APRIL 28 1934

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Alan Mannion's Powerful SHORT-WAVE CONVERTER

RADIO WORLD

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The First and Only National Radio Weekly

631st Consecutive Issue *Thirteenth Year*

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—

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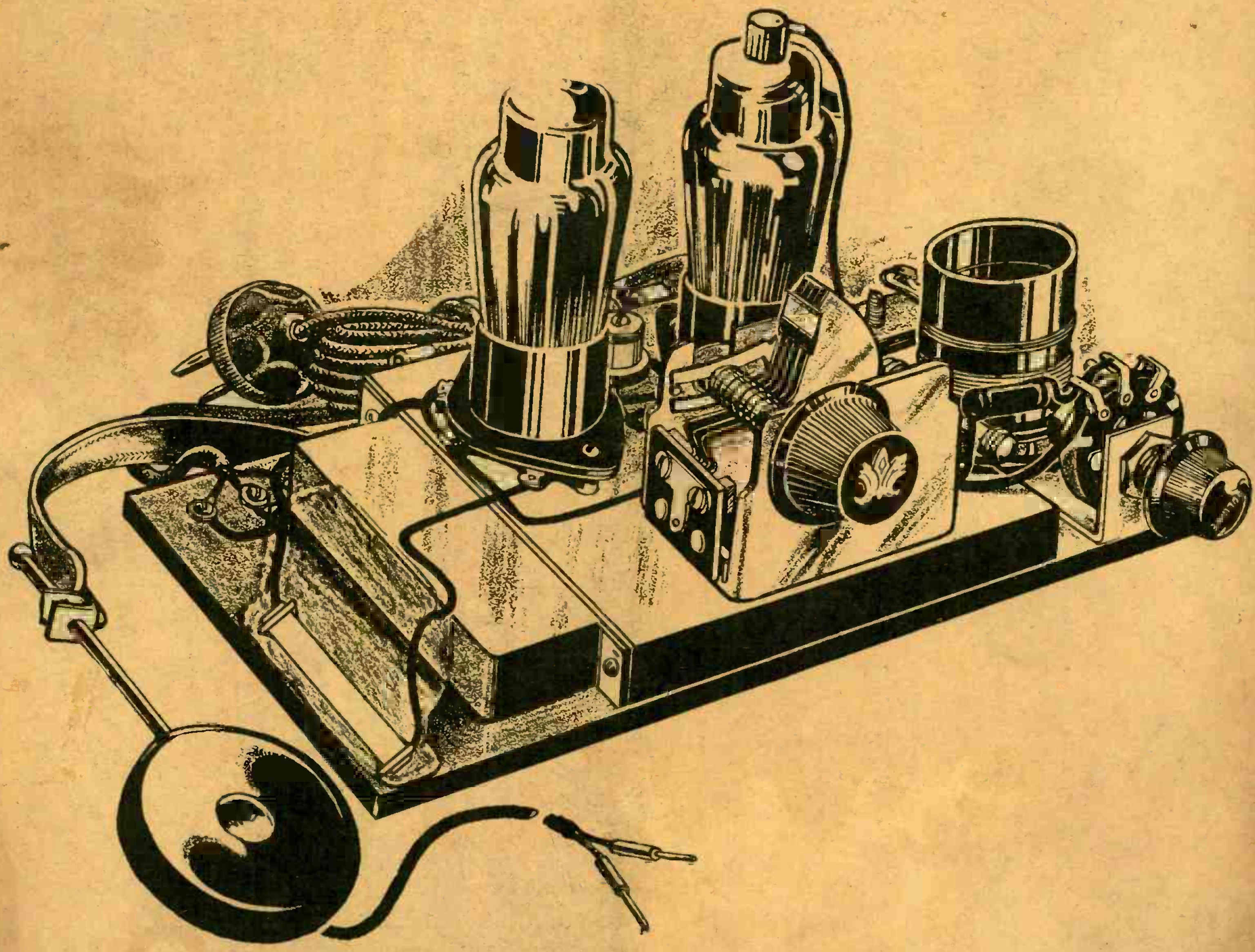
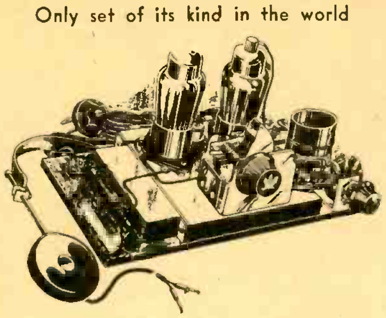


Here is a circuit for short waves, for a universal receiver, embodying some refreshing ideas conceived by H. G. Cisin. It covers broadcasts as well as short waves. See pages 4 and 5 for article.

ALL ELECTRIC
All-Wave Air Scout

Only set of its kind in the world



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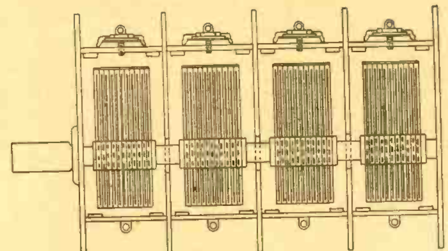

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Technical Editor

J. MURRAY BARRON
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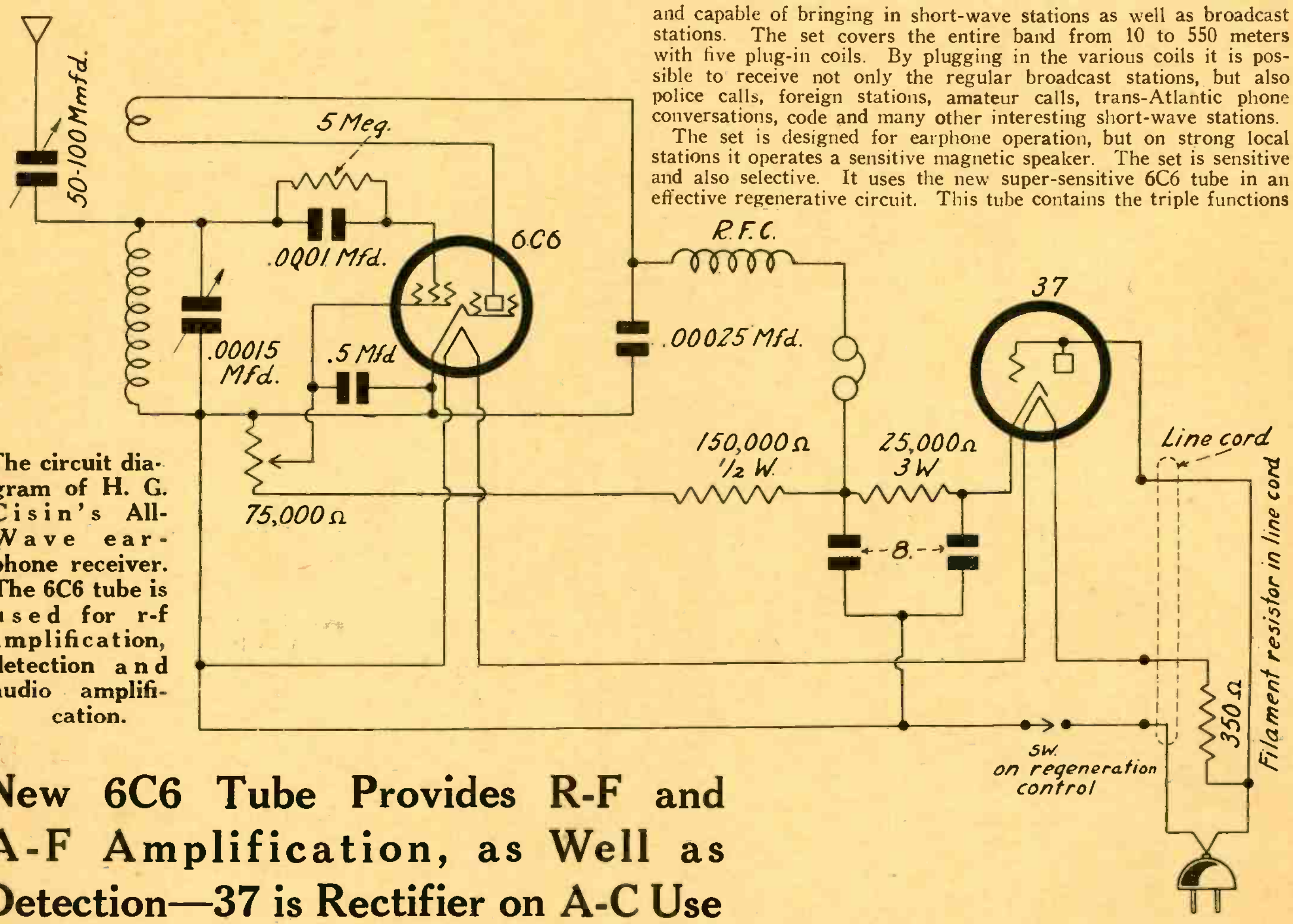
A 3-Lb. Universal All-Wave Earphone Set



The circuit diagram of H. G. Cisin's All-Wave earphone receiver. The 6C6 tube is used for r-f amplification, detection and audio amplification.

New 6C6 Tube Provides R-F and A-F Amplification, as Well as Detection—37 is Rectifier on A-C Use

A NEW YORK engineer, H. G. Cisin, holds a patent application Serial Number 592,586 on a radio circuit which permits the operation of a radio receiver interchangeably on either a.c. or d.c. and reduces the cost of a radio set considerably by eliminating the power transformer usually required in the ordinary electric set. This circuit is now used in practically all the sub-midget receivers put out by more than fifty set manufacturers.

The new All-Wave Air Scout is licensed by the inventor. Mr. Cisin has incorporated a number of other developments and claims this receiver is the "only set of its kind in the world."

For example, the set contains fewer parts than other a.c.-d.c. sets. It is simpler in design and in construction. It is moderately-priced and capable of bringing in short-wave stations as well as broadcast stations. The set covers the entire band from 10 to 550 meters with five plug-in coils. By plugging in the various coils it is possible to receive not only the regular broadcast stations, but also police calls, foreign stations, amateur calls, trans-Atlantic phone conversations, code and many other interesting short-wave stations.

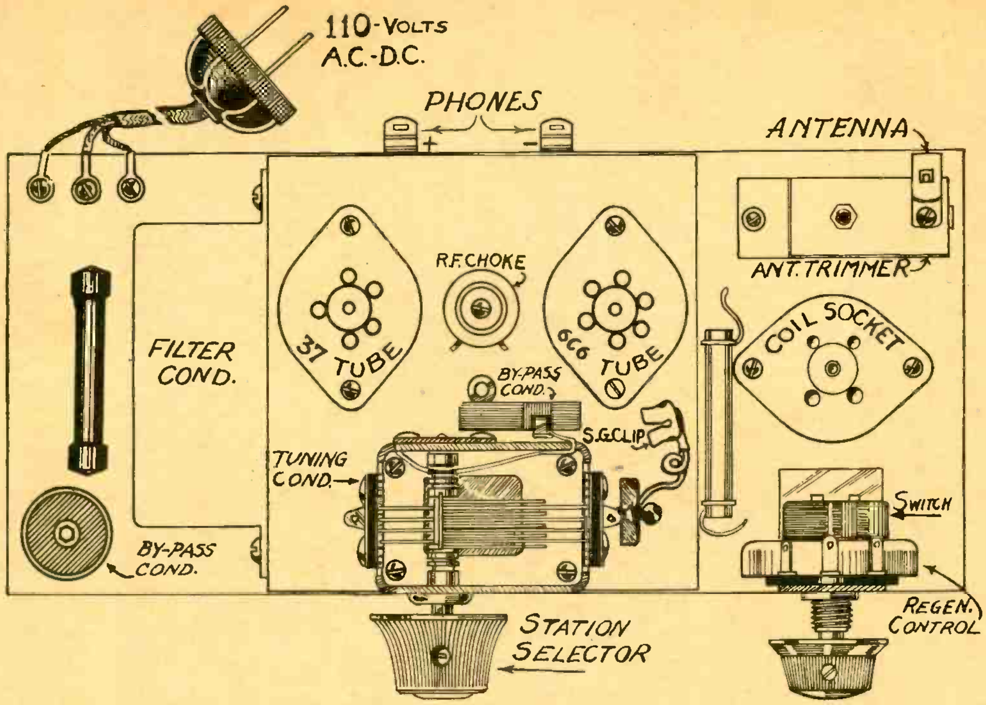
The set is designed for earphone operation, but on strong local stations it operates a sensitive magnetic speaker. The set is sensitive and also selective. It uses the new super-sensitive 6C6 tube in an effective regenerative circuit. This tube contains the triple functions of r.f. tube, detector and audio amplifier. In fact, it is really the only essential or "working" tube in the receiver. The other tube merely serves the purpose of rectifying when the receiver is used on alternating current. The rectifier tube is a 37.

Filter Choke Omitted

A glance at the circuit or layout immediately reveals the extreme simplicity. No filter choke is necessary. Even the conventional cabinet is no longer used. The set operates directly from any house-lighting circuit. It works as well on a.c. as on d.c. It will operate on any voltage of from 105 to 120 volts and when used on a.c. it will operate on any frequency from 40 to 60 cycles or even higher

LAYOUT OF PARTS FOR CISIN'S UNIVERSAL RECEIVER

Layout of the parts used in the all-wave universal receiver, as viewed from the top. The tuning knob is at center. The regeneration control and switch are at right as one unit. The fixed resistor at left is the 3-watt, 25,000-ohm unit in the B supply filter when the receiver is used on a.c. Because in circuit for d.c. it also then serves as a commutator-ripple remover.



frequency. The filaments of the two tubes are connected in series and then they are connected in series with a line cord resistor which drops the voltage of the line down to the value required for the tube filaments, 6 volts apiece.

The set, when used on a.c., employs the 37 tube to rectify the a.c. for the plate supply. The filter system which removes the last vestige of hum and smooths out the current most effectively consists of a 25,000-ohm resistor, by-passed at both ends by 8 mfd. electrolytic condensers. These capacities are combined in a single compact cardboard container.

Resistor Controls Regeneration

The voltage-limiting resistor used in the filament circuit is contained in the line cord to save space and distribute the heat away from the electrolytic condensers and other components of the set.

A condenser in series with the antenna permits this set to be used with any length aerial. This adjustable condenser is also of great value in tuning in weak, distant stations. The four-prong plug-in coils used have two windings. The longer winding is in the tuned circuit. A 0.00015 mfd. variable condenser of compact but accurate construction permits the set to be tuned smoothly over all bands from 10 to 550 meters.

The shorter winding is used as a tickler winding. It is connected in the plate circuit of the 6C6, providing very efficient regeneration which serves to "pep" up the circuit, thus providing the necessary sensitivity for one-tube foreign reception. The regenerative feature also aids the selectivity, so that even in localities where stations are congested, it is possible to separate them. Control of regeneration is provided by a 75,000-ohm potentiometer in the screen grid circuit of the 6C6 tube.

Few Feet of Wire for Connections

This control handles very easily and is amazingly smooth. The usual fuss and bother generally associated with the tuning in of short-wave stations is not present. Grid leak detection is employed, a 5.0-meg. grid leak shunted by a 0.0001 mfd. mica condenser. It will be noted that the screen grid circuit is by-passed by a good-sized (0.5 mfd.) fixed condenser.

The r-f choke in the plate circuit, in combination with the 0.00025 mfd. mica condenser, prevents r-f currents from passing through the earphone. This just about completes the technical description of the receiver.

Mechanically, it is just as remarkable as it is electrically. The chassis consists of a wood base and a wood pedestal, stained with an oak finish and then shellacked. All working parts are visible, including the wiring, but due to the simplicity of the circuit, only a few feet of wire are required, so that the wiring is hardly noticeable.

Economy of Parts

The design of the set, with tubes and variable condenser mounted on the pedestal, is distinctly modernistic, giving one the impression that here is a radio set which is different and better. Every effort has been made by the designer to save space and to cut out unnecessary parts and wiring. The "on-off" switch is combined with the regeneration control potentiometer, both being operated by the same knob. The ground connection is entirely eliminated.

It seems hard to believe that this compact little set will bring in foreign stations, but nevertheless this is a fact. In a very poor location in the downtown section of New York City, the set brought in England, Germany, Rome, Madrid and other foreign stations. It brought in police calls from cities in various parts of the United States, weather reports from the National Airway airport in Chicago, two-way scrambled trans-Atlantic conversations and amateur conversations from one end of the continent to the other.

The set is very easy to operate. The first step is to place the tubes in the sockets in the positions shown in the top view diagram. The screen grid clip is placed on the cap of the 6C6 tube. One of the plug-in coils is then placed in the coil socket. In making initial tests, it is preferable to start with the broadcast coil.

Never Use Ground with This Set

The aerial is connected to the antenna clip. A ground should never be used with this set. The earphone or earphones are connected and the connection cord is then plugged into any house lighting circuit. Since the line cord contains the voltage-limiting resistor, it will get quite warm while the set is in use. This heating is normal and should be disregarded.

The set is switched "on" by turning the knob to the right. It is necessary to wait about 30 seconds for the tubes to warm up. The set should then bring in stations, when the station selector at the center is turned. If the set is used on direct current it may be necessary to reverse the plug before the set will operate. On direct current, the set will operate only if the plug is inserted in a particular way. It is not necessary to reverse the plug when the set is used on alternating current, unless a hum is noticeable. In this case, the set will perform better with the plug reversed. The Air Scout can be used not only on 105 to 120 volt lines, but also on any 220-volt source, either a.c. or d.c., through the use of a reducing ballast.

The Three Controls

There are three controls. At right is the combined switch and regeneration control. As the knob is turned further it operates the regeneration control. The knob at the center turns the station selector. The third control is the one on the trimmer condenser, at right rear.

