltd.; 500 W.
CJRW—Winnipeg, Manitoba; T—Fleming, Saskatchewan, Can.; James Richardson & Sons, Ltd.; 500 W.

670 KILOCYCLES—447.5 METERS

WMAQ—Chicago, Ill.; T—Addison, Ill.; WMAQ (Inc.); 5 KW.

675 KILOCYCLES—444.2 METERS

VOWR—St. John's, N. F.; Wesley United Church; 500 W.

680 KILOCYCLES—440.9 METERS

WPTF—Raleigh, N. C.; Durham Life Insurance Co.; 1 KW.
KFEQ—St. Joseph, Mo.; Scroggin & Co. Bank; 2½ KW.
KPO—San Francisco, Calif.; Hale Bros. Stores (Inc.), and the Chronicle Publishing Co.; 5 KW.
XFG—Mexico City, Mex.; Sria de Guerra y Marina; 2 KW.

685 KILOCYCLES—437.7 METERS

VAS—Glace Bay, Nova Scotia, Can.; Canadian Marconi Co.; 2 KW.

690 KILOCYCLES—434.5 METERS

CFAC—Calgary, Alberta, Can.; The Calgary Herald; 500 W.
CFRB—Toronto, Ontario, Can.; T—King, Ontario, Can.; Rogers Majestic Corp., Ltd.; 10 KW.
CJCJ—Calgary, Alberta, Can.; Albertan Pub. Co., Ltd.; 500 W.
CNRX—Toronto, Ontario, Can.; T—King, Ontario, Can. (Uses transmitter of CFRB); Canadian National Railways; 4 KW.
XET—Monterrey, N. L., Mex.; Mexico Music Co., S. A.; 500 W.

700 KILOCYCLES—428.3 METERS

WLW—Cincinnati, O.; T—Mason, Ohio; Crosley Radio Corporation; 50 KW.

710 KILOCYCLES—422.3 METERS

WOR—Newark, N. J.; T—Kearny, N. J.; Bamberger Broadcasting Service (Inc.); 5 KW. (50 KW. C. P.)
KMPC—Los Angeles, Calif.; R. S. MacMillan; 500 W.
XEN—Mexico City, Mex. (Actual frequency 711 KC., 421.9 Meters); Cerveceria Modelo, S. A.; 1 KW.

720 KILOCYCLES—416.4 METERS

WGN-WLIB—Chicago, Ill.; T—Elgin, Ill.; WGN, Inc.; 25 KW.

730 KILOCYCLES—410.7 METERS

CHLS—Vancouver, British Columbia (Uses transmitter of CKCD); W. G. Hassell; 50 W.
CHYC—Montreal, Quebec, Can.; T—St. Hyacinthe, Quebec, Can. (Uses transmitter of CKAC); Northern Elec. Co., Ltd.; 5 KW.
CKAC—Montreal, Quebec, Can.; T—St. Hyacinthe, Quebec, Can.; LaPresse Pub. Co.; 5 KW.
CKCD—Vancouver, British Columbia, Can.; Vancouver Daily Province; 100 W.
CKFC—Vancouver, British Columbia, Can.; United Church of Canada; 50 W.
CKMO—Vancouver, British Columbia, Can.; Sprott-Shaw Radio Co.; 100 W.
CKWX—Vancouver, British Columbia, Can.; Western Broadcasting Co., Ltd.; 100 W.
CNRM—Montreal, Quebec, Can.; T—St. Hyacinthe, Quebec, Can. (Uses transmitter of CKAC); Canadian National Railway; 5 KW.
XER—Villa Acuna, Coah., Mex. (Actual frequency 735 KC., 408.1 Meters); Compania Radiodifusora de Acuna, S. A.; 75 KW.
CMK—Havana, Cuba; Cuban Bdcg. Co.; 3150 W.

740 KILOCYCLES—405.2 METERS

WSB—Atlanta, Ga.; Atlanta Journal Co.; 5 KW. (50 KW.—C. P.).
KMMJ—Clay Center, Nebr.; The M. M. Johnson Co.; 1 KW.
WHEB—Portsmouth, N. H.; Granite State Bldg. Corp.; 250 W. C. P.

745 KILOCYCLES—402.4 METERS

CJCA—Edmonton, Alta., Can.; Edmonton Journal; 500 W.

750 KILOCYCLES—399.8 METERS

WJR—Detroit, Mich.; T—Sylvan Lake Village, Mich.; WJR, The Goodwill Station (Inc.), 10 KW.
KGU—Honolulu, Hawaii; M. A. Mulroney and Advertiser Pub. Co., Ltd.
XEQ—C. Jaurez, Coah., Mex.; Feliciano Lopez Islas; 5 KW.

760 KILOCYCLES—394.5 METERS

WJZ—New York, N. Y.; T—Boundbrook, N. J.; National Broadcasting Co.; Inc.); 30 KW.
WBAL—Baltimore, Md.; Consolidated Gas, Electric & Power Co.; 1 KW.
WEW—St. Louis, Mo.; St. Louis University; 1 KW.

770 KILOCYCLES—389.4 METERS

KFAB—Lincoln, Neb.; KFAB Broadcasting Co.; 5 KW. (25 KW. C. P.).
WBBM-WJBT—Chicago, Ill.; T—Glenview, Ill.; WBBM Broadcasting Corp. (Inc.); 25 KW.

780 KILOCYCLES—384.4 METERS

WEAN—Providence, R. I.; Shepard Broadcasting Service (Inc.); 500 W.*
WTAR-WPOR—Norfolk, Va.; WTAR Radio Corporation; 500 W.
WMC—Memphis, Tenn.; T—Bartlett, Tenn.; Memphis Commercial Appeal, Inc.; 1 KW.*
KELW—Burbank, Calif.; Magnolia Park, Ltd.; 500 W.
KTM—Los Angeles, Calif.; T—Santa Monica, Calif.; Pickwick Broadcasting Corporation; 1 KW.*
CKY—Winnipeg, Manitoba, Can.; Manitoba Telephone System; 5 KW.
CNRW—Winnipeg, Manitoba, Can. (Uses Transmitter of CKY); Canadian National Railways; 5 KW.
XEZ—Mexico, D. F., Joaquin Capilla; 500 W.

790 KILOCYCLES—379.5 METERS

WGY—Schenectady, N. Y.; T—South Schenectady, N. Y.; General Electric Co.; 50 KW.
KGO—San Francisco, Calif.; T—Oakland, Calif.; National Broadcasting Co. (Inc.); 7½ KW.
CMBT—Havana, Cuba; E. Perera; 500 W.
CMBS—Havana, Cuba; Enrique Artalejo; 150 W.
CMHC—Tuinucu, Cuba; Frank H. Jones; 250 W.

800 KILOCYCLES—374.8 METERS

WBAP—Fort Worth, Tex.; Carter Publications (Inc.); 10 KW.
WFAA—Dallas, Tex.; T—Grapevine, Texas; Dallas News and Dallas Journal A. H. Belo Corporation; 50 KW.

810 KILOCYCLES—370.2 METERS

WPCH—New York, N. Y.; T—Hoboken, N. J.; Eastern Broadcasters (Inc.); 500 W.
WCCO—Minneapolis, Minn.; T—Anoka, Minn.; Northwestern Broadcasting (Inc.); 5 KW. (50 KW. C. P.)
VOAS—St. John's, N. F.; Ayre & Sons, Ltd.; 75 W.
XFC—Aguascalientes, Ags., Mex.; Gobierno Edo. Aguascalientes; 350 W.

815 KILOCYCLES—367.9 METERS

CHNS—Halifax, N. S., Can.; Maritime Bdcg Co., Ltd.; 500 W.
CNRA—Halifax, N. S., Can.; Can. Natl Railways; 500 W.

820 KILOCYCLES—365.6 METERS

WHAS—Louisville, Ky.; T—Jeffersontown, Ky.; The Courier Journal Co. and The Louisville Times Co.; 25 KW.
XFI—Mexico City, Mex.; Sria Ind. Com. y Trabajo (Actual frequency 818.1 KC—366.7 Meters); 1 KW.

830 KILOCYCLES—361.2 METERS

WHDH—Boston, Mass.; T—Gloucester, Mass.; Matheson Radio Co. (Inc.); 1 KW.
WRUF—Gainesville, Fla.; University of Florida; 5 KW.
KOA—Denver, Colo.; National Broadcasting Co. (Inc.), 12½ KW.
WEEU—Reading, Pa.; Berks Broadcasting Co.; 1 KW.

840 KILOCYCLES—356.9 METERS

CJBC—Toronto, Ontario, Can.; T—Bowmanville, Ontario, Can. (Uses transmitter of CKGW); Jarvis St. Baptist Church; 5 KW.
CKGW—Toronto, Ontario, Can.; T—Bowmanville, Ontario, Can.; Gooderham & Worts; 10 KW.
CKLC—Calgary, Alberta, Can.; T—Red Deer, Alberta, Can.; Alberta Pacific Grain Company; 1 KW.
CNRD—Red Deer, Alberta, Can. (Uses transmitter of CKLC); Canadian National Railways; 1 KW.
CPRY—Toronto, Ontario, Can.; T—Bowmanville, Ontario, Can. (Uses transmitter of CKGW); Canadian Pacific Railway Co.; 5 KW.