No special directions are required for tuning in broadcast stations on the orange coil. If the set tunes too broadly, a shorter aerial should be used or else the adjusting screw on the antenna trimmer condenser should be loosened. In many locations, the set will bring in local stations using a short length of wire thrown on the floor in place of a more conventional aerial. Tune in the station desired by means of the station selector knob at the center. Then turn the knob on the regeneration control until satisfactory volume is obtained.

A little practice will soon make the average person skillful enough to tune in distant short-wave stations.

How to Get Results

The first step is to place one of the short-wave coils in the coil socket. These coils are color-coded according to their wavelength range. Thus, the green coil covers the band from 70 to 200 meters, the yellow coil from 40 to 80 meters, the red coil from 15 to 45 meters and the blue coil from 10 to 20 meters. Each coil overlaps a bit. The broadcast (orange) coil covers from 200 to 550 meters.

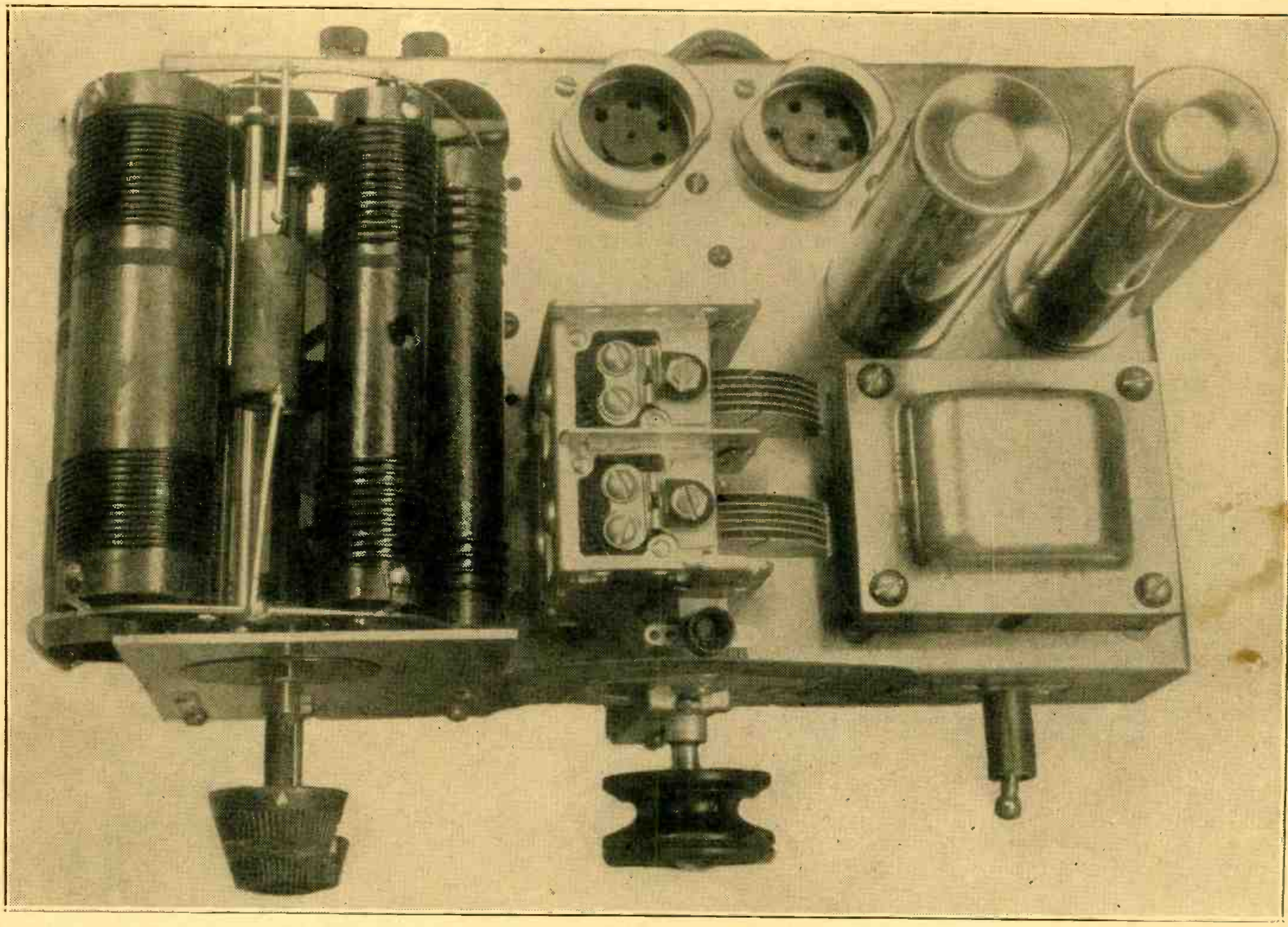
Getting back to the best method of tuning in short wave stations, the station selector knob is turned until a whistle is heard. It may be necessary to loosen the antenna trimmer condenser to get the whistle. As a station whistle is tuned in with the left hand, the regeneration control knob is turned in a clockwise direction with the right hand until the set "spills over" or a distinct hiss is heard.

The antenna trimmer should now be adjusted, either tightened or loosened, for the loudest hiss. The station selector knob is turned until a continual whistle is heard and it should be left at the point

(*Continued on next page*)

Mannion's Switch Type Short-Wave Converter

By Alan Mannion
Mannion Radio Laboratories



A revealing view of the completed converter, disclosing the layout to be literally followed in wiring this powerful converter. There is a fixed condenser of 0.1 mfd. or so from one end to the other of the coil-assembly frame, to be added to the diagram on next page.

THE switch-type short-wave converter shown herewith is the short-wave end of the Sky-Raider described in full in the April 17th and 21st issues, with a B supply added now for the converter alone.

It will be remembered that the Sky-Raider is an 11-tube set, a superheterodyne for the broadcast band, and a double super for short waves. By careful selection and location of parts the usual squealing to be expected from an ordinary double super was avoided, and the results are most excellent.

Receiver, It All Depends on You!

Of course, what a converter will do may be rated as to the converter itself, by measuring its own output. But what will be accomplished by the combination of even a powerful converter like this,

Universal Set Weighs Less Than 3 Lbs.

(Continued from preceding page)

where the squeal is loudest. The squeal can now be cleared by turning back the regeneration control knob until the set stops oscillating. A slight further readjustment of the station selector may be necessary.

The trimmer adjustment is not critical and need only be set for each coil, except for the reception of very weak signals which require careful adjustment all around for best reception. On such stations, readjustment of the station selector may be necessary, following the movement of either one of the other two controls.

The complete set, with tubes, earphone and all five coils, weighs less than 3 pounds. Its dimensions are 4½" by 9" by 5½", overall.

It will readily be seen that this is a portable outfit, capable of being stowed away in a corner of a suitcase or even in a brief case. It can be used in a hotel room, on a vacation and in thousands of places where the average radio set would cause trouble by annoying other people. If several people wish to listen in at the same time, this is easily accomplished, since the set will operate a number of earphones simultaneously and all of them with plenty of volume.

with some sort of receiver, is problematical. So much depends on the receiver. In fact, omitting the coupling consideration, in which the converter participates with the receiver, it might be said that everything depends on the receiver.

Nevertheless this converter has been used on receivers of no great consequence, some of them most inexpensive and modest tuned radio-frequency sets of none too recent origin, and results were excellent.

The Landsman Gets Excited

One example may be cited out of many instances. A woman got interested in short waves, evidently for the secret benefit of her doddering father, hoping to give him some new thrills in his declining days. The converter was built by me, as diagramed, and hooked up to an old t-r-f set. When the "old man" was told there was a set in the house capable of bringing in a station in his native Germany, in fact, Zeesen, in the environs of which he was born, his eyes popped in a way to make Eddie Cantor jealous. And when the station was brought in clearly and loudly, the old boy hobbled outside in his glee, to call in some landsmen to share listening to the voices of the Vaterland.

The aerial should be good and long, and the pickup then will be much greater, as converters seem to justify. It does not matter so much that the natural period of the antenna is out of gee with the frequency to be received, for the far greater pickup is more than an atonement.

The Shielded Cable

The connection from the converter to the receiver should be through a shielded cable. This is the lead from the stopping condenser to the antenna post of the set. But the ordinary type of shielded wire will not do. The conductor is then too close to the sheath, and there are far too great a loss to ground due to this capacity. Use shielded wire that has conductor separated from sheath by at least ½ inch.

Then of course the sheath itself may be used as the ground connection, the ground posts of receiver and converter thus being united to a common potential, so far as practical. Actually there will be a slight potential difference between these two points, as intensive oscillation can not be carried in, through or along wires, even at 650 kc, without affecting the extremes an intended ground lead differently.

Paper Condenser Next to Rectifier

The 650 kc i.f. is suitable because the commercial coil system works well in that region. It is not strictly vital that just 650 kc be used, for if there is a local station of some strength near this, shift the receiver dial a bit until there is no interference from this source.

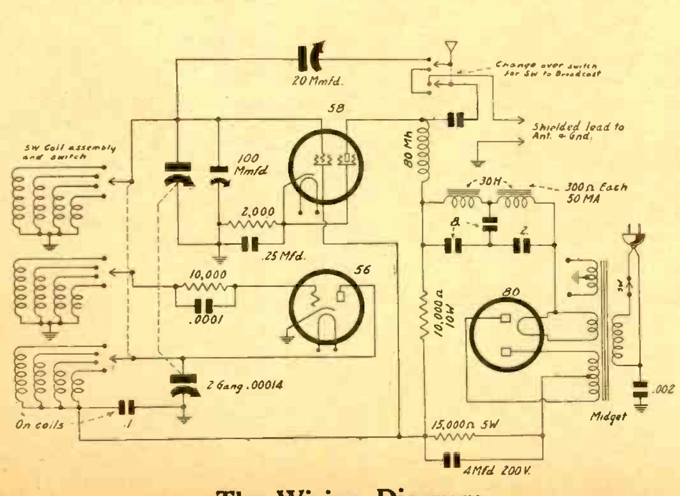
A small power transformer suffices. It should have four windings: (1) primary; (2) 2.5-volt secondary; (3) 5-volt winding, and (4) high-voltage winding. The high voltage may be around 300 volts or so, next to the rectifier.

The choke coils in the B supply are commercially rated at 30 henries each, at 50 milliamperes, and each has a d-c resistance of

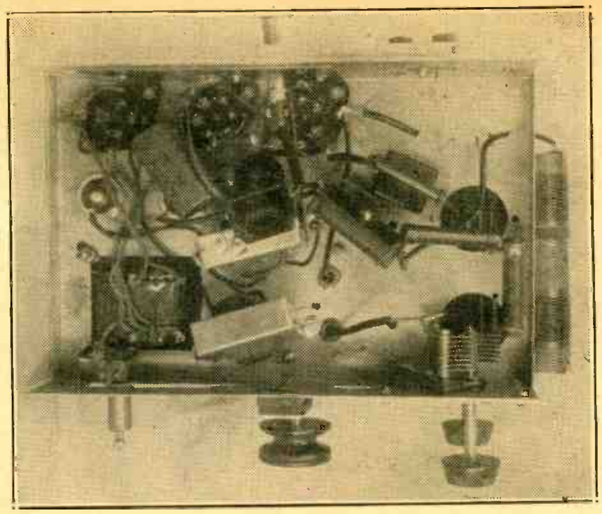
Series and Parallel Resistors

300 ohms.

A paper dielectric condenser is preferable next to the rectifier, and 2 mfd. is the suggested capacity. The reason is that electrolytics have sufficient leakage to render their impedance entirely too high at any radio frequencies that may get into the rectifier system. And they will get in.



The Wiring Diagram



Bottom View of the Converter

The two chokes are separate. Across the line from joint to ground is one 8 mfd. electrolytic while at the end of the choke system is another condenser of the same capacity. This filtration alone would be sufficient.

There is, however, still another filtration assistant, comprising a 15,000-ohm resistor in the negative B leg, across it a 4 mfd. condenser, 200-volt rating. This also reduces the effective B voltage, which otherwise would be too high from the customary power transformer.

A bleeder resistor of 10,000 ohms is used to maintain good regulation. In fact, the bleeder current is more than the plate currents of the two tubes.

The Modulator Bias

These tubes are a 58 modulator and a 56 oscillator. The bias on the modulator is maintained at a higher value than that which yields maximum sensitivity, because the bias must be great enough to exceed the amount of oscillation voltage put into the tube. In this way the harmonic generation in the modulator is kept low, although of course there are harmonics in the leak-biased 56 oscillator.

The leak for the 56 is only 10,000 ohms, and the condenser across it is 0.0001 mfd. The tuning capacity when between middle and high-capacity end of the dial takes care of frequency stability sufficiently to prevent wobble nuisance in the oscillator, but from the middle of the dial to the minimum-capacity end some additional assistance is required, and the low grid condenser across the low value of leak works in this direction. The higher the leak resistance, the greater the effect of the grid condenser of fixed capacity. Here the combination as used tends to check the otherwise excessive oscillation that might be present at the higher frequency half of the tuning in any band.

2-to-1 Frequency Ratio

The frequency ratio will be a little more than 2 to 1, which is satisfactory. If the receiver always is used at the same frequency level, the converter may be calibrated, and the calibration will hold well.

For convenience, a double-pole, double-throw switch is used for throwing the connection of antenna from the converter to the receiver and back again, without the nuisance of making wire disconnections.

Converter Coupling

One of the problems in a short-wave converter is to get a suitable output. That means the output system must be sensibly related to the receiver into which the converter's product is to be put. Good results may be obtained from a fixed system, based on some average impedance value of receivers, but an impedance-changing method may be introduced, and gain may be increased.

While a ground is shown as being used, it does not always follow that there is much improvement by introducing a ground. This applies to short waves generally. The test should be made on the following basis: (1) Does use of ground increase the signal strength? (2) If it does so increase the strength, does it increase the noise at a greater degree than it increases the signal?

See diagram on page 14.

Two Authentic Circuits for Short-Wave Results

By Einar Andrews

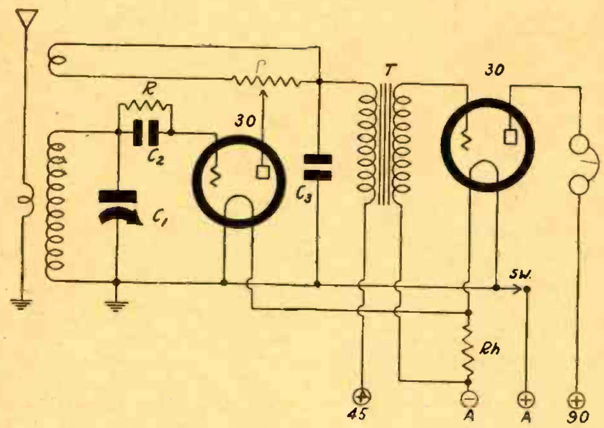


FIG. 1
The circuit of a two-tube regenerative short-wave receiver for battery operation. Potentiometer control of regeneration.

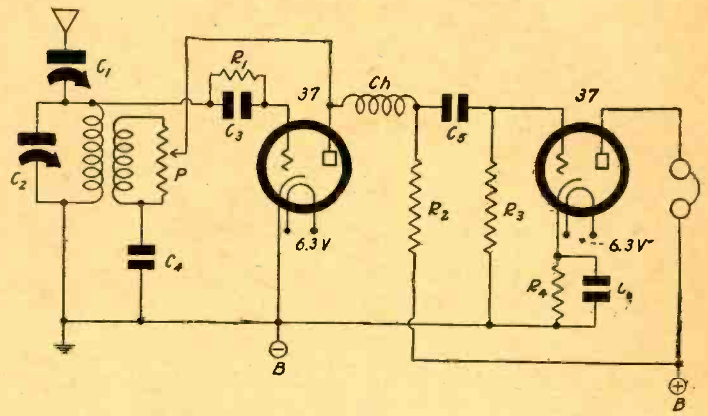


FIG. 2
The circuit of a two-tube short-wave receiver with direct coupling to the antenna. Simple plug-in coils can be used.

HERE are two simple short-wave receivers, one utilizing 30-type tubes and the other 37-type. While the two circuits differ in other respects than tubes, either circuit may be used with this type of tube, provided that the cathode is regarded as the negative end of the filament.

Let us first examine Fig. 1, the circuit utilizing the 30-type tubes. The antenna is coupled very loosely to the tuned circuit by means of a small inductance. The number of turns on the antenna coil will vary according to the number of turns on the secondary and on the distance between the two windings. For the highest frequency coil a single turn removed an inch from the tuned winding is about right while for the other short-wave extreme, that is, 200 meters, several turns should be used.

Then the tickler should be fixed on the form and the regeneration controlled by means of the potentiometer P, which should have a range of 25,000 ohms. When the slider connected to the plate is at the extreme left end of the resistance, most of the radio-frequency signal current goes through the coil and when the slider is at the opposite extreme practically no current flows through the tickler. Hence the control of the regeneration is nearly 100 per cent. effective. When the plate and control are connected as in this case there is no necessity of using a radio-frequency choke in series with the audio frequency load.

Condensers Employed

The tuning condenser C1 should have a value of 140 mmfd. or somewhat less. If it has a maximum value of 140 mmfd. the entire short-wave band can be covered with four coils, but if it is much smaller, it will require five or six coils. While it is better from the point of sensitivity and ease of tuning to have many coils, it is not convenient to have many coils when they are of the plug-in type. But if the different coils are picked up by means of a switch —a first rate switch—then there is no reason why there should not be as many coils as six or more. In that case the condenser C1 can be as small as 100 mmfd., or even smaller if the distributed capacity of the circuit is very small. Suppose we have six coils and the desired tuning band is from 200 to 10 meters. That is a ratio of 20. If we make the ratio for each coil 1.7, six coils will cover a range of nearly 25 to 1. Therefore there will be sufficient overlap. If we assume that the minimum capacity in the circuit is 20 mmfd., the maximum should be 57.8 mmfd. if the range is to be 1.7 for each coil. Since there will be a capacity of about 10 mmfd. in the circuit, that maximum capacity of the tuning condenser should be about 70 mmfd.

Therefore if a condenser rated at 80 or 100 mmfd. maximum capacity will be satisfactory if there are six coils in the set. But if only four are used as was said above, the tuning condenser should be 140 mmfd.

Detection

The grid leak R should have a value of 2 megohms or more, but not higher than 5 megohms. The usual value of the grid stopping condenser C2 is 250 mmfd. For short waves, however, the value may be reduced to 100 mmfd. A by-pass condenser C3 is put in the plate circuit of the detector tube as a means of increasing the regeneration efficiency. The value of this condenser should be 250 mmfd.

It will be noticed that the grid return of the first tube is made to the positive end of the filament. A grid leak detector is more efficient when the bias is slightly positive. This assumes that the applied plate voltage is 45 volts.

An audio transformer T couples the detector to the audio amplifier, and a 30 is used for the output tube as well as detector. This tube is large enough for earphone reception. While the indicated plate voltage on the second tube is 90 volts, it is not necessary to use more than 45 volts if listening is to be done with earphones only.

The Filament Supply

Since the tubes require a voltage of 2 volts on the filaments and the most suitable source has a voltage of 3 volts, that is, two dry cells connected in series, a ballast is needed in the filament circuit. A rheostat Rh is used for this purpose. The total filament current will be only 0.12 ampere. Since the voltage to be dropped is one volt, the required resistance is 8 and 1/3 ohms. A 20-ohm rheostat would be suitable for that would not only permit operation of the tubes a current below normal but it would also permit cutting out resistance to compensate for increased resistance in the battery.

A filament switch is put in the positive filament lead, but it may,

LIST OF PARTS
(Fig. 1)

Coils

One set of r-f tuning condensers, three-winding type.
One audio-frequency transformer.

Condensers

C1—One 140 mmfd. tuning condenser with vernier dial.
C2—One 100 mmfd. grid condenser.
C3—One 250 mmfd. condenser.

Resistors

R—One 2 to 5-meg. grid leak.
P—One 25,000-ohm potentiometer.
Rh—One 20-ohm rheostat.

Other Requirements

Two four-contact sockets.
One filament switch.
Binding posts.
Phone tip jacks.
One small chassis.

LIST OF PARTS
(Fig. 2)
Coils

One set of short-wave coils.
One 10-millihenry choke coil.

Condensers

C1—One adjustable 50 mmfd. antenna condensers.
C2—One 140 mmfd. tuning condenser with vernier dial.
C3—One 100 mmfd. grid condenser.
C4—One 250 mmfd. by-pass condenser.
C5—One 0.01 mfd. stopping condenser.
C6—One 4 mfd. by-pass condenser.

Resistors

P—One 100,000-ohm potentiometer.
R1—One 2 to 5-meg. grid leak.
R2—One 100,000-ohm plate resistor.
R3—One 0.5-meg. grid leak.
R4—One 2,400-ohm bias resistor.

Other Requirements

Two five-contact sockets.
Phone tip jacks.
One small chassis.

of course, be attached to the rheostat, which would eliminate one control.

The Heater Tube Circuit

The circuit in Fig. 2 differs in several particulars from that shown in Fig. 1, aside from the fact that the tubes are different. Thus the antenna is directly coupled to the tuned circuit, a small condenser C1 being used in series with the antenna to loosen the coupling and to increase the selectivity. This series condenser should be very small, say not more than 50 mmfd. maximum value. It is not necessary that it be accessible from the panel because it usually requires adjustment only once for each antenna, and it may just as well be placed at the rear of the set. It should be provided with an adjustment screw, and this should be accessible with a screw driver.

The regeneration control is about the same in this circuit as in Fig. 2. We have a potentiometer P across the tickler and a by-pass condenser C4 from one side of the potentiometer to ground. However, the slider on the potentiometer and the audio-frequency output coupler are both connected to the plate. Because of the parallel connection the radio-frequency choke Ch is necessary. A honeycomb coil of about 10 millihenries is suitable. A suitable value for C4 is 250 mmfd. While the potentiometer in Fig. 1 was only 25,000 ohms it is preferable to make it larger in this circuit because of the fact that resistance coupling is used between the detector and the audio-frequency amplifier. A good value is 100,000 ohms.

The grid leak resistance and the stopping condenser have the same values in this circuit as in the preceding, namely, 2 to 5 megohms for the grid leak and 100 mmfd. for the condenser.

What was said concerning the tuning condenser in Fig. 1 applies also to this circuit. In this case the coil is much simpler and it may be preferable to use many coils and a small tuning condenser. This has the advantage not only of making tuning easy but it allows a closer control of the regeneration, since a tickler that covers only a narrow band of frequencies can be held to closer limits than one that is to function over a wide band.

The Audio Amplifier

The audio-amplifier tube is a 37 like the detector tube. It is coupled to the detector by means of a stopping condenser C5 of 0.01 mfd, a grid leak resistance R3 of 0.5 megohm, and a plate coupling resistor R2 of 100,000 ohms.

The 37 output tube is biased by means of a resistance R4 in its cathode lead. The value of the resistance should be 2,400 ohms. The condenser across it, C6, should not be smaller than 4 mfd.

The plate voltage applied to B plus is supposed to be 90 volts, for this is sufficient for oscillation in the first tube and good amplification in the second. If it is desired to use a loudspeaker in the plate circuit of the second tube, it may be done by increasing the plate voltage on that tube. The voltage on the plate of the first tube should not be increased at the same time for then the detector would not function so well.

Power Supply

The heaters of the tubes require 6.3 volts, and this may be supplied by a storage battery. If a-c is available a 6.3-volt transformer can be used for heating the windings, but in that case it would be just as well to use 56-type tubes.

The B supply should be a dry cell battery of the usual type, giving up to 90 volts.

STATIONS CHANGE WAVES

All short-wave sets are classed as experimental and most of the larger ones have several frequency assignments, so the transmission frequency may be changed without notice. Failing to find a station on its accustomed frequency, try other channels.

CBS Seeks Steady World Coverage With Short-Wave Sending

Short-wave broadcasting is playing an ever-increasing role in the activities of the Columbia network, according to Edwin K. Cohan, CBS technical director. The chain's key station, WABC, alone operates eleven short-wave transmitters, used variously for experimental purposes and in covering special events.

Of outstanding importance is W2XE, New York, an experimental transmitter licensed to operate with a power not exceeding 5,000 watts. At present it is employing 1,000 watts.

"This station broadcasts the majority of Columbia features for the benefit of listeners in foreign countries," says Cohan. "We believe that it is an important factor in furthering international good-will because it makes available to radio fans of other nations the best in American broadcasting and thus enables them to have a greater appreciation of American life."

Heard in Far Places

Argentina, Australia, British Guiana, the Canal Zone, the Central American republics, Cuba, England, Hawaii, Puerto Rico, Scotland, Trinidad and the Dominion of Canada are among the foreign localities and outlying U. S. possessions where Columbia features are heard regularly through W2XE.

Since December 15, 1933, announcements for W2XE have been made in five languages—English, French, German, Spanish and Italian—in order that listeners abroad might readily identify the station. The transmitter is equipped with all the most recent improvements for short-wave broadcasting, including crystal control and 100 per cent. modulation. It has been found that signals below the regular broadcast band are received better on varying frequencies during different times of the day. W2XE at present operates variously on 6,120, 11,830 and 15,270 kilocycles, but is designed to broadcast on three additional channels.

Use Directional Antenna

Programs from 11 a.m. to 2 p.m., EST, on the 15,270 band are sent out on a directional antenna pointed at England. Later directional antennas for other countries will be constructed.

In addition to WABC and W2XE, the Atlantic Broadcasting Corporation, a CBS subsidiary, is licensed to operate short-wave stations WIEK, WIEL, W2XAB, KGWX, W2XDU, W2XDV, W2XAX, W10XZ, W10XZL and W2XX. W3XAU is the short-wave outlet functioning in association with WCAU, Columbia station in Philadelphia. KGWX is a fifteen-watt transmitter which broadcasts on a frequency of 1,554 kilocycles on the Pacific Coast.

WIEK and WIEL are portable fifty-watt units heard on either the 1,646 or 2,190 frequency. These transmitters, often used in airplanes, will come into heavy use during the spring and summer for the coverage of sports and other news events.

Fat Counts

"Incidentally," Cohan points out, "our field engineers are beginning to watch their waist-lines. Whenever we have a job involving broadcasting from a plane, the weight factor always is taken into consideration and the lightest engineer is picked for the assignment."

In many cases the signals from WIEK and WIEL are received on the roof of the Columbia building in mid-town New York and fed directly into the master-control room for relay to the network.

Columbia's regular short-wave schedule currently is as follows (all EST):

W2XE, New York, daily 11:00 a.m. to 1:00 p.m., 15,270 kc; 3:00 p.m. to 5:00 p.m., 11,830 kc; 6:00 p.m. to 11:00 p.m., 6,120 kc.

W3XAU, Philadelphia, Daily 12:00 noon to 6:00 p.m., 9,590 kc; 8:00 p.m. to 1:00 a.m., 6,060 kc.

Establishing Stability in a Beat Oscillator

Presumably a radio-frequency can be built on the heterodyne principle, for that is what is really done in superheterodynes. Suppose the range of the beat were such that the entire broadcast band were covered, would there be any difficulty in calibrating the beat? Would the beat oscillator be as steady as the frequencies of the two beating oscillators?

If the variable condenser used for varying the beat is small in comparison with the total capacity in the oscillator and of such ratio that the entire dial is required for varying the beat over the range, it is the same as if the oscillator were straight. The frequency stability of the beat would not be nearly as good as that of either of the two beating oscillators. However, if the two beating oscillators were both on the tuning condenser and arranged so that the frequency of one decreased by the same amount as the other is increased, the stability of the beat would be about as good as that of either of the beating oscillators. This assumes further that the two oscillators are similar and are powered by the same source.

How to Use the Frequency-Wavelength Conversion Table

By Sidney Fellows

WHEN we are dealing with short-wave signals we often have occasion to convert frequencies to meters and meters to frequencies Sometimes we are given the signal specification in meters and we want to convert to megacycles in order to compare it with some other frequency. At other times we have the frequency in megacycles but want to convert it to meters in order to estimate the required length of antenna or Lecher wires. How can the conversion best be made?

For rough work we can divide the number 300,000 by either the frequency, in kilocycles, or the wavelength, in meters, to get the other. That is, 300,000/meters equals kilocycles and 300,000/kilocycles equals meters. In most instances this formula is close enough, that is, for most applications of the relationship it is accurate enough to assume that the velocity of the wave is 300,000 kilometers per second. The error in the assumption does not amount to more than 0.06 per cent.

Accurate Velocity

The generally accepted velocity of light in free space, and hence of radio waves in free space, is 299,820 kilometers per second. Recent experiments seem to have changed this value a little, but the new value has not yet been accepted. Since the velocity of a wave is equal to the number of waves that pass a given point per second multiplied by the length of each wave, we have the fundamental relation $V = f\lambda$, where V is the velocity of the wave, f the frequency, and λ the length of each wave. This applies to any wave motion and therefore to radio waves. For accurate work we may assume that the velocity of the radio wave is 299,820 kilometers per second. This factor, then, is to be used in making conversions from meters to kilocycles or vice versa when accuracy is essential.

It should be remembered that this is the velocity of a radio or light wave in free space. In ionized space and in dielectrics the velocity is measurably less. For example, along a transmission line, such as Lecher wires or concentric conductors, the velocity is less than in free space by an amount depending on the losses in the line. For practical lines, however, and for frequencies that would be used with such conductors, the velocity of the wave is only negligibly less than in free space. In other words, even on transmission lines the factor 299,820 kilometers/second may be used, and if only rough work is in question then it is all right to use the factor 300,000.

Tabulation of Relations

When many conversions are to be made the work becomes very tedious if each problem is solved by long division. A table giving the relationship is then extremely useful. Such a table is printed on the opposite page and it covers the entire radio spectrum, indirectly at least. There are twenty columns in the table. Half of them are headed "kc or m" and the other half "m or kc." These occur in pairs as indicated by the heavy vertical lines. Any number in any column may be regarded either as expressing meters or kilocycles. The number in the same line in the adjacent column between the same two vertical lines then gives the other. For example, at the top of the last column in the table we have 33.28. Suppose we let this represent meters. The number next to it is 9,010. It must represent kilocycles. But we could just as well let 33.28 stand for kilocycles. Then 9,010 represents the corresponding meters.

The table progresses from 10 kc up to 10,000 kc in steps of 10 kc. or it progresses from 10 meters up to 10,000 meters in steps of 10 meters. All the values are based on the value 299,820 kilometers per second for the velocity of the waves.

Interpolation

There are many possible values which are not given in the table. For example, there is nothing between 10 and 20 meters, or 10 and 20 kilocycles. But if we go down the column we come to 100, 110, 120, etc. We may let 120 stand for 12 meters, because this involves only the shifting of the decimal point one place to the left. The number opposite 120 is 2,499. Since we shifted the decimal one place to the left in the other number we must shift it one place to the right in this in order to keep the product of the two numbers equal to 299,820. Therefore the result is that 12 meters is equivalent to 24,990 kc. In the same way, by going farther down the table, we get the result that 11.2 meters is equivalent to 26,770 kilocycles.

It may be that the number cannot be found in the table. Suppose, for illustration, that we want to convert 635.4 meters to kilocycles. The number does not appear in the table. In the seventh column headed "kc or m." we find the numbers 6350 and 6360. The corresponding factors in the adjacent column are 4722 and 4714. The number desired lies between these two because the given number lies between 635 and 336. The difference between 4722 and 4714 is 8. Four-tenths of this is 3.2. This is the amount by which 4722 should be diminished. Therefore we have 4718.8 as corresponding with 635.4. By noting the decimal points in the two numbers, we see that 635.4 meters corresponds to 471.88 kc.

Let us take another example requiring interpolation. We have a frequency of 5,341 kc. What does this represent in terms of meters? From the table we have 5,340 (56.15) and 5,350 (56.04). We see at once that the number sought is just a little less than 56.15. The difference between the two wavelength numbers is 0.11. Our given number is one kilocycle greater than 5,340 kc. Therefore 56.15 should be diminished by 0.1 of 0.11, or by 0.011. Therefore the required wavelength is 56.14 meters, as near as it can be determined from the tables. But that is close enough.

Ultra-Short Waves

The lower limit of usefulness of the table is not 10 meters, for just as we can move the decimal point either way for medium waves so we can move it for waves less than 10 meters. As a first illustration let us find the frequency corresponding to one meter. The very first number in the table is 10, which we can read as 10 meters. The corresponding frequency is 29,982 kc. If we move the decimal point one to left in first number and one to the right in the second number, we have the result that one meter is equivalent to 299,820 kc, or very nearly 300 megacycles. To find the frequency corresponding to 5 meters, we can divide the result for one meter or we can look under 50 meters and then multiply the frequency by 10. We have the result that 5 meters is equivalent to 59,960 kc.

Suppose that we want to find the frequency of a wave of 1.98 meter. The table contains 1,980 (151.4). If we divide the first number by 1,000 we get 1.98 meters. This division requires that we multiply the number within parentheses by 1,000, getting 151,500 kc.

By a liberal use of the power to move the decimal point, we can obtain any frequency from any corresponding wavelength or any wavelength from any corresponding frequency. It is only necessary to remember that if the decimal in one number of a pair is moved by a certain number of places, the decimal point in the other number of the pair should be moved the same number of places in the opposite direction.

ABOUT RADIOVOTING

A short while ago we had a news article telling about a new invention which enabled listeners to indicate whether or not they liked the program. It was to be done by pressing one of three buttons. If this is to work on the basis of power used, could not anybody spoil the vote by turning on more appliances, or by turning off such appliances?

No doubt, anybody could affect the vote in that manner. But suppose there are thousands voting. It is not likely that there will be thousands who wish to spoil the vote. Any change produced by "illegal" turning on or off of power would be small. The scheme has not been tried out yet.

Key to Kilocycle-Meter Conversion Table

The conversion table printed on the opposite page is highly accurate, because worked out by the factor 299,820. Most tables are based on the factor 300,000, which is erroneous to 6 parts in 100,000.

The table is entirely reversible, for instance, 10 meters equal 29,982 kc., or 29,982 meters equal 10 kc. Any quantities not included in the table may be read by shifting the decimal point. If moved to the right for frequency the point is moved to the left for wavelength, and vice versa. The shift is therefore in opposite directions.

The factor 299,820 is based on the velocity of a radio wave, which is equal to the velocity of light, or 299,820,000 meters per second. By dropping the three ciphers (dividing by 1,000), the factor 299,820 is used, and the answer reads in kilocycles.

Wavelength in meters is equal to velocity divided by frequency. Frequency in cycles is equal to the velocity divided by the wavelength.

That is, the numerator always is the same.