842 KILOCYCLES—356.1 METERS

CMC—Havana, Cuba; Cuban Telephone Co.; 500 W.
XEFD—Tiajuana, Mex.; Carlo de la Sierra; 300 W.

850 KILOCYCLES—352.7 METERS

KWKH—Shreveport, La.; T—Kennonwood, La.; Hello World Broadcasting Corporation; 10 KW.
WWL—New Orleans, La.; Loyola University; 10 KW.

860 KILOCYCLES—348.6 METERS

WABC-WBOQ—New York, N. Y.; T—West of Cross Bay Blvd., Queens Co., N. Y.; Atlantic Broadcasting Corporation; 5 KW.
WHB—Kansas City, Mo.; T—North Kansas City, Mo.; WHB Broadcasting Co.; 500 W.
XFX—Mexico City, Mex.; Sria de Educacion Publica; 500 W.

870 KILOCYCLES—344.6 METERS

WLS—Chicago, Ill.; T—Crete, Ill.; Agricultural Broadcasting Co.; 50 KW.
WENR—Chicago, Ill.; T—Downers Grove, Ill.; National Broadcasting Co., 50 KW.
XFF—Chihuahua, Mex.; Estado de Chihuahua; 500 W.

880 KILOCYCLES—340.7 METERS

WGBI—Scranton, Pa.; Scranton Broadcasters (Inc.); 250 W.
WQAN—Scranton, Pa.; E. J. Lynett, prop., The Scranton Times, 250 W.
WCOC—Meridian, Miss.; Mississippi Broadcasting Co. (Inc.); 1 KW.*
WSUI—Iowa City, Iowa; State University of Iowa; 500 W.
KLX—Oakland, Calif.; The Tribune Publishing Co.; 500 W.
KPOF—Denver, Colo.; Pillar of Fire; 500 W.
KFKA—Greeley, Colo.; The Mid-Western Radio Corporation; 1 KW.*
CHML—Mount Hamilton, Ontario, Can.; Maple Leaf Radio Co., Ltd.; 50 W.
CJCB—Sydney, Nova Scotia, Can.; N. Nathanson; 50 W.
CKCV—Quebec, Quebec, Can.; Vandry, Inc.; 50 W.
CKPC—Preston, Ontario, Can., Cyrus Dolph; 100 W.
CNRQ—Quebec, Quebec, Can. (Uses transmitter of CKCV); Canadian National Railways; 50 W.

890 KILOCYCLES—336.9 METERS

CMX—Havana, Cuba; Francisco Lavin; 1 KW.
WJAR—Providence, R. I.; the Outlet Co.; 500 W.
WKAQ—San Juan, P. R.; Radio Corporation of Porto Rico; 500 W.*
WMMN—Fairmount, W. Va.; Holt-Rowe Novelty Co.; 500 W.*
WGST—Atlanta, Ga.; Georgia School of Technology; 500 W.*
KGJF—Little Rock, Ark.; First Church of the Nazarene; 250 W.

890 KILOCYCLES—336.9 METERS (Cont.)

WILL—Urbana, Ill.; University of Illinois; 500 W.*
KARK—Little Rock, Ark.; Ark. Radio & Equip. Co.; 250 W.
KFNF—Shenandoah, Iowa; Henry Field Co.; 500 W.
KUSD—Vermillion, S. Dak.; University of South Dakota; 750 W.*
KFNF—Shenandoah, Iowa; Henry Field Co.; 1 KW.*
CFBO—St. John, New Brunswick, Can.; C. A. Munro, Ltd.; 500 W.
CKCO—Ottawa, Ontario, Can.; Dr. G. M. Geldert; 100 W.
CKPR—Port Arthur, Ontario, Can.; Dougall Motor Car Co., Ltd.; 50 W.
XES—Tampico, Tams., Mex.; Difusoral Portena; 500 W.
CMCF—Havana, Cuba; Raoul Karman; 250 W.

900 KILOCYCLES—333.1 METERS

WBEN—Buffalo, N. Y.; T—Martinsville, N. Y.; WBEN, Inc.; 1 KW.
WKY—Oklahoma City, Okla.; WKY Radiophone Co.; 1 KW.
WJAX—Jacksonville, Fla.; City of Jacksonville; 1 KW.
WLBL—Stevens Point, Wis.; State of Wisconsin, Department of Agriculture and Markets, 2 KW.
KHJ—Los Angeles, Calif.; Don Lee (Inc.); 1 KW.
KSEI—Pocatello, Idaho; Radio Service Corp.; 250 W. C. P. 500 W.
KGBU—Ketchikan, Alaska; Alaska Radio and Service Co. (Inc.), 100 W. (500 W., C. P.).

910 KILOCYCLES—329.5 METERS

CFQC—Saskatoon, Saskatchewan, Can.; The Electric Shop, Ltd.; 500 W.
CNRS—Saskatoon, Saskatchewan, Can. (Uses transmitter of CFQC); Canadian National Railways; 500 W.
XEW—Mexico City, Mex.; Mexico Music Co.; S. A.; 5 KW.

915 KILOCYCLES—327.7 METERS

CFLC—Prescott, Ontario, Can.; Radio Association of Prescott; 100 W

920 KILOCYCLES—325.9 METERS

WBSO—Needham, Mass.; Babson's Statistical Organization (Inc.); 500 W.
WWJ—Detroit, Mich.; The Evening News Association (Inc.); 1 KW.
KPRC—Houston, Tex.; T—Sugarland, Texas; Houston Printing Co.; 2½ KW.
WAAF—Chicago, Ill.; Drovers Journal Publishing Co.; 500 W.
KOMO—Seattle, Wash.; Fisher's Blend Station (Inc.); 1 KW.
KFEL—Denver, Colo.; Eugene P. O'Fallon (Inc.); 500 W.
KFXF—Denver, Colo.; Colorado Radio Corporation; 500 W.

925 KILOCYCLES—324.1 METERS

CMCD—Havana, Cuba; Angel Bertematy; 250 W.
CMCN—Havana, Cuba; Antonio Ginard; 250 W.

930 KILOCYCLES—322.4 METERS

WIBG—Elkins Park, Pa.; St. Paul's P. E. Church; 25 W.
WDBJ—Roanoke, Va.; Times-Royal Corp.; 500 W.*
WBRC—Birmingham, Ala.; Birmingham Broadcasting Co. (Inc.); 1 KW.*
KGBZ—York, Nebr.; Dr. George R. Miller; 1 KW.*
KMA—Shenandoah, Iowa; May Seed & Nursery Co.; 1 KW.*
KFWI—San Francisco, Calif.; Radio Entertainments (Inc.); 500 W.
KROW—Oakland, Calif.; T—Richmond, Calif.; Educational Broadcasting Corporation; 1 KW.*
CKX—Brandon, Manitoba, Can.; Manitoba Telephone System; 500 W.
CFCH—North Bay, Ontario, Can.; Northern Supplies, Ltd.; 100 W.
CFRC—Kingston, Ontario, Can.; Queens University; 250 W.*
CMJF—Camaguey, Cuba; John L. Stowers; 225 W.

940 KILOCYCLES—319.0 METERS

WAAT—Jersey City, N. J.; Bremer Broadcasting Corporation; 300 W.
WCSH—Portland, Me.; T—Scarboro, Me.; Congress Square Hotel Co.; 1 KW.
WFIW—Hopkinsville, Ky.; WFIW (Inc.); 1 KW.
WHA—Madison, Wis.; University of Wisconsin; 750 W.
WDAY—Fargo, N. Dak.; T—West Fargo, N. Dak.; WDAY (Inc.); 1 KW.
KOIN—Portland, Oreg.; T—Sylvan, Oreg.; KOIN (Inc.); 1 KW.
XEO—Mexico City, Mex.; Partido Nacional Rev.; 5 KW.

950 KILOCYCLES—315.6 METERS

WRC—Washington, D. C.; National Broadcasting Co. (Inc.); 500 W.
KMBC—Kansas City, Mo.; T—Independence, Mo.; Midland Broadcasting Co.; 1 KW.
KFWB—Hollywood, Calif.; Warner Bros. Broadcasting Corporation; 1 KW.
KGHL—Billings, Mont.; Northwestern Auto Supply Co. (Inc.); 1 KW.
VONA—St. Johns, N. F.; Lane, Gillard & Avery; 30 W.
CMHD—Caibarien, Cuba; Manuel Alvarez; 250 W.

960 KILOCYCLES—312.3 METERS

CHCK—Charlottetown, Prince Edward Island, Can.; W. E. Burke & J. A. Gesner; 100 W.
CHWC—Regina, Saskatchewan, Can.; T—Pilot Butte, Saskatchewan, Can.; R. H. Williams & Sons, Ltd.; 500 W.
CJBR—Regina, Saskatchewan, Can. (Uses transmitter of CKCK); Saskatchewan Co-operative Wheat Producers, Ltd.; 500 W.
CKCK—Regina, Saskatchewan, Can.; Leader Publishing Co., Ltd.; 500 W.
CKNC—Toronto, Ontario, Can.; Canadian National Carbon Co.; 500 W.
CNRR—Regina, Saskatchewan, Can. (Uses transmitter of CKCK); Canadian National Railways; 500 W.
XED—Reynosa, Tams., Mex. (Actual frequency 965 KC—310.8 Meters); Cia. Int. Dif. Reynosa, S. A.; 10 KW.