CHART COVERING FROM 10 TO 29,982 METERS OR KILOCYCLES

kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc
10	29,982	1,010	296.9	2,010	149.2	3,010	99.61	4,010	74.77	5,010	59.84	6,010	49.89	7,010	42.77	8,010	37.43	9,010	33.28
20	14,991	1,020	293.9	2,020	148.4	3,020	99.28	4,020	74.58	5,020	59.73	6,020	49.80	7,020	42.71	8,020	37.38	9,020	33.24
30	9,994	1,030	291.1	2,030	147.7	3,030	98.95	4,030	74.40	5,030	59.61	6,030	49.72	7,030	42.65	8,030	37.34	9,030	33.20
40	7,496	1,040	288.3	2,040	147.0	3,040	98.62	4,040	74.21	5,040	59.49	6,040	49.64	7,040	42.59	8,040	37.29	9,040	33.17
50	5,996	1,050	285.5	2,050	146.3	3,050	98.30	4,050	74.03	5,050	59.37	6,050	49.56	7,050	42.53	8,050	37.24	9,050	33.13
60	4,997	1,060	282.8	2,060	145.5	3,060	97.98	4,060	73.85	5,060	59.25	6,060	49.48	7,060	42.47	8,060	37.20	9,060	33.09
70	4,283	1,070	280.2	2,070	144.8	3,070	97.66	4,070	73.67	5,070	59.13	6,070	49.39	7,070	42.41	8,070	37.15	9,070	33.06
80	3,748	1,080	277.6	2,080	144.1	3,080	97.34	4,080	73.49	5,080	59.02	6,080	49.31	7,080	42.35	8,080	37.11	9,080	33.02
90	3,331	1,090	275.1	2,090	143.5	3,090	97.03	4,090	73.31	5,090	58.90	6,090	49.23	7,090	42.29	8,090	37.06	9,090	32.98
100	2,998	1,100	272.6	2,100	142.8	3,100	96.72	4,100	73.13	5,100	58.79	6,100	49.15	7,100	42.23	8,100	37.01	9,100	32.95
110	2,726	1,110	270.1	2,110	142.1	3,110	96.41	4,110	72.95	5,110	58.67	6,110	49.07	7,110	42.17	8,110	36.97	9,110	32.91
120	2,499	1,120	267.7	2,120	141.4	3,120	96.10	4,120	72.77	5,120	58.56	6,120	48.99	7,120	42.11	8,120	36.92	9,120	32.88
130	2,306	1,130	265.3	2,130	140.8	3,130	95.79	4,130	72.60	5,130	58.44	6,130	48.91	7,130	42.05	8,130	36.88	9,130	32.84
140	2,142	1,140	263.0	2,140	140.1	3,140	95.48	4,140	72.42	5,140	58.33	6,140	48.83	7,140	41.99	8,140	36.83	9,140	32.80
150	1,999	1,150	260.7	2,150	139.5	3,150	95.18	4,150	72.25	5,150	58.22	6,150	48.75	7,150	41.93	8,150	36.79	9,150	32.77
160	1,874	1,160	258.5	2,160	138.8	3,160	94.88	4,160	72.07	5,160	58.10	6,160	48.67	7,160	41.87	8,160	36.74	9,160	32.73
170	1,764	1,170	256.3	2,170	138.1	3,170	94.58	4,170	71.90	5,170	57.99	6,170	48.59	7,170	41.82	8,170	36.70	9,170	32.70
180	1,666	1,180	254.1	2,180	137.5	3,180	94.28	4,180	71.73	5,180	57.88	6,180	48.51	7,180	41.76	8,180	36.65	9,180	32.66
190	1,578	1,190	252.0	2,190	136.9	3,190	93.99	4,190	71.56	5,190	57.77	6,190	48.44	7,190	41.70	8,190	36.61	9,190	32.62
200	1,499	1,200	249.9	2,200	136.3	3,200	93.69	4,200	71.39	5,200	57.66	6,200	48.36	7,200	41.64	8,200	36.56	9,200	32.59
210	1,428	1,210	247.8	2,210	135.7	3,210	93.40	4,210	71.22	5,210	57.55	6,210	48.28	7,210	41.58	8,210	36.52	9,210	32.55
220	1,363	1,220	245.8	2,220	135.1	3,220	93.11	4,220	71.05	5,220	57.44	6,220	48.20	7,220	41.53	8,220	36.47	9,220	32.52
230	1,304	1,230	243.8	2,230	134.4	3,230	92.82	4,230	70.88	5,230	57.33	6,230	48.13	7,230	41.47	8,230	36.43	9,230	32.48
240	1,249	1,240	241.8	2,240	133.8	3,240	92.54	4,240	70.71	5,240	57.22	6,240	48.05	7,240	41.41	8,240	36.39	9,240	32.45
250	1,199	1,250	239.9	2,250	133.3	3,250	92.25	4,250	70.55	5,250	57.11	6,250	47.97	7,250	41.35	8,250	36.34	9,250	32.41
260	1,153	1,260	238.0	2,260	132.7	3,260	91.97	4,260	70.38	5,260	57.00	6,260	47.89	7,260	41.30	8,260	36.30	9,260	32.38
270	1,110	1,270	236.1	2,270	132.1	3,270	91.69	4,270	70.22	5,270	56.89	6,270	47.82	7,270	41.24	8,270	36.25	9,270	32.34
280	1,071	1,280	234.2	2,280	131.5	3,280	91.41	4,280	70.05	5,280	56.78	6,280	47.74	7,280	41.18	8,280	36.21	9,280	32.31
290	1,034	1,290	232.4	2,290	130.9	3,290	91.13	4,290	69.89	5,290	56.68	6,290	47.67	7,290	41.13	8,290	36.17	9,290	32.27
300	999.4	1,300	230.6	2,300	130.4	3,300	90.86	4,300	69.73	5,300	56.57	6,300	47.59	7,300	41.07	8,300	36.12	9,300	32.24
310	967.2	1,310	228.9	2,310	129.8	3,310	90.58	4,310	69.56	5,310	56.46	6,310	47.52	7,310	41.02	8,310	36.08	9,310	32.20
320	936.9	1,320	227.1	2,320	129.2	3,320	90.31	4,320	69.40	5,320	56.36	6,320	47.44	7,320	40.96	8,320	36.04	9,320	32.17
330	908.6	1,330	225.4	2,330	128.7	3,330	90.04	4,330	69.24	5,330	56.25	6,330	47.36	7,330	40.90	8,330	35.99	9,330	32.14
340	881.8	1,340	223.7	2,340	128.1	3,340	89.77	4,340	69.08	5,340	56.15	6,340	47.29	7,340	40.85	8,340	35.95	9,340	32.10
350	856.6	1,350	222.1	2,350	127.6	3,350	89.50	4,350	68.92	5,350	56.04	6,350	47.22	7,350	40.79	8,350	35.91	9,350	32.07
360	832.8	1,360	220.4	2,360	127.0	3,360	89.23	4,360	68.77	5,360	55.94	6,360	47.14	7,360	40.74	8,360	35.86	9,360	32.03
370	810.3	1,370	218.8	2,370	126.5	3,370	88.97	4,370	68.61	5,370	55.83	6,370	47.07	7,370	40.68	8,370	35.82	9,370	32.00
380	789.0	1,380	217.3	2,380	126.0	3,380	88.70	4,380	68.45	5,380	55.73	6,380	46.99	7,380	40.63	8,380	35.78	9,380	31.96
390	768.8	1,390	215.7	2,390	125.4	3,390	88.44	4,390	68.30	5,390	55.63	6,390	46.92	7,390	40.57	8,390	35.74	9,390	31.93
400	749.6	1,400	214.2	2,400	124.9	3,400	88.18	4,400	68.14	5,400	55.52	6,400	46.85	7,400	40.52	8,400	35.69	9,400	31.90
410	731.3	1,410	212.6	2,410	124.4	3,410	87.92	4,410	67.99	5,410	55.42	6,410	46.77	7,410	40.46	8,410	35.65	9,410	31.86
420	713.9	1,420	211.1	2,420	123.9	3,420	87.67	4,420	67.83	5,420	55.32	6,420	46.70	7,420	40.41	8,420	35.61	9,420	31.83
430	697.3	1,430	209.7	2,430	123.4	3,430	87.41	4,430	67.68	5,430	55.22	6,430	46.63	7,430	40.35	8,430	35.57	9,430	31.79
440	681.4	1,440	208.2	2,440	122.9	3,440	87.16	4,440	67.53	5,440	55.11	6,440	46.56	7,440	40.30	8,440	35.52	9,440	31.76
450	666.3	1,450	206.8	2,450	122.4	3,450	86.90	4,450	67.38	5,450	55.01	6,450	46.48	7,450	40.24	8,450	35.48	9,450	31.73
460	651.8	1,460	205.4	2,460	121.9	3,460	86.65	4,460	67.22	5,460	54.91	6,460	46.41	7,460	40.19	8,460	35.44	9,460	31.69
470	637.9	1,470	204.0	2,470	121.4	3,470	86.40	4,470	67.07	5,470	54.81	6,470	46.34	7,470	40.14	8,470	35.40	9,470	31.66
480	624.6	1,480	202.6	2,480	120.9	3,480	86.16	4,480	66.92	5,480	54.71	6,480	46.27	7,480	40.08	8,480	35.36	9,480	31.63
490	611.9	1,490	201.2	2,490	120.4	3,490	85.91	4,490	66.78	5,490	54.61	6,490	46.20	7,490	40.03	8,490	35.31	9,490	31.59
500	599.6	1,500	199.9	2,500	119.9	3,500	85.66	4,500	66.63	5,500	54.51	6,500	46.13	7,500	39.98	8,500	35.27	9,500	31.56
510	587.9	1,510	198.6	2,510	119.5	3,510	85.42	4,510	66.48	5,510	54.41	6,510	46.06	7,510	39.92	8,510	35.23	9,510	31.53
520	576.6	1,520	197.2	2,520	119.0	3,520	85.18	4,520	66.33	5,520	54.32	6,520	45.98	7,520	39.87	8,520	35.19	9,520	31.49
530	565.7	1,530	196.0	2,530	118.5	3,530	84.94	4,530	66.19	5,530	54.22	6,530	45.91	7,530	39.82	8,530	35.15	9,530	31.46
540	555.2	1,540	194.7	2,540	118.0	3,540	84.70	4,540	66.04	5,540	54.12	6,540	45.84	7,540	39.76	8,540	35.11	9,540	31.43
550	545.1	1,550	193.4	2,550	117.6	3,550	84.46	4,550	65.89	5,550	54.02	6,550	45.77	7,550	39.71	8,550	35.07	9,550	31.39
560	535.4	1,560	192.2	2,560	117.1	3,560	84.22	4,560	65.75	5,560	53.92	6,560	45.70	7,560	39.66	8,560	35.03	9,560	31.36
570	526.0	1,570	191.0	2,570	116.7	3,570	83.98	4,570	65.61	5,570	53.83	6,570	45.63	7,570	39.61	8,570	34.98	9,570	31.33
580	516.9	1,580	189.8	2,580	116.2	3,580	83.75	4,580	65.46	5,580	53.73	6,580	45.57	7,580	39.55	8,580	34.94	9,580	31.30
590	508.2	1,590	188.6	2,590	115.8	3,590	83.52	4,590	65.32	5,590	53.64	6,590	45.50	7,590	39.50	8,590	34.90	9,590	31.26
600	499.7	1,600	187.4	2,600	115.3	3,600	83.28	4,600	65.18	5,600	53.54	6,600	45.43	7,600	39.45	8,600	34.86	9,600	31.23
610	491.5	1,610	186.2	2,610	114.9	3,610	83.05	4,610	65.04	5,610	53.44	6,610	45.36	7,610	39.40	8,610	34.82	9,610	31.20
620	483.6	1,620	185.1	2,620	114.4	3,620	82.82	4,620	64.90	5,620	53.35	6,620	45.29	7,620	39.35	8,620	34.78	9,620	31.17
630	475.9	1,630	183.9	2,630	114.0	3,630	82.60	4,630	64.76	5,630	53.25	6,630	45.22	7,630	39.29	8,630	34.74	9,630	31.13
640	468.5	1,640	182.8	2,640	113.6	3,640	82.37	4,640	64.62	5,640	53.16	6,640	45.15	7,640	39.24	8,640	34.70	9,640	31.10
650	461.3	1,650	181.7	2,650	113.1	3,650	82.14	4,650	64.48	5,650	53.07	6,650	45.09	7,650	39.19	8,650	34.66	9,650	31.07
660	454.3	1,660	180.6	2,660	112.7	3,660	81.92	4,660	64.34	5,660	52.97	6,660	45.02	7,660	39.14	8,660	34.62	9,660	31.04
670	447.5	1,670	179.5	2,670	112.3	3,670	81.70	4,670	64.20	5,670	52.88	6,670	44.95	7,670	39.09	8,670	34.58	9,670	31.01
680	440.9	1,680	178.5	2,680	111.9	3,680	81.47	4,680	64.06	5,680	52.79	6,680	44.88	7,680	39.04	8,680	34.54	9,680	30.97
690	434.5	1,690	177.4	2,690	111.5	3,690	81.25	4,690	63.93	5,690	52.69	6,690	44.82	7,690	38.99	8,690	34.50	9,690	30.94
700	428.3	1,700	176.4	2,700	111.0	3,700	81.03	4,700	63.79	5,700	52.60	6,700	44.75	7,700	38.94	8,700	34.46	9,700	30.91
710	422.3	1,710	175.3	2,710	110.6	3,710	80.81	4,710	63.66	5,710	52.51	6,710	44.68	7,710	38.89	8,710	34.42	9,710	30.88
720	416.4	1,720	174.3	2,720	110.2	3,720	80.60	4,720	63.52	5,720	52.42	6,720	44.62	7,720	38.84	8,720	34.38	9,720	30.85
730	410.7	1,730	173.3	2,730	109.8	3,730	80.38	4,730	63.39	5,730	52.32	6,730	44.55	7,730	38.79	8,730	34.34	9,730	30.81
740	405.2	1,740	172.3	2,740	109.4	3,740	80.17	4,740	63.25	5,740	52.23	6,740	44.48	7,740	38.74	8,740	34.30	9,740	30.78
750	399.8	1,750	171.3	2,750	109.0	3,750	79.95	4,750	63.12	5,750	52.14	6,750	44.42	7,750	38.69	8,750	34.27	9,750	30.75
760	394.5	1,760	170.4	2,760	108.6	3,760	79.74	4,760	62.99	5,760	52.05	6,760	44.35	7,760	38.64	8,760	34.23	9,760	30.72
770	389.4	1,770	169.4	2,770	108.2	3,770	79.53	4,770	62.86	5,770	51.96	6,770	44.29	7,770	38.59	8,770	34.19	9,770	30.69
780	384.4	1,780	168.4	2,780	107.8	3,780	79.32	4,780	62.72	5,780	51.87	6,780	44.22	7,780	38.54	8,780	34.15	9,780	30.66
790	379.5	1,790	167.5	2,790	107.5	3,790	79.11	4,790	62.59	5,790	51.78	6,790	44.16	7,790	38.49	8,790	34.11	9,790	30.63
800	374.8	1,800	166.6	2,800	107.1	3,800	78.90	4,800	62.46	5,800	51.69	6,800	44.09	7,800	38.44	8,800	34.07	9,800	30.59
810	370.2	1,810	165.6	2,810	106.7	3,810	78.69	4,810	62.33	5,810	51.60	6,810	44.03	7,810	38.39	8,810	34.03	9,810	30.56
820	365.6	1,820	164.7	2,820	106.3	3,820	78.49	4,820	62.20	5,820	51.52	6,820	43.96	7,820	38.34	8,820	33.99	9,820	30.53
830	361.2	1,830	163.8	2,830	105.9	3,830	78.28	4,830	62.07	5,830	51.43	6,830	43.90	7,830	38.29	8,830	33.95	9,830	30.50
840	356.9	1,840	162.9	2,840	105.6	3,840	78.08	4,840	61.95	5,840	51.34	6,840	43.83	7,840	38.24	8,840	33.92	9,840	30.47
850	352.7	1,850	162.1	2,850	105.2	3,850	77.88	4,850	61.82	5,850	51.25	6,850	43.77	7,850	38.19	8,850	33.88	9,850	30.44
860	348.6	1,860	161.2	2,860	104.8	3,860	77.67	4,860	61.69	5,860	51.16	6,860	43.71	7,860	38.14	8,860	33.84	9,860	30.41
870	344.6	1,870	160.3	2,870	104.5	3,870	77.47	4,870	61.56	5,870	51.08	6,870	43.64	7,870	38.10	8,870	33.80	9,870	30.38
880	340.7	1,880	159.5	2,880	104.1	3,880	77.27	4,880	61.44	5,880	50.99	6,880	43.58	7,880	38.05	8,880	33.76	9,880	30.35
890	336.9	1,890	158.6	2,890	103.7	3,890	77.07	4,890	61.31	5,890	50.90	6,890	43.52	7,890	38.00	8,890	33.73	9,890	30.32
900	333.1	1,900	157.8	2,900	103.4	3,900	76.88	4,900	61.19	5,900	50.82	6,900	43.45	7,900	37.95	8,900	33.69	9,900	30.28
910	329.5	1,910	157.0	2,910	103.0	3,910	76.68	4,910	61.06	5,910	50.73	6,910	43.39	7,910	37.90	8,910	33.65	9,910	30.25
920	325.9	1,920	156.2	2,920	102.7	3,920	76.48	4,920	60.94	5,920	50.65	6,920	43.33	7,920	37.86	8,920	33.61	9,920	30.22
930	322.4	1,930	155.3	2,930	102.3	3,930	76.29	4,930	60.82	5,930	50.56	6,930	43.26	7,930	37.81	8,930	33.57	9,930	30.19
940	319.0	1,940	154.5	2,940	102.0	3,940	76.10	4,940	60.69	5,940	50.47	6,940	43.20	7,940	37.76	8,940	33.54	9,940	30.16
950	315.6	1,950	153.8	2,950	101.6	3,950	75.90	4,950	60.57	5,950	50.39	6,950	43.14	7,950	37.71	8,950	33.50	9,950	30.13
960	312.3	1,960	153.0	2,960	101.3	3,960	75.71	4,960	60.45	5,960	50.31	6,960	43.08	7,960	37.67	8,960	33.46	9,960	30.10
970	309.1	1,970	152.2	2,970	100.9	3,970	75.52	4,970	60.33	5,970	50.22	6,970	43.02	7,970	37.62	8,970	33.42	9,970	30.07
980	303.9	1,980	151.4	2,980	100.6	3,980	75.33	4,980	60.20	5,980	50.14	6,980	42.95	7,980	37.57	8,980	33.39	9,980	30.04
990	302.8	1,990	150.7	2,990	100.3	3,990	75.14	4,990	60.08	5,990	50.05	6,990	42.89	7,990	37.52	8,990	33.35	9,990	30.01
1,000	299.8	2,000	149.9	3,000	99.94	4,000	74.96	5,000	59.96	6,000	49.97	7,000	42.83	8,000	37.48	9,000	33.31	10,000	29.98