965 KILOCYCLES—310.7 METERS

CMBC—Havana, Cuba; Domingo Fernandez; 150 W.
CMBD—Havana, Cuba; Luis Perez Garcia; 150 W.

970 KILOCYCLES—309.1 METERS

WCFL—Chicago, Ill.; Chicago Federation of Labor; 1½ KW.
KJR—Seattle, Wash.; Northwest Broadcasting System (Inc.); 5 KW.

980 KILOCYCLES—305.9 METERS

KDKA—Pittsburgh, Pa.; T—Saxonburg, Pa., Westinghouse Electric & Manufacturing Co.; 50 KW.

985 KILOCYCLES—304.4 METERS

CFCN—Calgary, Alberta, Can.; T—Strathmore, Alta., Can.; W. W. Grant & H. G. Love; 10 KW.

987 KILOCYCLES—303.8 METERS

CMGF—Matanzas, Cuba; Bernabe R. de la Torre; 50 W.

990 KILOCYCLES—302.8 METERS

WBZ—Springfield, Mass.; T—East Springfield, Mass.; Westinghouse Electric & Manufacturing Co.; 25 KW.
WBZA—Boston, Mass.; Westinghouse Electric & Manufacturing Co.; 1 KW.
XEK—Mexico City, Mex.; Arturo Martinez; 100 W.

1000 KILOCYCLES—299.8 METERS

WHO—Des Moines, Iowa; Central Broadcasting Co.; 5 KW. (C. P. 50 KW.)
WOC—Davenport, Iowa; Central Broadcasting Co.; 5 KW. (C. P. 50 KW.).
KFVD—Culver City, Calif.; Los Angeles Broadcasting Co.; 250 W.
XEA—Guadalajara, Jal., Mex; Alberto Palos Sauza; 100 W.
XEC—Toluca, Mex.; Jesus R. Benavides; 50 W.
XEE—Oaxaca, Oax., Mex.; Alfonso Zorrilla B.; 105 W.
XEFE—N. Laredo, Tams., Mex.; Rafael T. Carranza; 100 W.
XEFI—Chihuahua, Chih., Mex.; Feliciano Lopez Islas; 100 W.
XEFS—Queretaro, Quer., Mex., Salvador Sanchez, 40 W.
XEI—Morelia, Mich., Mex.; Carlos Gutierrez; 100 W.
XEJ—C. Juarez, Chih., Mex.; Juan G. Buttner; 100 W.
XEL—Saltillo, Coah.; Antonio Garza Castro; 25 W.
XETC—Jalapa, Ver., Mex.; Juventino Canchez; 100 W.
XETG—Torreon, Coah., Mex.; Feliciano Lopez Islas; 100 W.
XEU—Veracruz, Ver., Mexico.; Fernando Pazos; 100 W.
XEV—Puebla, Pue., Mex.; Ciro Molino; 100 W.
XEY—Merida, Yuc., Mex.; Partido Socialista S. E.; 105 W.

1010 KILOCYCLES—296.8 METERS

WORK—York, Pa.; York Bdcg. Co.; 1 KW.
WQAO—New York, N. Y.; T—Cliffside, N. J.; Calvary Baptist Church; 250 W.
WHN—New York, N. Y.; Marcus Loew Booking Agency; 250 W.
WPAP—New York City; Palisades Amusement Park; 250 W.
WRNY—New York, N. Y.; T—Coytesville, N. J.; Aviation Radio Station (Inc.); 250 W.
KGGF—Coffeyville, Kans.; Hugh J. Powell and Stanley Platz, doing business as Powell & Platz; 500 W.
WNAD—Norman, Okla.; University of Oklahoma; 500 W.
WIS—Columbia, S. C.; South Carolina Broadcasting Co. (Inc.); 1 KW.*
KQW—San Jose, Calif.; Pacific Agricultural Foundation Ltd.; 500 W.
CHCS—Hamilton, Ontario; T—Fruitland, Ontario (Uses transmitter of CKOC—630 KC. temporarily); Hamilton Spectator; 1 KW.*
CKIC—Wolfville, Nova Scotia; Acadia University; 50 W.
CKOC—Hamilton, Ontario; T—Fruitland, Ontario (Uses 630 KC temporarily); Wentworth Radio Broadcasting Co., Ltd.; 1 KW.*
CKTB—St. Catharines, Ontario; T—Fruitland, Ontario. (Uses transmitter of CKOC, 630 KC., temporarily); Taylor & Bates, Ltd.; 1 KW.*
CMBZ—Havana, Cuba; Manuel y G. Salas; 150 W.

1017 KILOCYCLES—293.73 METERS

CMJH—Ciego de Avila, Cuba; Luis Marauri; 15 W.

1020 KILOCYCLES—293.9 METERS

WRAX—Philadelphia, Pa.; WRAX Broadcasting Co.; 250 W.
KYW-KFKX—Chicago, Ill.; T—Bloomingdale Township, Ill.; Westinghouse Electric & Manufacturing Co.; 10 KW.
XEFD—Tijuana, B. C., Mex.; Carlos de la Sierra, 300 W.

1030 KILOCYCLES—291.1 METERS

CFCF—Montreal, Quebec, Can.; Canadian Marconi Co.; 500 W.
CNRV—Vancouver, British Columbia, Can.; T—Lulu Island, British Columbia, Can.; Canadian National Railways; 500 W.
CMHI—Santa Clara, Cuba; Lavis y Paz; 30 W.

1034 KILOCYCLES—290 METERS

CMKC—Santiago de Cuba; M. P. Martinez; 150 W.

1,040 KILOCYCLES—288.3 METERS

WMAK—Buffalo, N. Y.; T—Grand Island, Buffalo, N. Y.; Buffalo Broadcasting Corporation; 1 KW.
WKAR—East Lansing, Mich.; Michigan State College; 1 KW.
KTHS—Hot Springs National Park, Ark.; Hot Springs Chamber of Commerce; 10 KW.
KRLD—Dallas, Tex.; KRLD Radio Corporation; 10 KW.
CMGH—Matanzas, Cuba.

1050 KILOCYCLES—285.5 METERS

KFBI—Milford, Kans.; Farmers & Bankers Life Insurance Co.; 5 KW.
KNX—Hollywood, Calif.; T—Los Angeles, Calif.; Western Broadcast Co.; 5KW.
XEFC—Merida, Yuc., Mex.; Hugo Molina Font.; 10 W.
CMJG—Camaguey, Cuba; Pedro Nogueras; 50 W.

1060 KILOCYCLES—282.8 METERS

WBAL—Baltimore, Md.; T—Glen Morris, Md.; Consolidated Gas, Electric Light & Power Company of Baltimore; 10 KW.
WTIC—Hartford, Conn.; T—Avon, Conn.; Travelers Broadcasting Service Corporation; 50 KW.
WJAG—Norfolk, Nebr.; Norfolk Daily News; 1 KW.
KWJJ—Portland, Ore.; KWJJ Broadcast Co. (Inc.); 500 W.

1070 KILOCYCLES—280.2 METERS

WTAM—Cleveland, Ohio; T—Brecksville Village, Ohio; National Broadcasting Co. (Inc.); 50 KW.
WCAZ—Carthage, Ill.; Superior Broadcasting Service (Inc.); 50 W.
WDZ—Tuscola, Ill.; James L. Bush; 100 W.
KJBS—San Francisco, Calif.; Julius Brunton & Sons Co.; 100 W.
XEG—Mexico, D. F.; Miguel Yarza; 250 W.
CMBG—Havana, Cuba; Francisco Garrigo; 225 W.
CMCB—Havana, Cuba; Antonio Capablanca; 150 W.

1080 KILOCYCLES—277.6 METERS

WBT—Charlotte, N. C.; Station WBT (Inc.); 5 KW.
WCBD—Zion, Ill.; Wilbur Glenn Voliva; 5 KW.
WMBI—Chicago, Ill.; T—Addison, Ill.; The Moody Bible Institute Radio Station; 5 KW.

1090 KILOCYCLES—275.1 METERS

KMOX—St. Louis, Mo.; Voice of St. Louis (Inc.); 50 KW.

1100 KILOCYCLES—272.6 METERS

WPG—Atlantic City, N. J.; WPG Broadcasting Corporation; 5 KW.
WLWL—New York, N. Y.; T—Kearny, N. J.; Missionary Society of St. Paul the Apostle; 5 KW.
KGDM—Stockton, Calif.; E. F. Peffer; 250 W.

1110 KILOCYCLES—270.1 METERS

WRVA—Richmond, Va.; T—Mechanicsville, Va.; Larus & Brother Co. (Inc.); 5 KW.
KSOO—Sioux Falls, S. Dak.; Sioux Falls Broadcast Association (Inc.); 2½ KW.

1120 KILOCYCLES—267.7 METERS

WDEL—Wilmington, Del.; WDEL (Inc.); 350 W.*
WDBO—Orlando, Fla.; Orlando Broadcasting Co. (Inc.); 250 W.
WTAW—College Station, Tex.; Agricultural and Mechanics College of Texas; 500 W.
KTRH—Houston, Tex.; Rice Hotel; 500 W.
WISN—Milwaukee, Wis.; Evening Wisconsin Co.; 250 W.
WHAD—Milwaukee, Wis.; Marquette University; 250 W.
KFSG—Los Angeles, Calif.; Echo Park Evangelistic Association; 500 W.
KRKD—Inglewood, Calif.; Dalton's (Inc.); 500 W. (1 KW. C.P.).
KRSC—Seattle, Wash.; Radio Sales Corporation; 50 W.
KFIO—Spokane, Wash.; Spokane Broadcasting Corporation; 100 W.
CFCA—Toronto, Ontario, Can.; Star Publishing & Printing Co.; 500 W.
CFJC—Kamloops, British Columbia, Can.; S. D. Dalgleish & Sons, Ltd.; 100 W.
CHGS—Summerside, Prince Edward Island, Can.; R. T. Holman, Ltd.; 500 W.