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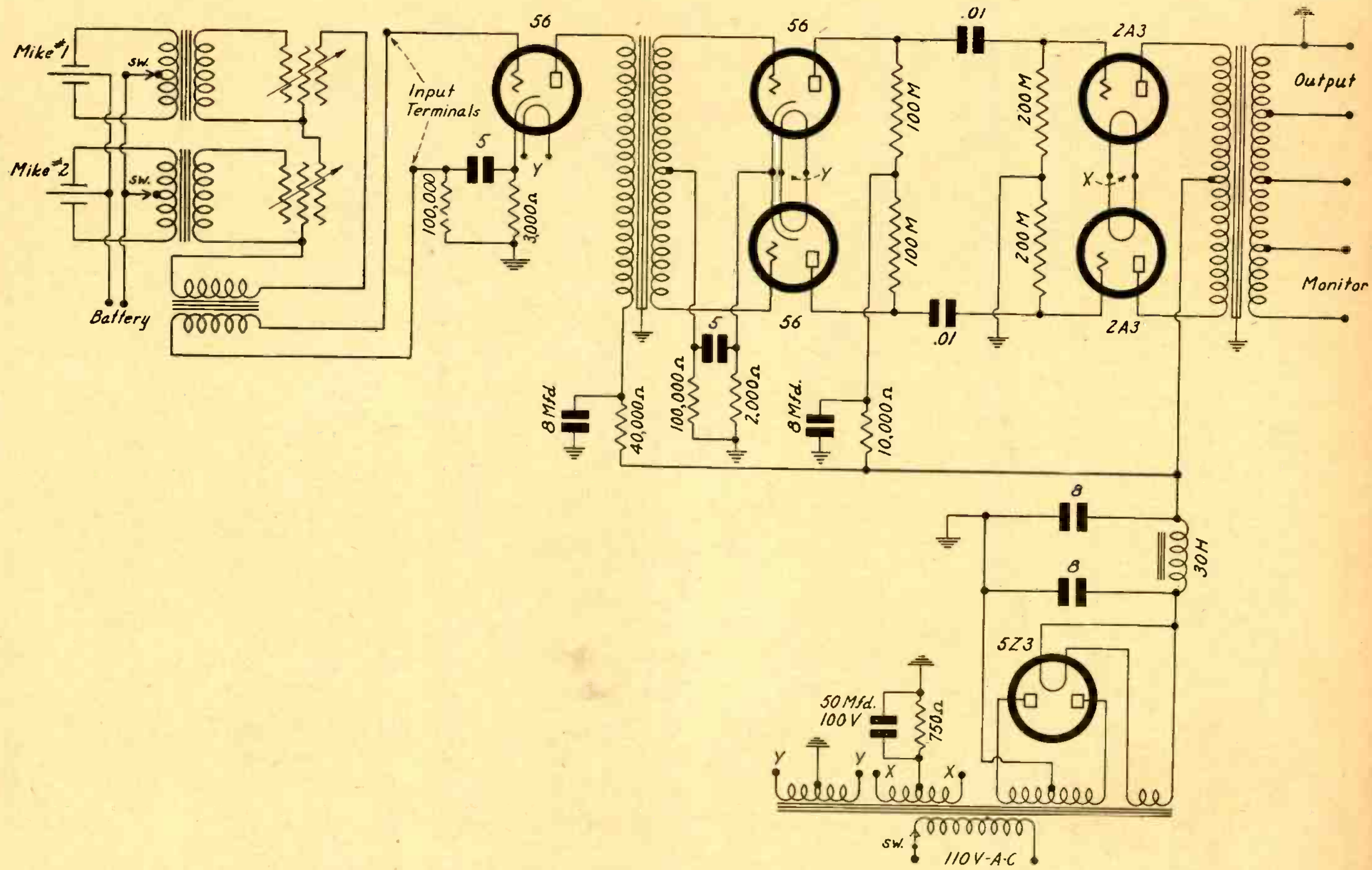
The Public Address System

The Choice of Kate Smith, Morton Downey, the Boswel
Stage System, with Push-Pul

By Harve

Harvey's



The circuit of a six-tube, three-stage public address amplifier with provision for two microphones and T-pad at output. Exceptionally good filtering insure good quality and stability.

THIS public address amplifier might be called the "Professional" because it is used by so many actors, entertainers and musicians. Many of these have gotten the habit of using the amplifier even though there may be a public address system of another type where they may be performing.

The PA system has been used on occasion by such famous radio entertainers as Singin' Sam. Mildred Bailey, Rubinoff, Jack Denny, Kate Smith, Morton Downey, Ingenues, Rex Cole Mountaineers, Will Osborne, Tasty Yeast Jesters, Guy Lombardo, Russ Columbo, Art Jarrett, Roger Wolfe Kahn, Eddie Leonard, Little Jack Little, Boswell Sisters, Sisters of the Skillet, Three Keys, Harold Stern, Ben Alley and Paul Whiteman.

Well, there is a reason why so many have selected this amplifier. There are several reasons, as a matter of fact. One reason is that it is capable of fine quality, another that it is capable of putting out ample volume of such quality, and still another is that it can be moved easily from place to place without the necessity of a truck. It is portable, for it weighs less than 40 pounds complete, including the carrying case.

In Fig. 1 we have the complete circuit diagram of the public address amplifier. It will be noticed that provision is made for two double-button microphones, both operating from the same battery. A switch is provided for each microphone so that either may be switched in or so that both may be used at the same time.

Fader and Mixer

In the secondary of each microphone transformer is a T-pad for mixing the outputs of the two microphones in different proportions. Both these pads are of the constant impedance type and for that reason there will be no change in quality as a result of changes in quantity or volume. The two secondaries are connected in series with each other and with the primary of a line-to-tube transformer.

The first tube in the amplifier is a 56 and the stage is single-sided. The tube is self-biased by means of a 3,000-ohm resistor connected between the cathode and ground. Between the grid return and ground is a resistor of 100,000 ohms and across the two resistors, connected in series, is a 5.0 mfd. electrolytic condenser. The connection of the by-pass condenser across the two resistors instead of across the bias resistor alone is for the purpose of increasing the by-pass efficiency of the condenser and thus greatly to reduce the reverse feedback.

The second stage also utilizes 56 tubes, but in this case they are in push-pull, the coupling between the first tube and the second stage being by means of a push-pull input transformer. The coupling

That the Radio Stars Use

Sisters, Rubinoff, Guy Lombardo and Others is a Three-
56's Driving 2A3's Push-Pull

y Sampson

Radio Shop

LIST OF PARTS

Coils

Two microphone-to-line transformers for double-button microphones
One line-to-tube transformer
One push-pull input transformer
One push-pull output transformer, with monitor winding
One 30-henry choke coil, 100 ma. capacity
One power transformer: one center-tapped high-voltage winding, two 2.5-volt, center-tapped windings, one 5-volt winding, one 110-volt winding.

Condensers

Two 5 mfd. electrolytic condensers
Two 8 mfd. electrolytic condensers
One 50 mfd. electrolytic condenser, 100-volt rating
One 8 mfd. electrolytic condenser, 500-volt rating
Two 4 mfd., 1,500-volt, by-pass condensers
Two 0.01 mfd. stopping condensers

Resistors

One 30,000-ohm bias resistor
One 2,000-ohm bias resistor
One 750-ohm bias resistor, wirewound
One 10,000-ohm resistor
One 40,000-ohm resistor
Three 100,000-ohm resistors
Two 200,000 resistors
Two T-pad faders

Other Requirements

Three 56-type sockets
Two 2A3 type sockets
One 5Z3 socket
Three binding posts
One toggle switch
One socket type male plug
One output strip containing one single circuit jack and one three-contact socket.
One steel chassis, 8 x 13 inches, black crackle finish.

between the middle stage and the output tubes is by resistance and capacity. There are two metallized 100,000-ohm coupling resistors in the plate circuits of the 56s, two 0.01 mfd. stopping condensers, and two 200,000-ohm grid leaks.

Thorough Filtering Throughout

We have already mentioned the thorough filtering in the grid circuit of the first 56 tube. But the thoroughness is not limited to this tube. In the plate circuit of the same tube we have a 40,000-ohm filter resistor and an 8 mfd. electrolytic condenser. The combination prevents feedback which might cause motorboating and similar audio disturbances.

A similar filter is used in the plate circuit of the middle stage, the filter resistance being 10,000 ohms and the by-pass condenser 8 mfd. This condenser also is an electrolytic. In the grid circuit of the push-pull 56 stage is a bias resistor of 2,000 ohms, a grid return resistor of 100,000 ohms, and a 5 mfd. electrolytic condenser across the two resistors in series. The 750-ohm bias resistor serving the two output tubes is shunted by a 50 mfd. electrolytic condenser, rated at 100 volts. Thus, even though the second and the third stages are push-pull, the leads are filtered as thoroughly as if the circuit were single sided throughout. This in part accounts for the excellent quality that is obtainable from this public address amplifier.

The B Supply

The B supply contains a 5Z3 rectifier, the usual filament windings, and a one-section filter. The first 8 mfd. condenser, the one next to the rectifier, is composed of two 4 mfd. paper deilectric units, each tested at 1,500 volts d-c. Condensers of such high rating are necessary next to the rectifier tube as a safeguard against possible breakdowns. The next 8 mfd. condenser in the filter is an electrolytic of 500-volt rating. A 30-henry choke completes the filter. It has been found by experience that a filter of this kind is entirely satisfactory in removing hum, provided that audio transformers are not too close to the power transformer and also provided that those which are on the same chassis are mounted with their cores at right angles to the external field of the power transformer. The correct placement is found by trial.

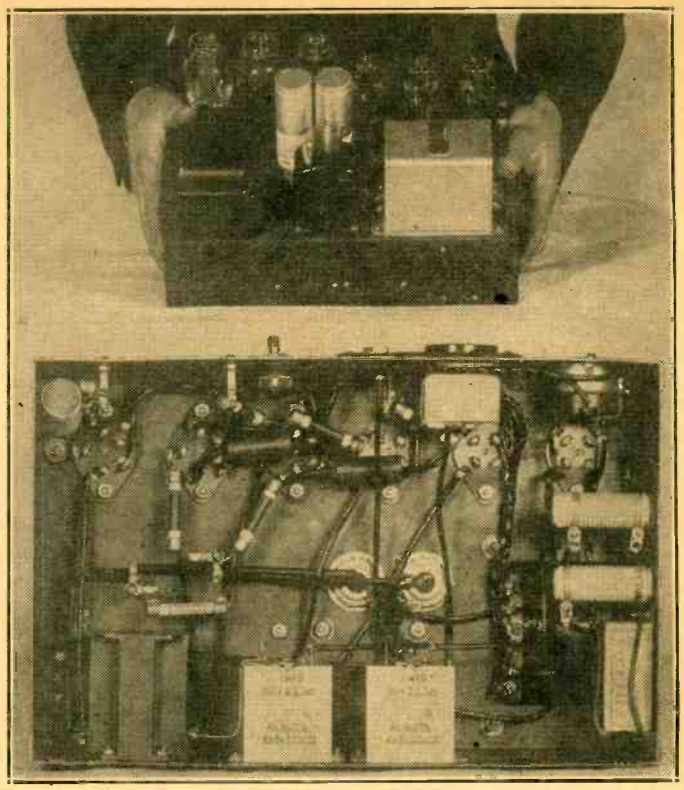
The designer of the public address system, and author of the accompanying article, before his own microphone, which is connected to his quality PA system.

The Output Transformer

A special high-grade output transformer is employed in the circuit. The primary is center-tapped and takes the output of the two 2A3's. The secondary contains many taps and is designed to be used with many different line impedances. In the present case the tap for a 500-ohm line is connected. Besides this there is provision

(*Continued on next page*)

Front view of Harvey Sampson's Portable PA System, in the carrying case of his own design. The earphone pack is for monitoring.



At top is the top view of the PA system removed from its handsome portable cabinet. Below is the underneath view of the wiring.

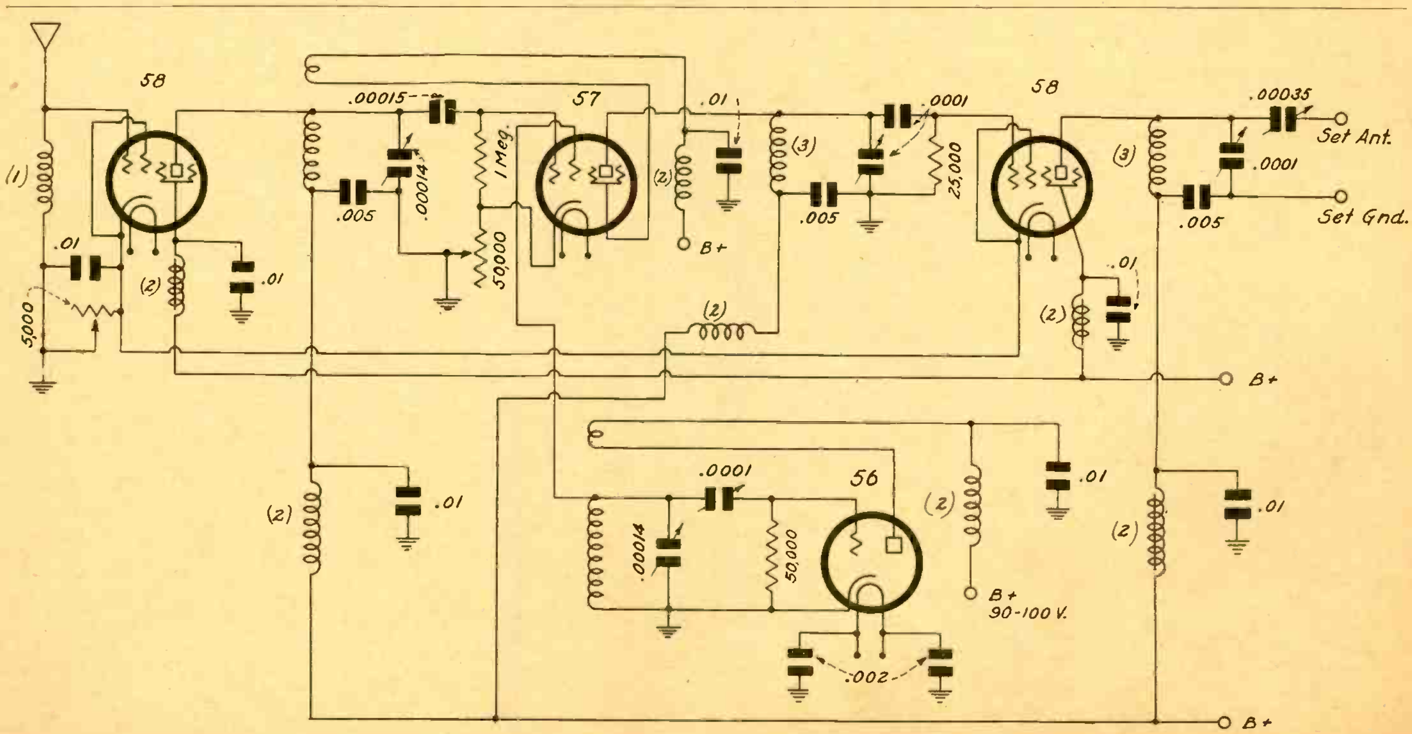
(Continued from preceding page)

for a monitor. At the rear of the chassis is a terminal escutcheon containing a jack for the monitor headset and a three-contact outlet for the loudspeaker.

On the rear upright is also a toggle switch for turning on and off the power, the switch being in the primary of the power transformer. A very convenient feature mounted on the chassis is a socket type male plug. This obviates the necessity of having a long line cord dangling from the chassis. One cannot step on the plug in this instance and in that manner put the circuit out of operation.

The chassis does not contain all that is shown in Fig. 1, but only those parts which are at the right of the input terminals. The line-to-tube transformer, the pads, the two microphone transformers, the two microphone switches, and the two jacks for the microphones are mounted on a special control panel at the top of the carrying cases. The amplifier and power supply chassis is near the bottom of the case. Between the two parts, that is, between the amplifier and the control panel, is a drawer compartment for spare tubes and for the microphone battery.

While the circuit is intended to be a portable public address system, it is not limited to the use of microphones nor the type of microphone indicated in the drawing. In the first place, the amplifier may be used for amplifying audio frequencies emanating from a radio detector. The input terminals may be used for this purpose, provided that the grid of the 56 is isolated from the plate voltage on the detector tube. In the second place, the amplifier may be used in connection with a phonograph pick-up unit. This may be connected directly to the input terminals, provided that there is a volume control built into the pick-up unit.



The output of this short-wave converter that uses plug-in coils has two variable condensers, one across (3), the other in series with the output. By adjusting the condenser across (3) and the series 0.00035 mfd. the series element alone need be varied if the receiver (i-f) frequency is shifted for any reason.

Aerials for Short Waves

And How They Can Help Correct Fading

By Louis L. Vollert

THE short-wave transmission from a station may result in fading or non-reception of that transmitter at a particular location. The fading may be due to the reflection of the sky-wave part of the transmitted wave reaching the receiving antenna at a different time than the ground wave, the one that travels above but near the earth. Sometimes the sky wave comes back to earth and darts up to the ionosphere, so as both components continue, one becomes a sort of additional ground wave, and causes of fading multiply. Non-reception of a station entirely would be due to location in an area between the transmitter, outside the ground-wave zone, and the point where the wave returns to earth from the layer. The zone is called the skip area and its linear extent is called distance.

Started as One But Divided

The reception of these different waves that started out as one and became segregated, or disintegrated, as it were, results in what is termed a phase shift. That means one aspect of the wave arrives at a different time than another aspect. Waxing and waning reception results. It is called fading.