1120 KILOCYCLES—267.7 METERS (Cont.)

CJOC—Lethbridge, Alberta, Can.; H. R. Carson; 100 W.
CNRT—Toronto, Ontario, Can.; (Uses transmitter of CFCA); Canadian National Railways; 500 W.

1125 KILOCYCLES—266.6 METERS

CMHJ—Cienfuegos, Cuba; Arturo Hernandez; 40 W.

1130 KILOCYCLES—265.3 METERS

WOV—New York City; T—Secaucus, N. J.; International Broadcasting Corporation; 1 KW.
WJJD—Mooseheart, Ill.; WJJD, Inc.; 20 KW.
KSL—Salt Lake City, Utah; Radio Service Corporation of Utah; 5 KW. (50 KW.—C. P.).
XEH—Monterrey, N. L., Mex.; Constantino Tarnaca; 1 KW. (Actual frequency 1,132 KC.—265 Meters).

1140 KILOCYCLES—263.0 METERS

WAPI—Birmingham, Ala.; WAPI Broadcast Co.; 5 KW.
KVOO—Tulsa, Okla.; Southwestern Sales Corporation; 5 KW. (25 KW.—C.P.).
CMBW—Havana, Cuba; Modesto Alvarez; 150 W.
CMCQ—Havana, Cuba; Andres Martinez; 1 KW.
XETA—Mexico, D. F.; M. E. Taglo; 500 W.

1150 KILOCYCLES—260.7 METERS

WHAM—Rochester, N. Y.; T—Victor Township, N. Y.; Stromberg-Carlson Telephone Manufacturing Co.; 5 KW.
CMGI—Colon, Cuba; Armando Lizama; 30 W.

1160 KILOCYCLES—258.5 METERS

WWVA—Wheeling, W. Va.; West Virginia Broadcasting Corporation; 5 KW.
WOWO—Fort Wayne, Ind.; Main Auto Supply Co.; 10 KW.

1170 KILOCYCLES—256.3 METERS

WCAU—Philadelphia, Pa.; T—Byberry; Universal Broadcasting Co.; 10 KW.

1180 KILOCYCLES—254.1 METERS

WINS—New York, N. Y.; T—Astoria, L. I., N. Y.; American Radio News Corp.; 500 W.
WDGY—Minneapolis, Minn.; Dr. George W. Young; 1 KW.
KEX—Portland, Ore.; Western Broadcasting Co.; 5 KW.
KOB—State College, N. Mex.; New Mexico College of Agriculture and Mechanic Arts, 20 KW.
WMAZ—Macon, Ga.; Southern Broadcasting Co., Inc.; 500 W.
CMJE—Camaguey, Cuba; Manuel Fernandez; 30 W.

1190 KILOCYCLES—252.0 METERS

WOAI—San Antonio, Tex.; T—Selma, Tex.; Southern Equipment Co.; 50 KW.

1200 KILOCYCLES—249.9 METERS

WRBL—Columbus, Ga.; WRBL Radio Station Inc.; 50 W.
WABI—Bangor, Me.; Universalist Society of Bangor; 100 W.
WNBX—Springfield, Vt.; First Congregational Church Corporation; 10 W.
WCAX—Burlington, Vt.; Burlington Daily News; 100 W.
WORC-WEPS—Worcester, Mass.; T—Auburn, Mass.; Albert Frank Kleindeinst; 100 W.
KERN—Bakersfield, Calif.; Bakersfield Bdcg. Co.; 100 W.
WIBX—Utica, N. Y.; WIBX (Inc.); 300 W.*
WFBE—Cincinnati, Ohio; Post Publishing Co.; 250 W.*
WHBC—Canton, Ohio; St. John's Catholic Church; 10 W.
WLBG—Petersburg, Va.; T—Ettrick, Va.; WLBG Inc.; 250W.*
WNBO—Washington, Pa.; John Brownlee Spriggs; 100 W.
WCOD—Harrisburg, Pa.; Keystone Broadcasting Corporation; 100 W.
WNBW—Carbondale, Pa.; C. F. Schiessler and M. E. Stephens, doing business as Home Cut Glass & China Co.; 10 W.
KMLB—Monroe, La.; J. C. Liner; 100 W.
WABZ—New Orleans, La.; Samuel D. Reeks; 100 W.
WJBW—New Orleans, La.; C. Carlson; 100 W.
WBBZ—Ponca City, Okla.; C. L. Carrell; 100 W.
WFBC—Knoxville, Tenn.; Virgil V. Evans; 50 W.
KGHI—Little Rock, Ark.; O. A. Cook; 100 W.
KBTM—Paragould, Ark.; W. J. Beard, Beard's Temple of Music; 100 W.
WJBC—La Salle, Ill.; Wayne Hummer & H. J. Dee, doing business as Kaskaskia Broadcasting Co.; 100 W.
WJBL—Decatur, Ill.; Commodore Broadcasting Corporation; 100 W.
WWAE—Hammond, Ind.; Hammond-Calumet Broadcasting Corporation; 100 W.
KFJB—Marshalltown, Iowa; Marshall Electric Co. (Inc.); 250 W.*
WCAT—Rapid City, S. Dak.; South Dakota State School of Mines; 100 W.
KGDY—Huron, S. Dak.; Voice of South Dakota; 100 W.
KFWF—St. Louis, Mo.; St. Louis Truth Center (Inc.); 100 W.
KGDE—Fergus Falls, Minn.; Jaren Drug Co.; 250W.*
WCLO—Janesville, Wis.; WCLO Radio Corporation; 100 W.
WHBY—Green Bay, Wis.; T—West De Pere, Wis.; St. Norbert College; 100 W.
WIL—St. Louis, Mo.; Missouri Broadcasting Corporation; 250 W.*
KGFJ—Los Angeles, Calif.; Ben S. McGlashan; 100 W.
KGVO—Missoula, Mich.; Mosby's (Inc.); 100 W.
KFXD—Nampa, Idaho; Frank E. Hurt, trading as Service Radio Co.; 500 W.
KWG—Stockton, Calif.; Portable Wireless Telephone Co. (Inc.); 100 W.
KGEK—Yuma, Colo.; Elmer C. Beehler, trading as Beehler Electrical Equipment Co.; 100 W.
KGEW—Fort Morgan, Colo.; City of Fort Morgan; 100 W.
KVOS—Bellingham, Wash.; KVOS (Inc.); 100 W.
WFAM—South Bend, Ind.; South Bend Tribune; 100 W.
WBHS—Huntsville, Ala.; The Hutchens Co.; 50 W.
CKOV—Kelowna, British Columbia, Can.; J. W. B. Browne; 100 W.
10AB—Moose Jaw, Saskatchewan, Can.; Moose Jaw Radio Assn.; 25 W.
10AK—Stratford, Ontario, Can.; Classic Radio Club; 10 W.
10BJ—Prince Albert, Saskatchewan, Can.; Prince Albert Radio Club; 25 W.
10BP—Wingham, Ontario, Can.; Wingham Radio Club; 15 W.
10BQ—Brantford, Ontario, Can.; Telephone City Radio Assn.; 5 W.
10BU—Canora, Saskatchewan, Can.; Canora Radio Association; 15 W.

1205 KILOCYCLES—248.8 METERS

CMGB—Matanzas, Cuba; Jose Anorga; 30 W.

1210 KILOCYCLES—247.8 METERS

WMRJ—Jamaica, N. Y.; Peter J. Prinz; 100 W.
WJBI—Redbank, N. J.; Monmouth Broadcasting Co.; 100 W.
WGBB—Freeport, N. Y.; Harry H. Carman; 100 W.
WCOH—Yonkers, N. Y.; T—Greenville, N. Y.; Westchester Broadcasting Corporation, 100 W.
KGY—Olympia, Wash.; KGY Inc.; 100 W.
WOCL—Jamestown, N. Y.; A. E. Newton; 50 W.
WLCI—Ithaca, N. Y.; Lutheran Association of Ithaca, N. Y.; 50 W.
WPAW—Pawtucket, R. I.; Shartenberg & Robinson Co.; 100 W.
WSEN—Columbus, Ohio; Columbus Broadcasting Corporation; 100 W.
WJW—Mansfield, Ohio; John F. Weimer (owner Mansfield Broadcasting Association); 100 W.
WALR—Zanesville, Ohio; WALR Broadcasting Corp.; 100 W.
WBAX—Wilkes-Barre, Pa.; T—Plains Township, Pa.; John H. Stenger, Jr.; 100 W.
WJBU—Lewisburg, Pa.; Bucknell University; 100 W.
WBBL—Richmond, Va.; Grace Covenant Presbyterian Church; 100 W.
WMBG—Richmond, Va.; Havens & Martin (Inc.); 100 W.

(Continued on next page)

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—Troy, Ala.; Troy Bdcg. Co.; 100 W.

1210 KILOCYCLES—247.8 METERS (Cont.)

WSIX—Springfield, Tenn.; Jack M. and Louis R. Draughon, doing business as 638 Tire and Vulcanizing Co.; 100 W.
WSOC—Gastonia, N. C.; WSOC (Inc.); 100 W.
WJBY—Gadsden, Ala.; Gadsden Broadcasting Co. (Inc.); 100 W.
WQDX—Thomasville, Ga.; Stevens Luke; 50 W.
WRBQ—Greenville, Miss.; J. Pat Scully; 250 W.*
KWEA—Shreveport, La.; Hello World Broadcasting Corporation; 100 W.
KDLR—Devils Lake, N. Dak.; KDLR (Inc.); 100 W.
KGCR—Watertown, S. Dak.; Greater Kampeska Radio Corp.; 100 W.
KFOR—Lincoln, Nebr.; Howard A. Shuman; 250 W.*
WHBU—Anderson, Ind.; Anderson Broadcasting Corp.; 100 W.
KFVS—Cape Girardeau, Mo.; Oscar C. Hirsch, trading as Hirsch Battery & Radio Co.; 100 W.
WEBQ—Harrisburg, Ill.; First Trust & Savings Bank of Harrisburg, Ill.; 100 W.
KGNO—Dodge City, Kans.; Dodge City Broadcasting Co. (Inc.); 100 W.
KGRS—Amarillo, Tex.; E. B. Gish; 1 KW.
WSBC—Chicago, Ill.; World Battery Co. (Inc.); 100 W.
WCRW—Chicago, Ill.; Clinton R. White; 100 W.
WEDC—Chicago, Ill.; Emil Denemark (Inc.); 100 W.
WCBS—Springfield, Ill.; Chas. H. Messter and Harold L. Dewing; 100 W.
WTAX—Springfield, Ill.; WTAX (Inc.); 100 W.
WHBF—Rock Island, Ill.; Beardsley Specialty Co.; 100 W.
WOMT—Manitowoc, Wis.; Francis M. Kadow; 100 W.
WIBU—Poynette, Wis.; William C. Forrest; 100 W.
KMJ—Fresno, Calif.; James McClatchy Co.; 100 W.
KFXM—San Bernardino, Calif.; J. C. & E. W. Lee (Lee Bros. Broadcasting Co.); 100 W.
KPPC—Pasadena, Calif.; Pasadena Presbyterian Church; 50 W.
KFJI—Klamath Falls, Ore.; KFJI Broadcasters, Inc.; 100 W.
WPRO—Providence, R. I.; Cherry & Webb Broadcasting Co.; 100 W.
KGMP—Elk City, Okla.; Bryant Radio & Electric Co.; 100 W.
CFCO—Chatham, Ontario, Can.; John Beardall; 100 W.
CFNB—Fredericton, New Brunswick, Can.; Jas. S. Neill & Sons, Ltd.; 50 W.
CJOR—Vancouver, British Columbia, Can.; T—Sea Island, British Columbia, Can.; G. C. Chandler; 500 W.
CKMC—Cobalt, Ontario, Can.; R. L. MacAdam; 100 W.
XEX—Mexico City, Mex.; Excelsior; 500 W.

1220 KILOCYCLES—245.8 METERS

WCAD—Canton, N. Y.; St. Lawrence University; 500 W.
WCAE—Pittsburgh, Pa.; WCAE, Inc.; 1 KW.
WDAE—Tampa, Fla.; Tampa Publishing Co.; 1 KW.
WREN—Tanganoxie, Kans.; Jenny Wren Co.; 1 KW.
KFKU—Lawrence, Kans.; University of Kansas; 500 W.
KWSC—Pullman, Wash.; State College of Washington; 2 KW.*
KTW—Seattle, Wash.; First Presbyterian Church; 1 KW.

1225 KILOCYCLES—244.8 METERS

CMBY—Havana, Cuba; Callejas-Cosculluela; 350 W.

1230 KILOCYCLES—243.8 METERS

WNAC-WBIS—Boston, Mass.; T—Quincy, Mass.; Shepard Broadcasting Service (Inc.); 1 KW.
WPSC—State College, Pa.; The Pennsylvania State College; 500 W.
WSBT—South Bend, Ind.; South Bend Tribune; 500 W.
WFBM—Indianapolis, Ind.; Indianapolis Power & Light Co.; 1 KW.
KGGM—Albuquerque, N. Mex.; New Mexico Broadcasting Co.; 500 W.*
KYA—San Francisco, Calif.; Pacific Broadcasting Corporation; 1 KW.
KFQD—Anchorage, Alaska; Anchorage Radio Club; 250 W.
XETQ—Mexico City, Mex.; Carlos G. Caballero; 100 W.

1235 KILOCYCLES—242.8 METERS

CMCA—Havana, Cuba; Manuel Cruz; 150 W.

1240 KILOCYCLES—241-8 METERS

WXYZ—Detroit, Mich.; Kunsky-Trendle Broadcasting Corporation; 1 KW.
KTAT—Fort Worth, Tex.; T—Birdville, Tex.; S. A. T. Broadcast Co.; 1 KW.
WACO—Waco, Tex.; Central Texas Broadcasting Co. (Inc.); 1 KW.
KGCU—Mandan, N. Dak.; Mandan Radio Assn.; 250 W.
KLPM—Minot, N. Dak.; John B. Cooley; 250 W.
KTFI—Twin Falls, Idaho; Radio Bdcg. Corp.; 500 W.

1249 KILOCYCLES—240 METERS

CMAB—Pinar del Rio, Cuba; Francisco Martinez; 20 W.

1250 KILOCYCLES—239.9 METERS

WGCP—Newark, N. J.; May Radio Broadcast Corporation; 250 W.
WODA—Paterson, N. J.; Richard E. O'Dea; 1 KW.
WAAM—Newark, N. J.; WAAM (Inc.); 2 KW.*
WDSU—New Orleans, La.; T—Gretna, La.; Joseph H. Uhalt; 1 KW.
WLB—Minneapolis, Minn.; T—St. Paul, Minn.; University of Minnesota; 1 KW.
WRHM—Minneapolis, Minn.; T—Fridley, Minn.; Minnesota Broadcasting Corporation; 1 KW.
KFMX—Northfield, Minn.; Carlton College; 1 KW.
WCAL—Northfield, Minn.; St. Olaf College; 1 KW.
KFOX—Long Beach, Calif.; Nichols and Warriner (Inc.); 1 KW.
XEFA—Mexico City, Mex.; Manuel F. Murguia; 250 W.

1260 KILOCYCLES—238.0 METERS

WLBW—Oil City, Pa.; Radio-Wire Program Corporation of America; 1 K.*
KWWG—Brownsville, Tex.; The Brownsville Herald Publishing Co.; 500 W.
WTOC—Savannah, Ga.; Savannah Broadcasting Co., (Inc.); 500 W.
KRGV—Harlingen, Tex.; KRGV (Inc.); 500 W.
KOIL—Council Bluffs, Iowa; Mona Motor Oil Co.; 1 KW.
KVOA—Tuscon, Ariz.; Robert M. Riculfi; 500 W.

1270 KILOCYCLES—236.1 METERS

WEAI—Ithaca, N. Y.; Cornell University; 1 KW.
WFBR—Baltimore, Md.; Baltimore Radio Show (Inc.); 500 W.
WASH—Grand Rapids, Mich. (Uses transmitter of WOOD); WASH Broadcasting Corporation; 500 W. (1 KW.—C.P.).
WOOD—Grand Rapids, Mich.; T—Furn-Kunsky-Trendle Broadcasting Corp.; 500 W.
WJDX—Jackson, Miss.; Lamar Life Insurance Co.; 1 KW.
KWLC—Decorah, Iowa; Luther College; 100 W.
KGCA—Decorah, Iowa; Charles W. Greenley; 50 W.
KOL—Seattle, Wash.; Seattle Broadcasting Co. (Inc.); 1 KW.
KVOR—Colorado Springs, Colo.; Reynolds Radio Co., Inc.; 1 KW.
CMCU—Havana, Cuba; Jorge Garcia Serra; 150 W.

1280 KILOCYCLES—234.2 METERS

WCAM—Camden, N. J.; City of Camden; 500 W.
WCAP—Asbury Park, N. J.; Radio Industries Broadcast Co.; 500 W.
WOAX—Trenton, N. J.; WOAX (Inc.); 500 W.
WDOD—Chattanooga, Tenn.; T—Brainerd, Tenn.; WDOD Broadcasting Corporation; 1 KW. (5 KW.—C.P.).
WRR—Dallas, Tex.; City of Dallas, Tex.; 500 W.
WIBA—Madison, Wis.; Badger Broadcasting Co.; 500 W.
KFBB—Great Falls, Mont.; Buttrey Broadcast (Inc.); 2½ KW.*

1285 KILOCYCLES—233.4 METERS

CMCW—Havana, Cuba; Jose Lorenzo; 150 W.