Many factors contribute to fading, and also there is fading on different frequencies. Take the transmitted wave itself. It has modulation, present as an audio-frequency rate of change of the carrier amplitude. There is one form of fading that causes the loss of some of the frequencies of modulation, so close may fading "tune." Frequencies equivalent to 3,000 cycles or more may fade from a signal that maintains excellent uniformity for frequencies of modulation from less than 3,000 to 50 cycles. This is called selective fading.

In every instance where special aerials are used for establishing directivity there is some form of impedance matching, or transmission line, and therefore such means as tilted antennas, inverted V antennas, horizontal double V antennas and the like always have associated with them the proper coils or condensers for establishing the desired effect.

Wherever there are two wires there is a capacity between them. If chokes are put between the wires at given points the effect of this capacity can be balanced out. Also the phase can be accelerated. Electrically the best results with parallel-wire systems has been obtained when the equivalent velocity of the phase has been greater than the velocity of light. That means the apparent phase movement is faster than that of the wave.

Yes and No

It isn't so actually, for no electrical quantity is made to move faster than light travels, but the constants of the circuit are so selected that the comparative result is the same as if the velocity of light were exceeded in the antenna system.

That gets us somewhat beyond anything we can hope to cope with, using screwdriver, coil-winder and soldering iron, but it does indicate that weighy considerations are before us.

When we consider any wire in space we must acknowledge that it has a certain impedance. It responds best to one frequency. It is reactive. We do not deal with wires in space, but wires in some definite and known medium, related somehow to surrounding and even impinging objects. The impedance in space is one thing, and is theoretical. The impedance amid definite surroundings is known as the surge impedance. It is that impedance which the wire possesses with all the contributants at work on it. The capacity to ground is one of them.

Adjustments Introduced

This is the true or real impedance and from its value the frequency to which the system will best respond can be ascertained. It can not be well computed for high frequencies.

At the natural frequency the voltage in the antenna rises to its height, that is, a voltage surge takes place. It is the surge impedance that has to be ascertained before the transmission line can be accurately constructed. The impedance of the transmission line must be equal to the surge impedance of the system it serves. Transformers at the two ends of the double down-leads must be experimentally selected. There must be step-down ratio from the antenna to the downleads and step-up ratio from the downleads to the set.

The object of the transformers is to create a condition equal to that of pure equal resistances at both ends of the downleads.

Since we are confronted with the fact that any antenna is more sensitive to a particular frequency than to others, and more sensitive to certain sub-divisions of that frequency than to others, we must compromise and introduce some method that shifts the antenna impedance considerably. That instrument may be a tuning condenser. It may be a combined instrument, a variable condenser and a variocoupler. Preferably it should be such a combination. Even with tilted antennas, condenser adjustment atones for the fairly close directivity and adjustment of the condenser has the same effect as changing the tilt.

Time to Get Busy

Meanwhile experimenters will have to get busy, as there is much work to be done. The parallelepiped representing the horizontal double-V, requiring four supports, and having the two terminals, or angles of each proper V accessible for termination, offers one possibility for an indoor frame that can be rotated like a loop for directional effects, and which has sufficient interception at various angles to offer a suitable compromise for perpendicular shifting.

The object in general is to get more out of the aerial itself, without causing interference to be picked up by downleads that are in the zone where interference is worst.

On short waves particularly, little man-made or natural interference is brought in from a distance. The experience with sparking commutators, generators, sputtering arcs and the like, in the immediate vicinity, remind one that we must look for much of the trouble near home, or rather, seek to eliminate it on the basis of where most of it originates. The trolley car that is a thing of electrical silence to a broadcast set is indeed a noise contraption for certain short waves. As the waves become shorter and shorter, this vice begins to disappear, until at ultra frequencies both man and nature seem to be at a loss to generate interference. Hence there is no static, there is no fading, there is nothing but joy on the ultra frequencies, with the awful shortcoming, however, that transmission in general is limited to the horizon distance.

This Won't Do It

At all hazards, the antenna-eliminator, that causes the aerial to be omitted in favor of running the ground wire to the antenna post of the set, will not be the solution for short-wave and all-wave antennas. Whatever the solution will be, it will not be that.

Higher I. F. Cited As a Remedy on Short Waves

The entire radio industry is now struggling with the probably impossible problem of getting fine results at the higher frequencies of short waves, retaining a low intermediate frequency, somewhere around the four hundreds of kilocycles.

The history of the superheterodyne has been the gradual increase of the intermediate frequency, starting from around 30 kc, then going to around 90 kc, then to 110 or 115 kc, and next to the three hundreds, until two years ago the four hundreds became popular. Going somewhat higher would introduce a broadcast-band frequency, which is impractical.

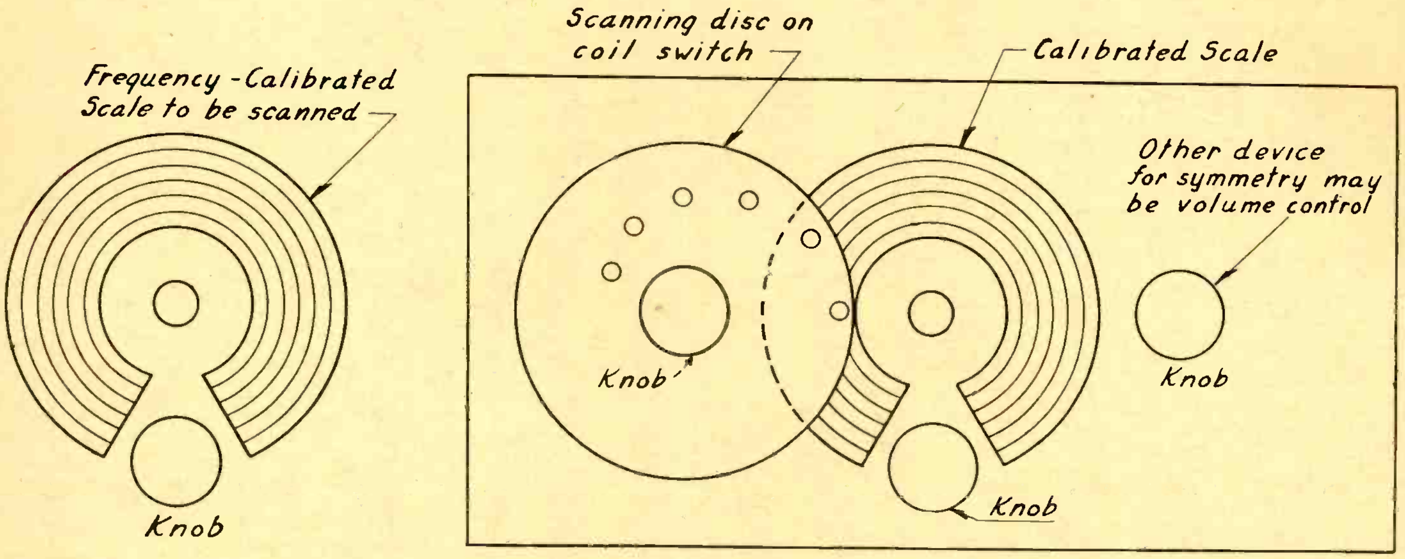
But it is entirely practical to skip the broadcast band. The "intermediate" frequency then would be really a supermediate frequency for signal frequencies lower than the fixed-frequency channel's frequency, and a true intermediate frequency for signal frequencies higher than the frequency of the fixed channel.

That is exactly what should be done and will be done. The locking vice sets in so early, at such a relatively low frequency, that the benefit of r-f tuning is lost. There is only one frequency of acceptance and generation, instead of the required two. The plan I suggest is that the ratio of tuning be determined, and that a 40-kc gap be left, the super-inter-mediate frequency being located there. For instance, suppose one band stops at 2,100 kc. The i.f. could be 2,120 kc. Signal frequencies lying between 2,100 and 2,140 kc would be blanked by inductance selection. The super-intermediate channel frequency could not be received without unjustifiably elaborate precautions.—Herman Bernard.

A Scanning-Disc Dial

for Automatic Indication of Only One Band at a Time in Frequency-Calibrated Multi-Wave Receiver

By Herman Bernard



The frequency-calibrated scale at left is to be subjected to a system that exposes only one tier of frequencies (or band) at a time. The method of doing this is shown at right. Turning the condenser dial exposes the different frequency numbers in any single band, and never in more than one band.

ASSUMING a disc dial 3½ inches in diameter, with frequencies calibrated on it for six tiers, for all-wave coverage, it is obvious that, starting from near the periphery, each succeeding tier will be nearer the center or hub. It is assumed further that there is equal radial space devoted to the areas for numbers designating the frequencies.

Since it is desirable to have some automatic method of exposing only the tier representing the frequencies of the band in which the receiver is being worked, it is plain that some device must be connected with the coil-switch for accomplishing this.

If a metal disc is used, holes may be drilled in it, so that when the scanning disc is fastened to the shaft of the coil-switch, the disc will rotate with the switch shaft and stop with the switch shaft. Therefore, if the holes are measured as to their position in respect to the tiers on the dial scale proper, being displaced to left or right by the space allowed for the numbers written on the dial proper, and being disposed about a circle in arcs equal to the number of degrees of a circle between switch-stop positions, there will be coincidence of switch position with the calibration of the dial applicable only to that band.

Switch Positions Located

If there is an oblong escutcheon, whatever light is used for illumination behind the escutcheon or behind the dial scale, will be partly shut off in one direction by the escutcheon and totally in all directions by the masking disc, except for the hole exposing the desired band.

The switch used was that manufactured by Central Radio Corporation, of Beloit, Wisc. The tabs on the switch were 30.6 degrees apart. It was assumed that the switch positions actually would be the same as the tabs or lugs indicated, but when a masking disc was prepared, with equal spacing of 30.6 degrees around 153 degrees of the circle, it was found that some of the holes were off. This was due to the actual switch stopping positions being controlled by a ratchet into which a sprung ball bearing was forced by the switch operation, and the ratchet stopping points were slightly different. This difference is taken into account in the detail of the masking disc herewith, whereby the first displacement is 30.6 degrees, the second 30.15 degres, the third 31.35 degrees, the fourth 31.5 degrees and the fifth 30 degrees, instead of all being 30.6 degrees. Only five angles are required for six positions, as the first position in respect to the center line is zero angle.

Center Switch Shaft and Condenser Shaft

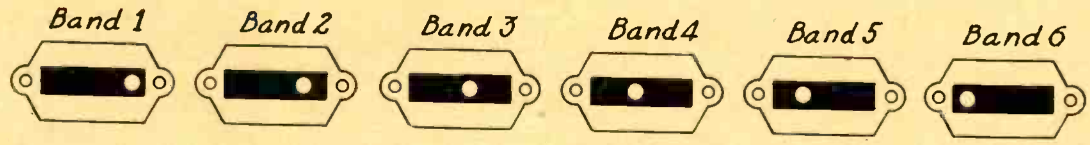
The dimensions for accomplishing automatic scanning of the frequency-calibrated scale are as follows: the masking disc and the dial scale are 3½ inches in diameter, as already stated. The switch shaft center is in line with the center of the condenser shaft. The dial probably will have a vernier shaft below the condenser shaft, but the alignment of the coil-switch must not be made with the vernier shaft but with the condenser shaft. The distance between the two shafts (condenser and switch) is 4 inches. The total width of the dial scale area to be viewed or scanned is 1½ inches, and the numbers must not be more than ¼ inch high. The total width of all the space devoted to the rows of numbers, including the blank spaces between tiers of numbers, is the same as the minimum exposed escutcheon distance, 1.25 inches, plus the diameter of one hole.

The total width to be scanned may be derived from the masking disc drawing, since it is the difference between the extreme radii, or 3 17/64 minus 2 1/64, or 1¼ inches, plus the ¼-inch hole diameter. The six holes are disposed about the center so that each succeeding hole exposes a part of the dial scale, or an imprint of the calibration. Hence, if the six holes were put side by side on one plane, instead of being displaced by certain arcs, the result would be a continuous opening of a width equal to 1¼ inches plus the width of one hole.

Lowest Frequency Band Nearest Hub

The masking or scanning disc may be prepared from the drawing, and attached to a fixture, by riveting or by using small screws and bolts, the fixture having a bushing or other provision for ac-

HOW THE SPOT OF LIGHT IS MADE TO MOVE ACROSS SCREEN



The apparent movement of the illumination, due to scanning. The circle of light is obviously confined to one band. The coil-switch determines which band has illumination. The calibrated scale is attached to the condenser dial and rotating that dial exposes the particular frequency in the band.

commodating the ¼-inch shaft of the switch, and a setscrew for fastening the fixture to the switch shaft.

If a blank scale is to be calibrated, the masking disc is placed on the switch shaft so that one extreme hole coincides with any useful area of the blank scale, and with a pencil the diameter of the opening may be registered through the hole on a horizontal line. Then the switch is turned to the next notch and the process repeated, and so on, until the twelve boundaries for the six points are established. Then with a compass the distances may be measured from the removed blank scale and the dial may be frequency-calibrated without reference to the switch, except that bands should be of course progressive. It is well to put the lowest-frequency band nearest the hub and put the higher frequency bands in next succeeding positions toward the outer circumference of the blank scale.

Then, with the calibrated dial affixed, the scanning disc is lined up with the scale on the center line for the extreme switch position. The scale itself is moved as far to the left as possible if the system is to have the switch at left, condenser at right, as is supposed in the present discussion.

Methods of Indication

Now as the switch is turned to the five other positions, each of the five other bands will be exposed, and no two or more bands at one time, for reasons previously stated. The spot of light therefore is moved along the distance of the escutcheon opening as the six bands are traversed.

The question of an index arises. If small transparencies are put where the six masking-disc holes are, and a horizontal line drawn where experience dictates it should be, this will serve as an index, although with some parallax, due to the necessity of the same distance existing between masking disc and dial scale, to avoid one scraping the other.

If the scale of the dial is a transparency or a translucency, then the pilot lamp will cast its rays through the scale, exposing only so much of the scale as is due to light passing through one of the six holes of the scanning disc, and then the escutcheon may have a transparency or translucency affixed, with a single indicating line which will avoid parallax.

Owing to the smallness of the size of the numbers used for frequency indication, a lens may be put between the scanning disc and the escutcheon, for enlargement by projection, or a cylindrical lens may be put in front of the escutcheon.

Details of Cylindrical Lens

Such a cylindrical lens may be simply a piece of glass tubing, ¼ inch diameter, as long as the escutcheon exposure is wide. The smaller the lens diameter, the greater the magnification, and also the smaller the original numbers must be, but there must be scarcely any distance between the spherical lens and the transparency or translucency on the escutcheon, otherwise the figures will not be clear and will read backward.

By using a lens system, of course, the original size of the disc and dial may be reduced, but this is another experimental operation, and it is suggested that the dimensions already given be followed.

It is preferable that the scanning disc holes be punched, but if you haven't the punches, use drills, but clean the holes carefully of burrs.

The system just outlined has been devised by the author and actually tried out. It works very well indeed and is being made the basis of commercial reproduction.

Nature's Way

It is a simple method. It uses nature's preferred method, of making things turn around, spherical-like objects and elliptical paths, or parabolic paths, and not up and down. When things move up and down or left-and-right, or so, in such indicating systems there are wires that must travel, and this presents a danger to long life of the device.

It is a system that in practice does not wear out, any more than any wedge-driven dial does, or any scale merely affixed to a switch. There are not belts, ropes or pulleys.

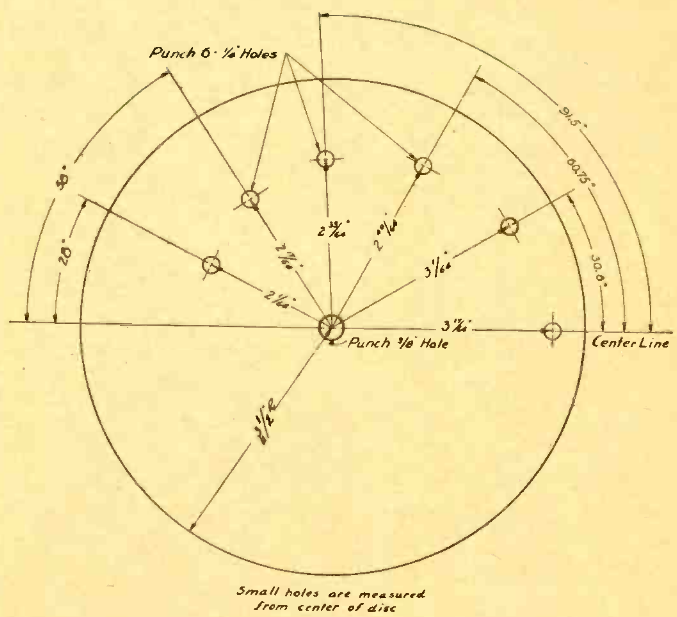
The method just outlined can be introduced at small cost, another attractive feature. But it does require that a calibrated dial be prepared, and most experimenters do not feel equal to the task.

Not Yet Obtainable

At the present writing there is no dial-switch-coil-condenser system on the kit market that a fellow can buy, with which to build a multi-range receiver. If he could get hold the combination he could construct his own scanning disc from the directions just given, not following the exact values, as these will change with differences in diameters of calibrated dials, but introducing the principle, which can be done experimentally by those not gifted mathematically.

However, preparations are being made to commercialize such an outfit for the kit field, and it is expected by the Fall the device will be on the market.

This is the Disc for Scanning Dial



Dimensions of a scanning disc to be attached to a coil-switch. A fixture, comprising a hub and set-screw, must be provided. This may be removed from a direct-drive disc dial. The dial scale (on condenser) should be 3½ inches diameter also. Switch and condenser shafts should be 4 inches apart, condenser to right of switch.