1290 KILOCYCLES—232.4 METERS

WNBZ—Saranac Lake, N. Y.; Earl J. Smith and William Mace, doing business as Smith & Mace; 50 W.
WJAS—Pittsburgh, Pa.; T—North Fayette Township, Pa.; Pittsburgh Radio Supply House; 2½ KW.*
KTSA—San Antonio, Tex.; Lone Star Broadcasting Co. (Inc.); 2 KW.*
KFUL—Galveston, Tex.; News Publishing Co.; 500 W.
KLCN—Blytheville, Ark.; Charles Leo Lintzenich; 50 W.
WEBC—Superior, Wisc.; Head of the Lakes Broadcasting Co.; 2½ KC.*
KDYL—Salt Lake City, Utah; Intermountain Broadcasting Corporation; 1 KW.

1300 KILOCYCLES—230.6 METERS

WBBR—Brooklyn, N. Y.; T—Rossville, N. Y. (Staten Island); Peoples Pulpit Association; 1 KW.
WFAB—New York, N. Y.; T—Carlstadt, N. J.; Defenders of Truth Society (Inc.); 1 KW.
WEVD—New York, N. Y.; T—Forest Hills, N. Y.; Debs Memorial Radio Fund (Inc.); 500 W.
WHAZ—Troy, N. Y.; Rensselaer Polytechnic Institute; 500 W.
WIOD—Miami, Fla.; T—Miami Beach, Fla.; Isle of Dreams Broadcasting Corporation; 1KW.
KFH—Wichita, Kans.; Radio Station KFH Co.; 1 KW.
WOQ—Kansas City, Mo.; Unity School of Christianity; 1 KW.
KFJR—Portland, Ore.; Ashley C. Dixon, trading as Ashley C. Dixon & Son; 500 W.
KTBR—Portland, Ore.; M. E. Brown; 500 W.
KFAC—Los Angeles, Calif.; Los Angeles Broadcasting Co.; 1 KW.
XEM—Mexico City, Mex.; Maria T. de Gutierez; 250 W.

1310 KILOCYCLES—228.9 METERS

—Galesburg, Ill.; S. E. Yaste and Burrell Banash; 100 W.; C. P. only.
WKAV—Laconia, N. H.; Laconia Radio Club; 100 W.
WEBR—Buffalo, N. Y.; Howell Broadcasting Co. (Inc.); 250 W.*
WMBO—Auburn, N. Y.; WMBO, Inc.; 100 W.
WNBH—New Bedford, Mass.; T—Fairhaven, Mass.; Irving Vermilya, trading as New Bedford Broadcasting Co.; 100 W.
WOL—Washington, D. C.; American Broadcasting Co.; 100 W.
WGH—Newport News, Va.; Hampton Roads Broadcasting Corporation; 100 W.
WEXL—Royal Oak, Mich.; Royal Oak Broadcasting Co.; 50 W.
WFDF—Flint, Mich.; Frank D. Fallain; 100 W.
WBEO—Marquette, Mich.; Lake Superior Broadcasting Co.; 100 W.
WHAT—Philadelphia, Pa.; Independence Broadcasting Co.; 100 W.
WTEL—Philadelphia, Pa.; Foulkrod Radio Engineering Co.; 100 W.
WJAC—Johnstown, Pa.; Johnstown Automobile Co.; 100 W.
WFBG—Altoona, Pa.; William F. Gable Co.; 100 W.
WRAW—Reading, Pa.; Reading Broadcasting Co.; 100 W.
WGAL—Lancaster, Pa.; WGAL, Incorporated; 100 W.
WSAJ—Grove City, Pa.; Grove City College; 100 W.
WBRE—Wilkes-Barre, Pa.; Louis G. Baltimore; 100 W.
WKBC—Birmingham, Ala.; R. B. Broyles, trading as R. B. Broyles Furniture Co.; 100 W.
WTJS—Jackson, Tenn.; Sun Pub. Co.; 100 W.
WTSL—Laurel, Miss.; G. H. Houseman; 100 W.
WROL—Knoxville, Tenn.; Stuart Broadcasting Corporation; 100 W.
KRMD—Shreveport, La.; Radio Station KRMD, Inc.; 50 W.
WSJS—Winston-Salem, N. C.; Winston-Salem Journal Co.; 100 W.
KTLC—Houston, Tex.; Houston Broadcasting Co.; 100 W.
KFPM—Greenville, Tex.; Dave Ablowich, trading as The New Furniture Co.; 15 W.
KTSM—El Paso, Tex.; W. S. Bledsoe and W. T. Blackwell; 100 W.
WDAH—El Paso, Tex.; W. S. Bledsoe and W. T. Blackwell; 100 W.
KFPL—Dublin, Tex.; C. C. Baxter; 100 W.
KFXR—Oklahoma City, Okla.; Exchange Avenue Baptist Church; 250 W.*
WKBS—Galesburg, Ill.; Permil N. Nelson; 100 W.
WCLS—Joliet, Ill.; WCLS (Inc.); 100 W.
WKBB—Joliet, Ill.; Sanders Brothers Radio Station; 100 W.
KFGQ—Boone, Iowa; Boone Biblical College; 100 W.
KGFW—Ravenna, Nebr.; Central Nebraska Broadcasting Corporation; 100 W.
WBOW—Terre Haute, Ind.; Banks of Wabash (Inc.); 100 W.
WJAK—Marion, Ind.; Marion Broadcast Co.; 50 W.
WLBC—Muncie, Ind.; Donald H. Burton; 50 W.
KGBX—St. Joseph, Mo.; KGBX (Inc.); 100 W.
KFBK—Sacramento, Calif.; James McClatchy Co.; 100 W.
KCRJ—Jerome, Ariz.; Charles C. Robinson; 100 W.
KGCX—Wolf Point, Mont.; First State Bank of Vida; 250 W.*
KGEZ—Kalispell, Mont.; Donald C. Treloar; 100 W.
KFXJ—Grand Junction, Colo.; R. G. Howell and Charles Howell, doing business as Western Slope Broadcasting Co.; 100 W.
KMED—Medford, Ore.; Mrs. W. J. Virgin; 100 W.
KXRO—Aberdeen, Wash.; KXRO (Inc.); 100 W.
KIT—Yakima, Wash.; Carl E. Haymond; 100 W.
KFYO—Lubbock, Tex.; Kirksey Bros.; 250 W.

1320 KILOCYCLES—227.1 METERS

WADC—Akron, Ga.; Allen T. Simmons; 1 KW.
WSMB—New Orleans, La.; Saenger Theatres (Inc.) and Maison Blanche Co.; 500 W.
KID—Idaho Falls, Idaho; KID Broadcasting Co.; 500 W.*
KGHF—Pueblo, Colo.; Curtis P. Ritchie and Joe E. Finch; 500 W.*
KGMB—Honolulu, Hawaii; Honolulu Broadcasting Co. (Ltd.); 250 W.

1330 KILOCYCLES—225.4 METERS

KMO—Tacoma, Wash.; KMO. Inc.; 250 W.
WDRC—Hartford, Conn.; T—Bloomfield, Conn.; WDRC (Inc.); 500 W.
WSAI—Cincinnati, O.; T—Mason, Ohio; Crosley Radio Corporation (lessee); 1 KW.*
WTAQ—Eau Claire, Wis.; T—Township of Washington, Wis.; Gillette Rubber Co.; 1 KW.
KSCJ—Sioux City, Iowa; Perkins Brothers Co.; 2½ KW.*
KGB—San Diego, Calif.; Don Lee, Inc.; 500 W.

1340 KILOCYCLES—223.7 METERS

KGIR—Butte, Mont.; KGIR (Inc.); 500 W.
WSPD—Toledo, Ohio; Toledo Broadcasting Co.; 1 KW.
KFPW—Fort Smith, Ark.; Southwestern Hotel Co.; 50 W.
WCOA—Pensacola, Fla.; Pensacola Bdcg. Co.; 500 W.
KFPY—Spokane, Wash.; Symons Broadcasting Co.; 1 KW.

1345 KILOCYCLES—223 METERS

CMCR—Havana, Cuba; Aurelio Hernandez; 150 W.
CMCY—Havana, Cuba; M. D. Autran; 250 W.

1350 KILOCYCLES—222.1 METERS

WAWZ—Zarephath, N. J.; Pillar of Fire; 250 W.
WMSG—New York, N. Y.; Madison Square Garden Broadcast Corporation; 250 W.
WCDA—New York, N. Y.; T—Cliffside Park, N. J.; Italian Educational Broadcasting Co. (Inc.); 250 W.
WBNX—New York, N. Y.; Standard Cahill Co. (Inc.); 250 W.
KWKK—St. Louis, Mo.; T—Kirkwood, Mo.; Greater St. Louis Broadcasting Corporation; 1 KW.

1350 KILOCYCLES—222.1 METERS (Cont.)

WEHC—Emory, Va.; Emory & Henry College; 500 W.
KIDO—Boise, Idaho; Boise Broadcasting Station; 1 KW.

1360 KILOCYCLES—220.4 METERS

WFBL—Syracuse, N. Y.; Onondaga Radio Broadcasting Corporation; 1 KW.
WQBC—Vicksburg, Miss.; Delta Broadcasting Co. (Inc.); 500 W.
WCSC—Charleston, S. C.; South Carolina Broadcasting Co., Inc.; 500 W.
WJKS—Gary, Ill.; Johnson-Kennedy Radio Corporation; 1¼ KW.*
WGES—Chicago, Ill.; Oak Leaves Broadcasting Station (Inc.); 1 KW.*
KGER—Long Beach, Calif.; Consolidated Broadcasting Corp.; 1 KW.

1370 KILOCYCLES—218.7 METERS

WRDO—Augusta, Me.; WRDO, Inc.; 100 W.
WQDM—St. Albans, Vt.; A. J. St. Antoine; 100 W.
WLEY—Lexington, Mass.; Carl S. Wheeler, trading as Lexington Air Stations; 250 W.*
WSVS—Buffalo, N. Y.; Elmer S. Pierce, principal, Seneca Vocational High School; 50 W.
WBGF—Glens Falls, N. Y.; W. Neal Parker and Herbert H. Metcalfe; 50W.
WCBM—Baltimore, Md.; Baltimore Broadcasting Corporation; 250 W.*
WBTM—Danville, Va.; L. H., R. G. and A. S. Clarke, doing business as Clarke Electric Co.; 100 W.
WLVA—Lynchburg, Va.; Lynchburg Broadcasting Corporation; 100 W.
WHBD—Mount Orab, Ohio; F. P. Moler; 100 W.
WHDF—Calumet, Mich.; Upper Michigan Broadcasting Co.; 250 W.*
WJBK—Highland Park, Mich.; James F. Hopkins (Inc.); 50 W.
WIBM—Jackson, Mich.; WIBM (Inc.); 100 W.
WRAK—Williamsport, Pa.; Clarence R. Cummins; 100 W.
WHBQ—Memphis, Tenn.; Broadcasting Station WHBQ (Inc.); 100 W.
KGFG—Oklahoma City, Okla.; Oklahoma Broadcasting Co. (Inc.); 100 W.
KCRC—Enid, Okla.; Enid Radiphone Co.; 250 W.*
WMBR—Tampa, Fla.; F. J. Reynolds; 100 W.
KMAC—San Antonio, Tex.; W. W. McAllister; 100 W.
KFJZ—Fort Worth, Tex.; Ralph S. Bishop; 100 W.
KONO—San Antonio, Tex.; Mission Broadcasting Co.; 100 W.
KGKL—San Angelo, Tex.; KGKL (Inc.), 100 W.
KFLX—Galveston, Tex.; George Roy Clough; 100 W.
WGL—Fort Wayne, Ind.; Fred C. Zeig (Allen-Wayne Co.); 100 W.
KGDA—Mitchell, S. Dak.; Mitchell Broadcasting Corporation; 100 W.
KFJM—Great Forks, N. Dak.; University of North Dakota; 100 W.
KWKC—Kansas City, Mo.; Wilson Duncan, trading as Wilson Duncan Broadcasting Co.; 100 W.
WRJN—Racine, Wis.; Racine Broadcasting Corporation; 100 W.
KGAR—Tucson, Ariz.; Tucson Motor Service; 250 W.*
KRE—Berkeley, Calif.; First Congregational Church of Berkeley; 100 W.
KOOS—Marshfield, Ore.; H. H. Hansetly (Inc.); 100 W.
KFBL—Everett, Wash.; Otto Leese and Robert Leese, doing business as Leese Bros.; 50 W.
KVL—Seattle, Wash.; KVL, Incorporated; 100 W.
KGFL—Raton, N. Mex.; KGFL, Inc.; 50 W.
KUJ—Walla Walla, Wash.; KUJ, Inc.; 100 W.
WRAM—Wilmington, N. C.; Wilmington Radio Asso.; 100 W.
WJTL—Tifton, Ga.; Oglethorpe University; 100 W.
WPFB—Hattiesburg, Miss.; Hattiesburg Bdcg. Corp.; 100 W.
CMGH—Matanzas, Cuba; Alberto Alvarez; 150 W.

1375 KILOCYCLES—218 METERS

CMAC—Pinar del Rio, Cuba; Oscar S. Mechoso; 30 W.
CMGE—Cardenas, Cuba; Genaro Sebater; 30 W.

1380 KILOCYCLES—217.3 METERS

WSMK—Dayton, Ohio; Stanley M. Krohn, Jr.; 200 W.
KQV—Pittsburgh, Pa.; KQV, Inc.; 500 W.
KSO—Clarinda, Iowa; Iowa Broadcasting Co.; 500 W.
WKBH—LaCrosse, Wis.; WKBH (Inc.); 1 KW.
KOH—Reno, Nev.; The Bee, Inc.; 500 W.
KQV—Pittsburgh, Pa.; KQV Broadcasting Co.; 500 W.
XETB—Torreon Coah., Mex.; Jose A. Berumen; 125 W.

1382 KILOCYCLES—217.25 METERS

CMJC—Camaguey, Cuba; Feliciano Isaac; 75 W.

1390 KILOCYCLES—215.7 METERS

WHK—Cleveland, Ohio; T—Seven Hills, Ohio; Radio Air Service Corporation; 1 KW.
KLRA—Little Rock, Ark.; Arkansas Broadcasting Co.; 1 KW.
KUOA—Fayetteville, Ark.; Southwestern Hotel Co.; 1 KW.
KOY—Phoenix, Ariz.; Nielsen Radio & Sporting Goods Co.; 500 W.

1395 KILOCYCLES—215 METERS

CMCG—Havana, Cuba; Jose Justo Moran; 30 W.

1400 KILOCYCLES—214.2 METERS

CMCH—Havana, Cuba; Hernani Torralbas; 20 W.
CMCM—Havana, Cuba; Martinez-Madicu; 15 W.
WCGU—Brooklyn, N. Y.; United States Broadcasting Corporation; 500 W.
WFOX—Brooklyn, N. Y.; Paramount Broadcasting Corporation; 500 W.
WLTH—Brooklyn, N. Y.; Voice of Brooklyn (Inc.); 500 W.
WBBC—Brooklyn, N. Y.; Brooklyn Broadcasting Corporation; 500 W.
KOCW—Chickasha, Okla.; Oklahoma College for Women; 500 W.*
WCMA—Culver, Ind.; General Broadcasting Corporation; 500 W.
WKBF—Indianapolis, Ind.; T—Clermont, Ind.; Indianapolis Broadcasting (Inc.); 500 W.
WBAA—West Lafayette, Ind.; Purdue University; 1 KW.*
KLO—Ogden, Utah; Peery Building Co.; 500 W.
XEP—N. Laredo, Tams., Mex.; Asociacion Radiodifusora Latino-Americana, S. A.; 200 W.

1410 KILOCYCLES—212.6 METERS

WRBX—Roanoke, Va.; Richmond Development Corporation; 250 W.
WBCM—Bay City, Mich.; T—Hampton Township, Mich.; James E. Davidson; 500 W.
KGRS—Amarillo, Tex.; E. B. Gish (Gish Radio Service); 1 KW.
WDAG—Amarillo, Tex.; National Radio and Broadcasting Corporation; 1 KW.
WODX—Mobile, Ala.; T—Springhill, Ala.; Mobile Broadcasting Corporation; 500 W.
WSFA—Montgomery, Ala.; Montgomery Broadcasting Co. (Inc.); 500 W.
KFLV—Rockford, Ill.; Rockford Broadcasters (Inc.); 500 W.
WHBL—Sheboygan, Wis.; Press Publishing Co.; 500 W.
WAAB—Boston, Mass.; Bay State Broadcasting Corp.; 500 W.
WHIS—Bluefield, W. Va.; Daily Telegraph; 250 W.

1420 KILOCYCLES—211.1 METERS

WTBO—Cumberland, Md.; Associated Broadcasting Corporation; 210 W.*
WILM—Wilmington, Del.; T—Edge Moor, Del.; Delaware Broadcasting Co. (Inc.); 100 W.
—Springfield, Mass.; Albert S. Moffat; 100 W.
WPAD—Paducah, Ky.; Paducah Broadcasting Co.. Inc.; 100 W.

1420 KILOCYCLES—211.1 METERS (Cont.)

WERE—Erie, Pa.; Erie Dispatch-Herald Broadcasting Corporation; 100 W.
WMBC—Detroit, Mich.; Michigan Broadcasting Co.; 210 W.*
WELL—Battle Creek, Mich.; Enquirer-News Co.; 50 W.
WFDW—Anniston, Ala. T—Talladega, Ala.; Raymond C. Hammett; 100 W.
WJBO—New Orleans, La.; Valdemar Jensen; 100 W.
KGFF—Shawnee, Okla.; D. R. Wallace (owner KGFF Broadcasting Co.); 100 W.
KABC—San Antonio, Tex.; Alamo Broadcasting Co. (Inc.); 100 W.
KXYZ—Houston, Tex.; Harris County Broadcast Co.; 100 W.
WSPA—Spartanburg, S. C.; Virgil V. Evans, trading as The Voice of South Carolina; 250 W.*
KICK—Red Oak, Iowa; Red Oak Radio Corporation; 100 W.
WIAS—Ottumwa, Iowa; Iowa Broadcasting Co.; 100 W.
WLBF—Kansas City, Kans.; The WLBF Broadcasting Co.; 100 W.
WMBH—Joplin, Mo.; Edwin Dudley Aber; 250 W.*
WEHS—Evanston, Ill.; WEHS (Inc.); 100 W.
WHFC—Cicero, Ill.; WHFC, Inc.; 100 W.
WKBI—Chicago, Ill.; WKBI, Inc.; 100 W.
KFIZ—Fond du Lac, Wis.; The Reporter Printing Co.; 100 W.
KFXY—Flagstaff, Ariz.; Albert H. Scherman; 100 W.
KGIX—Los Vegas, Nev.; Los Vegas Radio Corp.; 100 W.
KGIW—Trinidad, Colo.; Leonard E. Wilson; 100 W.
KGKX—Sandpoint, Idaho; Sandpoint Broadcasting Co., 100 W.
KGGC—San Francisco, Calif.; The Golden Gate Broadcasting Co.; 100 W.
KXL—Portland, Ore.; KXL Broadcasters, Inc.; 100 W.
KBPS—Portland, Ore.; Benson Polytechnic School; 100 W.
KORE—Eugene, Ore.; Frank L. Hill and C. G. Phillips, doing business as Eugene Broadcast Station; 100 W.
WJMS—Ironwood, Mich.; Morris Johnson; 100 W.
WDEV—Waterbury, Vermont; Harry C. Whitehall; 50 W.
WENC—Americus, Ga.; Americus Broadcasting Co.; 100 W.
WAGM—Presque Isle, Me.; Aroostock Broadcasting Corp.; 100 W.
WHDL—Tupper Lake, N. Y., Tupper Lake Bdcg. Co., Inc.; 100 W.