AN I-F AMPLIFIER

To Go With a High-Powered B Supply and Audio System

By J. E. Anderson

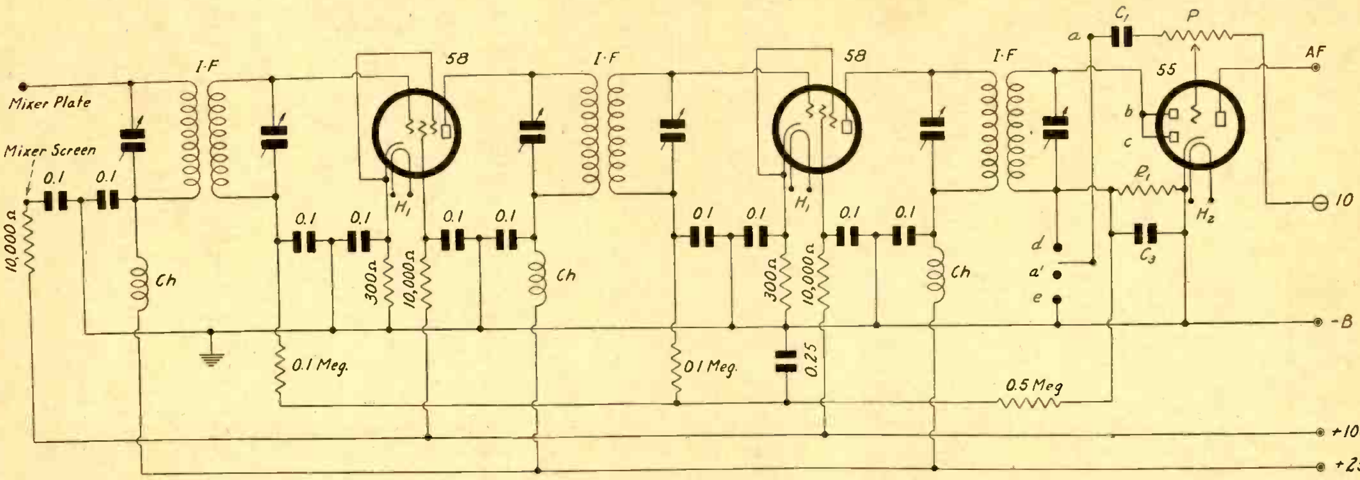


FIG. 1

The circuit of a two-tube intermediate-frequency amplifier together with the detector and first audio amplifier. Thorough filtering is a feature.

LAST week we described a heavy-duty B supply and an audio-frequency amplifier. We shall now add an intermediate frequency amplifier, which we show in diagram in Fig. 1. This circuit contains a part of the audio-frequency amplifier described last week, the detector being repeated the more clearly to show the connections.

There are two super-control tubes in the amplifier and three doubly tuned i-f transformers. Just what the intermediate frequency is does not make a great deal of difference, but for the sake of definiteness we shall assume that it is 175 kc. Therefore, we have six tuned circuits adjusted to this frequency.

Thorough Filtering Essential

In order to take advantage of all the possible gain in an amplifier having two super-control tubes and three doubly tuned intermediate frequency transformer, it is necessary not only that the tubes and coils be shielded but also that the filtering in the supply leads be as thorough as possible. Associated with each 58 tube are four 0.1 mfd. by-pass condensers. One goes from the screen to ground, another from the plate return to ground, still another from the cathode to ground, and the fourth from the grid return to ground. Another way of arranging these condensers is to by-pass to the cathode instead of to ground. That would require changing the side of the condenser now between the grid return and ground to the cathode and the common side of the screen and plate by-pass condensers from ground to the cathode.

The first two 0.1 mfd. condensers in the circuit serve the mixer tube, which is not shown.

In each plate return lead, including that of the mixer, is a radio-frequency choke coil Ch the purpose of which is to stop the intermediate frequency currents from straying into undesired channels. The value of each of these chokes should be about 10 millihenries. In each screen lead, including that of the mixer tube not shown, is a 10,000-ohm resistor which aids the filtering.

Biasing of Tubes

The tubes in the intermediate-frequency amplifier are self as well as signal biased. It is not worth while to take the fixed bias for the intermediate tubes from the C supply because by-pass condensers of comparatively small size are very effective in preventing reverse feedback. The self-bias on each tube is obtained by means of a 300-ohm resistor in the cathode lead.

In the grid return of each tube is a 0.1 meg. resistor and at the point where they are joined a by-pass condenser of 0.25 mfd. is connected to ground. A 0.5-meg. resistor joins the grid returns to the negative end of the lead resistor on the diode, that is, to point (d) in this diagram as well as in Fig. 2, page 17 of last week's issue. Since the grid returns of the two a.v.c. controlled tubes are made to the negative end of the load resistance, the full rectified voltage is available for automatic control. The full audio component of the rectified signal is also impressed on the audio amplifier when the potentiometer is set at maximum.

Switching Arrangement

When the signal is of audio frequency, such as that from a microphone or a phonograph pickup, it should be impressed between (a') and (e) and these two points should be either binding posts or a single-circuit jack. When audio signals not of radio origin are

(Continued on next page)

LIST OF PARTS

Coils

Three doubly tuned and shielded 175 kc. intermediate frequency transformers
Three radio frequency chokes, 10 millihenries each

Condensers

Ten 0.1 mfd. by-pass condensers
One 0.25 mfd. by-pass condenser
One 250 mmfd. condenser (C3)
C1—One 0.01 mfd. or larger stopping condenser (part of amplifier)

Resistors

Two 300-ohm resistors
Three 10,000-ohm resistors
Two 100,000-ohm resistors
Two 0.5-meg. resistors
P—One 0.5-meg. potentiometer (part of amplifier)

Other Requirements

Two 58 sockets
Two grid clips
Two tube shields
One single pole double throw switch

Radio University

Answers to Questions of General Interest to Readers. Only Selected Questions are Answered and Only by Publication in These Columns. No Correspondence Can be Undertaken.

Rule for Winding Small Inductances

WILL you kindly give a simple rule for winding inductance coils to be used in short-wave receivers? I have tried formulas given in various books, but they do not seem to hold, or I cannot apply them correctly.—W. N. J.

If the formulas do not hold there is no way of computing the turns. It may well be that the computed inductances are close enough but that the distributed capacities cause the trouble. About the only way to wind short-wave coils to fit a given band is by trial and error. Wind a coil and adjust the turns experimentally until a given frequency comes in where it is desired. If it is only a matter of winding a coil so that its range will overlap the range of another coil by a small amount, set an oscillator so that its frequency comes in near either 100 or zero, and then turn the condenser to zero, or 100, and without changing the oscillator adjust the new coil until the same frequency comes in. This process can be continued from one end of the short-wave band to the other.

* * *

Grid Current Distortion

CAN you give a brief explanation of why there is distortion in an amplifier in which the grid leak resistance is high? I do not see any reason why there should be distortion, but I know from experience that there is, and I also know that the tube manufacturers recommend certain maximum values of grid circuit resistances.—G. H.

If no grid current flowed, it would not make any difference how large the grid resistance is. But it is not possible to make tubes and circuits in which grid current will not flow, and if a strong signal is impressed on the grid, so strong that the grid went positive during part of the cycle, there would be much grid current. As soon as grid current flows, there will be a voltage drop in the grid leak, and this will oppose the signal. The actual grid potential cannot follow the signal voltage, and therefore the plate current cannot follow it, either. Distortion is the result.

* * *

Supplying Screen Voltage

WHICH IS THE BETTER WAY of supplying the screen voltage: using a voltage divider or a resistance in series with the screen lead?—F. W. H.

The essential thing is to get the screen voltage correct for the particular application of the screen grid tube. If that is correct, it should not make any difference how it is obtained. But the screen voltage should not depend on the signal. Hence, there should be a large condenser between the screen and the cathode. If that is used there will be little fluctuation in the screen voltage from the mean as determined by the voltage divider or the series resistance. The series resistance method is the simpler since it requires a single resistor, whereas the voltage divider method requires two. The writer prefers the voltage divider method because the voltage is more nearly constant that way.

* * *

Phase Change of Condenser and Resistor

HOW can the phase change due to a resistor and condenser in series be computed? Please show the details of the computation.—R. T. L.

The tangent of the phase angle is the ratio of the reactance to the resistance. The reactance of the condenser is Cw, where C is the capacity of the condenser in farads and w is the radian frequency, that is 6.28 times the frequency. Therefore the tangent of the phase angle is 0.159/RC. As soon as R and C are known, the angle can be obtained from trigonometric tables. Suppose, for example, that $R = 100{,}000$ ohms and $C = 0.25$ mfd. Then $RC = 0.025$. The tangent is 0.159/0.025, or 6.36. Tables will show that this is the tangent of 81 degrees. In the same way the phase angle of a coil and a resistance can be computed. In this case, however, the tangent is Lw/R, where L is the inductance in henries, w is the frequency in radians, and R is the resistance in ohms.

* * *

Radio-Frequency Boosters

IF A SHORT-WAVE receiver is not satisfactorily sensitive, can anything be gained if a stage of radio-frequency amplification is added, or if two such stages are added? I have heard that at ultra-high frequencies amplifiers are not of much use since the tubes will not amplify. I have seen boosters advertised by reputable concerns.—W. B. N.

If the short-wave set is regenerative and there is a close control of the regeneration, there is something to be gained by adding a booster, although any amplification resulting from the booster may be small compared with the gain due to regeneration. If the signal is boosted before the regenerative detector, the gain in the detector sometimes may not be so great as it would have been had the weaker signal been applied. In fact, the output from the detector is generally about the same in the two cases, except that with regeneration the selectivity would be much higher. In case there is no regeneration, a booster is particularly advantageous, as this would apply to superheterodynes mainly.

* * *

Ultra-High Frequency Circuits

I HAVE TRIED many short-wave regenerative receivers but have had little luck around ten meters. There is no indication whatsoever that the circuits oscillate, but whether this is because there is no oscillation or because there is no signal with which to beat I cannot say. Can you suggest a method of determining whether or not the circuit is oscillating? And if it is not oscillating, can you suggest anything that will help make it oscillate?—T. R. N.

It is always possible to set up two similar circuits and to listen in on one of them. If there is oscillation it will become known by squealing. That will show that both are oscillating. A test oscillator, even one of comparatively low fundamental, will beat with the high frequency and thus make oscillation known. Another way is to connect a headset in the plate circuit of the high frequency oscillating tube and listen for the click. Suppose you increase the filament current slowly. If the circuit starts oscillating at any value of current that start will be evidenced by a dull click, or a thud, in the phones. Still another way of detecting the presence of oscillation is to couple a thermo-milliammeter to the oscillating coil. If the coupling is purely inductive, the indication of current in the thermo-milliammeter is positive evidence of oscillation. The milliammeter could also be connected in series with the condenser. If there is current in that, it can only be alternating current, that is, oscillating current.

* * *

Slideback Vacuum Tube Voltmeter

WHAT TUBES should be used for a slideback vacuum tube voltmeter in order to get the closest readings of the voltage? Which is important, the plate current or the bias at which the plate current cuts off?—W. N. A.

Any tube that has a sharp cut-off is suitable for a slideback vacuum tube voltmeter, provided that the cut-off occurs in the negative grid region. The so-called super-control tubes, or exponential tubes, are not suitable because they have no definite cut-off. Usually a high-mu tube is best. A necessary condition for accuracy is that a sensitive milliammeter be used in the plate circuit of the tube to indicate cut-off.

* * *

Lecher Wire Transmission Line

IS a pair of Lecher wire as good for a transmission line as a pair of concentric conductors? If not, wherein is the concentric line superior? What are energy and power?—G. H.

The line made of two concentric conductors is better because there is no radiation from it. The effective resistance is lower and more of the transmitted energy will reach the load at the end of the line.

(*Continued on next page*)

An Intermediate Channel for a Powerful Set

(*Continued from preceding page*)

to be amplified the single pole, double throw switch should be set on (a'). The radio part of the circuti is then out and will not interfere. When the audio signal originates in the detector, the switch should be thrown to the (d) position. This puts the load resistance R1 into the input of the audio amplifier and any signal arriving by way of the intermediate channel will be amplified.

The heaters, H1, of the 58s are supposed to be connected to the first filament winding on the power transformer, that is to (1, 2, 3), with the middle point grounded. H2 in this circuit is supposed to be connected to winding (6, 7, 8) on the power transformer, (7) being grounded when the power tubes are biased by means of the C supply.

(*Continued from preceding page*)

In a technical sense work is the product of force and distance. If anybody or anything moves a material body a certain distance against forces, that somebody or something does work, or expends energy. The rate of doing this work, or of expending energy, is the power. Let us illustrate more specifically. Gravity pulls everything down. To lift something against the force of gravity requires the expenditure of energy. That is, we have to do work to lift something. The rate at which we lift the body is the power. Suppose we lift ourselves against gravity by climbing a hill. To reach a certain altitude we have to do a certain amount of work. If we do that work in half an hour we have to do work twice as fast as if we did it in one hour. If we are not powerful enough we may not be able to make the hill in half an hour. Then we would have to take a longer time and do the work with less power. Potential (voltage) in electricity is work done per unit charge. If Q is the charge and V the potential, QV is the work done. The rate of change of Q is the current. Hence if I is the rate of change of charge, VI is the rate of doing work, or the power. If t is the time during which I flows and VI is constant, VIt is the work done in a time t. If energy and power are used with the same meaning, there is only confusion of terms, possibly lack of understanding of the technical difference.

* * *

Calibration of Oscillators

I HAVE built an oscillator which I am attempting to calibrate against broadcast stations. For the purpose I am using a superheterodyne receiver sensitive enough to pick up all the broadcast channels used in North America. I have had no luck. There are entirely too many squeals and and it appears to be impossible to identify any of them. If you have a means of calibrating will you explain it? I should like to use the superheterodyne if it is possible. —R. L. E.

It is practically impossible to calibrate against broadcast stations when the receiver is a superheterodyne. The reason for this is that the oscillator generates too many harmonics and these harmonics are not related simply to the frequencies received. The frequency received is always lower than the oscillator frequency by the amount of the intermediate frequency. It is best to use a t-r-f receiver during calibration. By means of a regenerative receiver it is possible to calibrate and to pick up most of the stations. This need not have more than one tube provided a headset is used for listening.

* * *

Disadvantages of Inductance Switches

WHY is it that so many speak against using switches for changing the tuning ranges of short-wave receivers? It seems to me that they are the only logical way of changing the coils. Certainly plug-in coils are not practical, especially when it requires opening up the set when changing.—F. R.

There are several objections to switches. First, long leads are usually required to and from the switches. Second, poor contacts often result at the switch points. Of course, it is usually possible to shorten the leads and to dispose them so that no trouble develops. But it is not easy to get good contacts. Notwithstanding these objections, the switching scheme is the most practical.

* * *

Angular Measure

OCCASIONALLY you speak of radians in place of frequency. Just what is meant by a radian? In what way is it related to frequency, if there is a relation?—F. L. J.

The radian is the natural measure of angle. It is an angle such that two radii bounding it intercept on the circumference an arc equal to the radius of the circle of which that arc is a part. Since the ratio between the circumference and the diameter is 3.1416, and there are two radii in a diameter, the ratio of the circumference to the radius is 6.2832. Therefore in the complete circle, 360 degrees, there are 6.2832 radians. One cycle represents one complete circle. Hence if the frequency is f, the same frequency expressed in radians is 6.2832f. The factor 6.2832 always enters when conversion is made from frequency to natural angular measure or vice versa. One cannot compute reactance, for example, without using the number.

* * *

Attenuation

ONCE more will you kindly explain attenuation. If the number of decibels by which two powers differ is known, how can the ratio between the two be computed? Or if the ratio is known how can the decibels be computed?—W. E. L.

Attenuation is the decrease in power level as we go along a line away from the generator. The relation between power ratios and decibels is $A = 10 \log (P/Po)$, in which A is the attenuation in decibels, P is one of the powers and Po is the power used for the comparison. The logarithm is to the base 10. This formula is to be used when the number of decibels is to be determined when the power ratio is known. If the attenuation is known and the power ratio is to be computed, the formula is written in the form: $P/Po = 10^{0.1A}$.

* * *

Velocity and Dynamic Microphones

WHAT is the difference between the velocity, or ribbon, type microphone and the dynamic microphone? It seems to me that they two are the same except in minor details.—W. K. L.

Yes, the two are the same in principle. In the velocity microphone the ribbon is not only the diaphragm, but it is also the armature and the source of electromotive force. The ribbon is connected in series with a transformer primary, consisting probably of a turn or less.

* * *

Weak Signal Detection

IS IT a fact that the weaker the signal the greater is the detecting efficiency of a regenerative detector? If it is so, can you give a reason for it?—P. L. R.

Yes, it is a fact. The reason for it is to be found in the limited range of the vacuum tube characteristic. If the signal is so strong that the grid voltage varies between cut-off and saturation, there can be no increase in amplification due to regeneration, for even when the circuit is oscillating freely the grid voltage does not swing any more. On the other hand, when the signal is vanishingly small the regeneration can build up the grid voltage to about the same value as before. Therefore the amplification is increased in the ratio of decrease of the signal voltage.

* * *

Closer Calibration

IN A COMMERCIAL receiver that I have been using recently, for covering broadcasts and short waves, I find that the calibration of the dial for the broadcast band is pretty good, only fair for the first and second short-wave bands, but for the higher frequencies the gaps are too wide, that is, megacycle designations represent too great a difference in frequency, with nothing in between, and even these wide markers are not accurate. In fact, they have changing inaccuracy, and I wonder what can be done to cure this?—K. D. C.

As the frequencies become higher it is increasingly difficult to accomplish an accurate and reliable calibration of a dial. Since the same trimming condensers as are used for the broadcast band probably are used for the short waves, and these are of the compression type, with mica dielectric, a slight change in capacity, due to mechanical displacement arising from jolt or jar, or from meteorological conditions, will cause a large change in frequency. If such a component does not stay put, naturally the calibration will not hold strictly. But it will do for an approximation. Air dielectric trimming condensers would be one remedy. Stabilization of the oscillator—prevention of drift—is an additional one.