1430 KILOCYCLES—209.7 METERS

WHP—Harrisburg, Pa.; T—Lemoyne, Pa.; WHP (Inc.); 1 KW.*
WBAK—Harrisburg, Pa.; Pennsylvania State Police, Commonwealth of Pennsylvania; 1 KW.*
WCAH—Columbus, Ohio; Commercial Radio Service Co.; 500 W.
WNBR—Memphis, Tenn.; Memphis Broadcasting Co.; 500 W.
KGNF—North Platte, Nebr.; Great Plains Broadcasting Co.; 500 W.
KECA—Los Angeles, Calif.; Earle C. Anthony, Inc.; 1 KW.
WFEA—Manchester, N. H.; New Hampshire Broadcasting Co.; 500 W.
WHEC—Rochester, N. Y.; WHEC, Inc.; 500 W.
WOKO-WABO—Albany, N. Y.; T—Mount Beacon, N. Y.; WOKO (Inc.); 500 W.

1440 KILOCYCLES—208.2 METERS

WCBA—Allentown, Pa.; B. Bryan Musselman; 250 W.
WSAN—Allentown, Pa.; Allentown Call Publishing Co. (Inc.); 250 W.
WBIG—Greensboro, N. C.; North Carolina Broadcasting Co. (Inc.); 500 W.
WTAD—Quincy, Ill.; Illinois Broadcasting Corporation; 500 W.
WMBD—Peoria Heights, Ill.; E. M. Kahler (owner Peoria Heights Radio Laboratory); 1 KW.*
KLS—Oakland, Calif.; E. N. and S. W. Warner, doing business as Warner Bros.; 250 W.
WMBD—Peoria Heights, Ill.; Peoria Bdcg. Co.; 1 KW.
WTAD—Quincy, Ill.; Ill. Bdcg. Corp.; 500 W.
KDFN—Casper, Wyo.; Donald L. Hathaway; 500 W.
CMBI—Havana, Cuba; Francisco Mayorquim; 30 W.
CMBN—Havana, Cuba; Armado Romeu; 30 W.
CMBL—Havana, Cuba; Julio C. Hidalgo; 20 W.

1450 KILOCYCLES—206.8 METERS

WSAR—Fall River, Mass.; Doughty & Welch Elec. Co., Inc.; 250 W.
WBMS—Hackensack, N. J.; WBMS Broadcasting Corporation; 250 W.
WNJ—Newark, N. J.; Radio Investment Co. (Inc.); 250 W.
WHOM—Jersey City, N. J.; New Jersey Broadcasting Corporation; 250 W.
WSAR—Fall River, Mass.; Doughty & Welch Electric Co. (Inc.); 250 W.
WGAR—Cleveland, Ohio; WGAR Broadcasting Co.; 500 W.
WTFI—Athens, Ga.; Toccoa Falls Institute; 500 W.
KTBS—Shreveport, La.; Tri State Broadcasting System (Inc.); 1 KW.

1460 KILOCYCLES—205.4 METERS

WJSV—Alexandria, Va.; T—Mt. Vernon Hills, Va.; WJSV, Inc.; 10 KW.
KSTP—St. Paul, Minn.; T—Westcott, Minn.; National Battery Broadcasting Co.; 10 KW.

1470 KILOCYCLES—204.0 METERS

WLAC—Nashville, Tenn.; Life and Casualty Insurance Co.; 5 KW.
KGA—Spokane, Wash.; Northwest Broadcasting System (Inc.); 5 KW.

1480 KILOCYCLES—202.6 METERS

WKBW—Buffalo, N. Y.; T—Amherst, N. Y.; Buffalo Broadcasting Co.; 5 KW.
KFJF—Oklahoma City, Okla.; National Radio Manufacturing Co.; 5 KW.

1490 KILOCYCLES—201.2 METERS

WCKY—Covington, Ky.; T—Crescent Springs, Ky.; L. B. Wilson (Inc.); 5 KW.
WCHI—Chicago, Ill.; T—Batavia, Ill.; Midland Broadcasting Co.; 5 KW.

1500 KILOCYCLES—199.9 METERS

WFDV—Rome, Ga.; Rome Broadcasting Corp.; 100 W.
WMBA—Newport, R. I.; LeRoy Joseph Beebe; 100 W.
WLOE—Boston, Mass. T.—Chelsea, Mass.; Boston Broadcasting Co. 250 W.
WNBF—Binghamton, N. Y.; Howitt-Wood Radio Co. (Inc.); 100 W.
WMBQ—Brooklyn, N. Y.; Paul J. Gollhofer; 100 W.
WLBX—Long Island City, N. Y.; John N. Brahy; 100 W.
WWRL—Woodside, N. Y.; Long Island Broadcasting Corporation; 100 W.
WSYB—Rutland, Vt.; H. E. Seward, Jr., and Philip Weiss, doing business as Seward & Weiss Music Co.; 250 W.
WKBZ—Ludington, Mich.; Karl L. Ashbacker; 50 W.
WMPC—Lapeer, Mich.; First Methodist Protestant Church of Lapeer; 100 W.
WPEN—Philadelphia, Pa.; Wm. Penn Broadcasting Co.; 250 W*.
WWSW—Pittsburgh, Pa.; Walker & Downing Radio Corp.; 100 W.
WOPI—Bristol, Tenn.; Radiophone Broadcasting Station WOPI (Inc.) 100 W.
KNOW—Austin, Tex.; A. P. Miller; 100 W.
WRDW—Augusta, Ga.; Musicove (Inc.); 100 W.
KGFI—Corpus Christi, Tex.; Eagle Broadcasting Co. (Inc.); 250 W*.
KGKB—Tyler, Tex.; East Texas Bldg. Co.; 100 W.
KGIZ—Grant City, Mo.; Grant City Park Corporation; 100 W.
KGKY—Scottsbluff, Nebr.; Hillard Co. (Inc.); 100 W.
WKBV—Connersville, Ind.; William O. Knox, trading as Knox Battery & Electric Co.; 150 W*.
KGFK—Moorehead, Minn.; Red River Broadcasting Co. (Inc.); 50 W.
KPJM—Prescott, Ariz.; A. P. Miller; 100 W.
KXO—El Centro, Calif.; E. R. Irey and F. M. Bowles; 100 W.
KDB—Santa Barbara, Calif.; Santa Barbara Broadcasters, Ltd.; 100 W.
KREG—Santa Ana, Calif.; J. S. Edwards; 100 W.
KPQ—Wenatchee, Wash.; Wescoast Broadcasting Co.; 50 W.
WMIL—Brooklyn, N. Y.; Arthur Faske; 100 W.
XETZ—Coyoacan, D. F., Mex.; Manuel Zetina; 100 W.
CMBQ—Havana, Cuba; Gali-Sardinas; 50 W.
CMBR—Havana. Cuba; Tomas Basail; 15 W.

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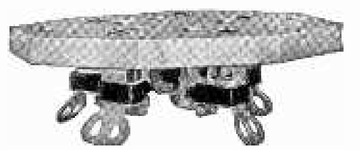
Cat. HCF-6—(six-pin base). Net price...59c

ISOLANTITE SOCKETS



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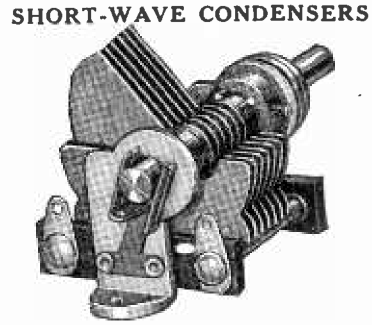

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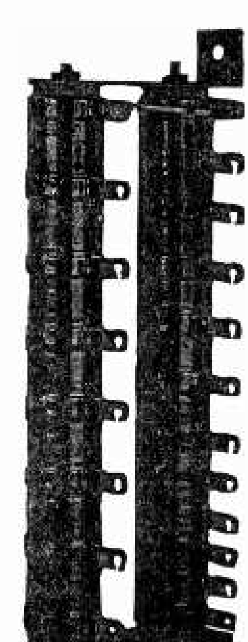

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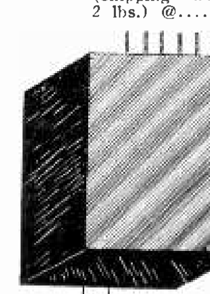

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