Station Sparks

By Alice Remsen

GENE LOCKHART DOES THEM

Just found out that Gene Lockhart writes those Lazy Dan skits which are done so well by Irving Kaufman on Sundays over WABC. Gene not only writes the dialogue, but also composes special songs for Irving to sing; that's what I call clever; and don't forget that Gene is one of the big hits of Eugene O'Neill's new play, "Ah, Wilderness!"

TRAGEDY CAUSES POSTPONEMENT

The sudden death of Charles Wakefield Cadman's mother, at her California home, prevented the famous composer from keeping his radio engagement scheduled for April 15th, over NBC. . . . "Dangerous Paradise," dramatic serial starring Elsie Hitz and Nick Dawson, made its final bow to the radio public on April 20th. . . . And so East and Dumke, those corpulent Sisters of the Skillet, are back again over an NBC network. They will be sponsored by Tastyeast, Inc., and may be heard each Tuesday, at 7:30 p.m. over an NBC-WEAF network. . . . Ed Wynn has not yet found his hats. . . . Ethel Park Richardson is the author of those "Hillbilly Heart Throb" sketches which are so popular with NBC listeners. Miss Richardson was born in the heart of the Tennessee hills, so should know something of that district. . . . Little Mary Small, the eleven-year-old singing star, could have been a concert artist had she so chosen, for Mary is an accomplished pianist. . . . Joe White, who used to be known as the Silver Mask Tenor, is singing just as well as ever on his song-spot over WEAF and network, Friday at 10:35 a.m. . . .

LANNY ROSS THRILLS 'EM

Lanny Ross was chosen as judge by the University of Kansas co-eds—that is, judge of beauty; Lanny selected the three prettiest girls from the class photos. What a thrill for the girls! . . . The Hoover Sentinels program has moved its broadcast time, and will now be heard at 5:30 p.m. each Sunday, over an NBC-WEAF network. . . . Cheerio has a new broadcasting period each Friday at 6:30 p.m.; it's a fifteen-minute program which he calls "Musical Mosaics," and is poetry and music woven into a picture. I heard his first presentation of "Hiawatha's Wooing"; it was very beautiful. . . . Peter Van Steeden, the clever young maestro, has composed a victory song for his alma mater —New York University. . . . Ernest Cutting gave the Scotch a break on his "Air Breaks" recently. The program was all-Scotch! And was it "thick," as Harry Lauder used to say! Well, rather! The banks an' braes were well represented. . . . "Sweetheart Melodies," the program sponsored by the Manhattan Soap Company, has another period over NBC, Wednesday at 11:15 a.m. on WEAF; the De Marco Girls are heard with Jack Arthur, well-known and popular baritone. They will still continue their other broadcast for the same firm over WJZ on Thursdays at 11:30 a.m., with William Kennedy, tenor. . . . Another program has made additions for the summer; the Fox Fur Trappers will broadcast two more fifteen-minute periods in addition to their regular weekly Friday night broadcast with Bert Hirsch. The new program will feature Ed Smalle and his Leaders Quartet, each Tuesday and Thursday at 11:00 p.m. WEAF. . . .

DOROTHY REPLACES DOTTY

A new series opened recently on Columbia, sponsored by the Reiser Company, consisting of Rip Lasher, Broadway commentator, with guest stars and an orchestra: Saturdays at 6:15 p.m. . . . Evelyn MacGregor is the new soloist to be featured with Mark Warnow each Thursday evening at 9:00 p.m. I am always glad to hear of Evelyn's success, for she has worked hard and deserves recognition as a fine artist. . . . There's a new singer also on the Old Gold program. Her name is Dorothy Compton; she is replacing Dotty Hill in the Debutantes Trio. . . . Two more recruits from the field of literature have joined the ranks of radio personalities. They are James Thurber, humorist, and Roy Helton, poet and novelist. Mr. Thurber is heard each Thursday evening at 10:45 p.m.; and Mr. Helton, each Saturday at 9:30 p.m. WABC and network. . . . Everett Marshall is to be the new star on "Broadway Melodies," each Wednesday at 8:30 p.m. commencing May 2nd. Jerry Freeman's Orchestra will continue to supply the music. . . . Ray Heatherton, of NBC's Junis Face Cream, and "Castles in the Air" programs, rides every morning. Ray lives in Floral Park, Long Island, and there are many leafy back roads in his neighborhood; Ray knows them all, and so does his horse. . . . Lanny Ross likes to fish and play tennis and golf. He doesn't care to eat in restaurants, nor does he like highly seasoned foods. . . .

STICKING TO THAT 700

Formal application to use its new 500,000-watt transmitter at full power on Station WLW's regular day-and-night schedule was filed last week with the Federal Radio Commission by the Crosley Radio Corporation. Tests have definitely confirmed the predictions of Crosley and RCA-Victor engineers in charge of the new transmitter's construction that, despite its stupendous power, there is no interference with other stations, due to the extreme accuracy with which the transmitter is maintained on WLW's assigned frequency of 700 kilocycles. . . . Peter Dixon is spending his spare time these days pottering around his new home in Bronxville, planting flowers in its extensive grounds, and having a good time generally. Peter is a regular home lad. His "Bobby Benson" programs, which he writes and directs, keeps him busy five days a week, but week-ends he devotes to home. . . . Jack Foster says he will positively be back on the job in June. Hurry up, Jack! We are all anxious to get a look at all that weight you have gained. . . . When you hear the swish of the paddle wheels on Captain Henry's Show Boat program, you are listening to the handiwork of Harry Saz, sound effect man. Harry works on fourteen major programs a week, which means he must attend all rehearsals as well as performances. So Harry is what you might call a busy man, supplying such sound effects as: the clatter of horses hoofs, slamming of doors, firing of pistols, thump of marching feet and ringing of bells. Harry works with a script, just the same as an actor, and woe betide him if he misses a cue. When Harry has a spare moment, he experiments with new effects. He invented the show boat curtain. . . . Dance orchestra leaders are getting interested in high-fidelity receivers on the assumption such sets will bring in better the art of the maestros.

SHORT-WAVE EARFULS

Notwithstanding the great popularity of short-wave reception, there are still many readers of radio publications who show no interest in this branch. Whether because of lack of sufficient time would be hard to say. Even with all that has been written on the subject, there are countless numbers who are not aware of the big improvements in short-wave transmitters and receivers. There is really a thrill in foreign reception and in so many instances various stations come in with unbelievable volume. Going back over the days when broadcast stations at distant points had their individual or local color, when some of the stars of today were struggling to make a name for themselves in broadcasting and create a following, a surprise treat was often in store for listeners. Today in short-wave reception the treat is even greater in many respects. Here one has a sort of an air trip of adventure, with great variety. In the short-wave tour one actually hears native singers and instrumentalists, and often news and talks on subjects of world-wide interest.

* * *

Atwater Kent has compiled a world-wide radio directory that lists the 300 principal world-wide short-wave stations as well as the 150 police stations in this country, and more than 700 broadcasting stations in North America. It is being distributed by radio dealers at 10 cents a copy. The listing of the short-wave stations gives the call letters, the frequency in megacycles and the wave-length in meters. The time schedules of the principal foreign stations are given and also their identifying signatures.

* * *

Recommendations for names and frequency ranges to be applied to the "all-wave" and other receivers were made at a recent meeting in New York of the RMA receiver committee, of which E. T. Dickey, of Camden, N. J., is chairman. The recommendations of the nomenclature and frequency ranges of the standard and other receivers were transmitted to the RMA board of directors.

* * *

During the past week some very interesting experiments were put through on the Postal International Short-Wave Receiver. Capt. Horace Hall, known to most of the short-wave fans, and who is a regular feature over WBNX, New York City, made several good pick-ups of South American and other short-wave stations and rebroadcast them over this station on 1,350 kilocycles. The telephone company has installed a special cable in the Captain's home and all his catches are made there, and at various times sent out over the air. This installation is one of the very few in a private residence in New York Cty.

A THOUGHT FOR THE WEEK

If broadcasting licenses are to be restricted to one year, in accordance with the rule drafted by the new body which takes over the powers of the Radio Commission, there is good reason for believing that new stations and chains will be slow in coming along. It costs a lot of money to equip even one station and the risk would be too great if there is only a one-year guarantee of the right to do business.

If you don't believe all this, just ask Ed Wynn!

Tradiograms

By J. MURRAY BARRON

Dumont Electric Co. Inc. 453 Broome Street New York City reports that manufacturers of radio receivers find Duco Dry Electric Condensers are actually self-healing. On special test made the condensers healed after application of 3,000 volts, whereas another brand failed at 1,500 volts.

* * *

Those who may have use for a very small 45-volt B battery or a small-sized A source as used in portable short-wave receivers or for other special purposes will be glad to learn that these are obtainable at Thor's Bargain Basement, 167 Greenwich Street, New York City. The B battery is about the size of the very small-sized 22½ volt B. The A is somewhat like the 4½-volt C battery in appearance.

* * *

Allied Engineering Institute, 98 Park Place, New York City, is attracting much attention with its All-Wave Scout, a unique one-tube all-wave set, designed by H. G. Cisin. There is a number of outstanding features not found in any other one-tube receiver. One particularly advantageous is that of the simplified assembly process that enables one to follow a color scheme for foll-proof assembly.

* * *

Already the demand for auto radio receivers is making the retailer plan to avoid a shortage in stock. With the advent of fine weather as a permanent thing and not as stray visitor the installations are expected to exceed those of 1933, which in itself was a very good year. With the larger number of folks on payrolls this year the spending will be much greater. Folk enjoy spending money and having a good time, and as the auto industry is now having one of the most successful years it means more cars rolling on the roads in 1934, which will actually means more motor-radio receivers

* * *

Ten years of service to the radio industry will be observed at the Tenth Annual Convention of the RMA. It is expected that the meeting will be held in June. Chicago and other cities are under consideration.

* * *

Further and indefinite delay in revision of the electrical code has occurred in Washington. No action is expected before May 15th. General Johnson, administrator of the NRA, sent general requests to code authorities to reduce code hours to 30 hours weekly and increase wages 10 per cent. The code authorities were asked to consider such changes and advise the NRA "if not, why not." Another unsettled general policy of NRA, the future of the "open price" plan, also requires final determination by the Government before the electrical code and its "open price" plan can be finally revised.

* * *

The supplemental code for radio wholesalers, submitted to NRA by the Radio Wholesalers Association, has been completed and its signature by General Johnson is expected. The completed radio jobbers' code retains limits of one per cent. of jobbers' sales volume for their trade promotion and one and one-half per cent. for co-operative advertising. Jobbers would be permitted to adopt the "open price" plan by two-thirds vote in various geographical sections and the wholesalers' code also contains many trade practice provisions which are declared helpful to manufacturers and the entire radio trade.

* * *

The radio industry has just escaped an increase in the 5 per cent. excise tax on radio and phonograph apparatus. Termination in 1935 of this "nuisance" tax is reported as probable. Efforts of the RMA to obtain modification or repeal of the radio excise taxes appear to have been effective at least in preventing immediate increase in the tax which, it is reliably learned, had been under consideration by Congress.

* * *

The Internal Revenue Bureau, during consideration of the pending tax revision bill is reported to have recommended that the 5 per cent. tax be imposed upon completed radio sets instead of upon the limited component parts now taxable. The Treasury suggestion, it has been learned, was not approved in Congress and it now seems probable that the tax will remain unchanged until it expires automatically on July 1, 1935, as provided in the National Industrial Recovery Act.

* * *

An increase of 56 per cent. in radio manufacture last February is indicated by Federal reports of radio and phonograph excise taxes collected. Internal Revenue collections during February, 1934, of the 5 per cent. excise tax on radio products and phonograph records amounted to $272,335.09, according to an official statement just released in Washington. This compares with excise tax collections of $173,987.28 in February, 1933.

Tax collections on mechanical refrigerators last February were reported at $97,-264.58 against $22,626.77 in February, 1933.

* * *

Figures presented by the Treasury Department to Congress in connection with the pending tax revision bill contain an estimate by the Treasury that radio sales will increase 50 per cent. in the two years ending July 1, 1935. In consideration of the tax revision bill by the Senate Finance Committee, the Treasury submitted estimate of revenue from radio and other taxes. The actual receipts in radio and phonograph excise taxes for the fiscal year ending July 1, 1933, were $2,206,-763.39. The estimate of the Treasury to the Senate Committee for tax receipts from radio and phonograph sales for the year ending July 1, 1934, are placed at $2,800,000, while the estimate for such taxes for the year ending July 1, 1935, was $3,400,000. These Treasury estimates were a part of the figures considered by Congress in calculating its revenue from the excise or "nuisance" and other taxes in connection with the federal budget and are an indication of the opinion of Treasury actuaries regarding prospective sales in the radio industry for the next two fiscal years.

* * *

Employment statistics for January, issued by the Bureau of Labor Statistics, U. S. Department of Labor, show that the radio and beverage industries were the only two reporting more than 100 per cent. increased employment over a year's interval. The employment gain in radio over January 1933 was 114 per cent. while that in the beverage industry, attributed to legalization of beer manufacturing, was 121.7 per cent. Compared with 1926 averages, January, 1934, employment in the radio industry was 123.9 and comparative payroll 83.5. February radio employment declined, according to incomplete data, although payrolls were somewhat larger. With the 1926 average as the base, the February, 1934, index of employment in radio and phonograph factories was 121.0 as against 123.9 in January, compared with 61.9 in February, 1933. Payroll totals were 84.6 last February against 83.5 in January, 1934, compared with 45.5 in February, 1933.

* * *

Following RMA opposition, bills in the Kentucky and Massachusetts legislatures which were harmful to radio interests have been defeated, according to reports from both States. The Kentucky bill proposed to levy a special 5 per cent. sales tax on radio products, pianos, jewelry and a few other articles. The Massachusetts bill proposed to require regulation and registration of all receiving sets, of whatever character, used in automobiles. Those favoring the Massachusetts bill contended that such legislation was necessary to prevent intereference with police radio broadcasting.

* * *

The RMA Board of Directors at a meeting in Chicago promulgated tentative standards, defining the nomenclature and frequency ranges for "all-wave," "short-wave," standard and other receivers. Demand from the buying public as well as the trade for definite standards and names to be applied to receivers has caused the RMA to develop nomenclature and frequency ranges for receivers.

* * *

Advices of a market for small receivers in Porto Rico have been received from Andrew W. Cruse, chief, electrical division, Bureau of Foreign & Domestic Commerce, U. S. Department of Commerce. The Government bulletin received from the Porto Rican Director of Commercial Relations states that "there is a market in Porto Rico for radio receiving sets, small type, for local reception only, one which would retail at $10 or less, including the 2 per cent. sales tax." There also is a Porto Rican demand for small crystal sets retailing for $3.50.

* * *

Despite many obstacles, including tariffs, quota systems, exchange and other restrictions, exports of American radio apparatus during 1933 increased 21 per cent., according to the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce. American exports in 1933 were $16,125,719 as against $13,312,136 in 1932, according to a bulletin issued March 20 by Andrew W. Cruse, Chief of the Electrical Equipment Division. In 1933 the value of receiving sets exported was $9,323,535 compared with $7,321,849 in the previous year. Tube exports were $2,623,261 as compared with $2,-012,656 in 1932. Component part exports amounted to $2,783,730 against $2,517,287.

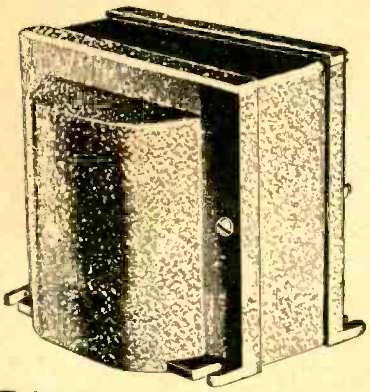
LITERATURE WANTED

P. L. Mass (catalogues and information on Short Wave Converters and kits), 1254 Ky St., Quincy, Ill.
Jesse Kralik, R. No. 1, Cromwell, Iowa.
Albert Miller, Box 24, Shenandoah, Penna.
Albert J. Santoro, 190 Hudson Ave., Brooklyn, N. Y.
Wm. E. Mallory (particularly on short waves), Waterford, Penna.
George Taylor, 1133 Ross Ave., Hamilton, Ohio.
McIntyre's Radio Shop, 1302 Jersey Lane, Ft. Worth, Tex.
Richard A. Bryan, 1324 - 3rd Ave., North, Columbus, Miss.
L. C. McNellis, Carlton, Minn.
The Radio Research & Repair Laboratories, 239 Columbia Street, Cambridge, Mass.
Vernon Lancaster, R.F.D. No. 3, Malvern, Ark.
P. Tropp, 40-15 - 81st St., Jackson Heights, N. Y.
E. J. Shalek. Brunswick Music & Radio Shop, 3228 West Madison St., Chicago, Ill.
Edward A. Lannen, 109 No. 6th St., Apt. A-5, Newark, N. J.
Lewis Patterson, 404 College St., Pulaski, Tenn.
E. W. Grimes, 810 Lincoln St., Middletown, Ohio.
George Ronk, 910 Center Ave., N.W., Roanoke, Va.
Rev. Walter G. Barow, M.E. Parsonage, Tighman Md.
Frank Wison, ARRL, c/o Headquarters & Military Police Co., Fort Wood, New York Harbor.
Oscar W. Schlupp, 714 Vinton St., Toledo, Ohio.
R. E. Gifford, 6312 Ridge Ave., Cincinnati, Ohio.
Jack Schroder, 2822 - 11th Avenue, Oakland, Calif.
Charles C. Goodwin, 1227 West Jackson Blvd., Chicago, Ill.
Edward Chay, 801 - 18th St., Bakersfield, Calif.
Thomas H. Keegan, c/o David Wines Store, 735 Cranston St., Providence, R. I.
W. J. Anderson, 1178 New Britain Ave., Elmwood, Conn.
Robert Hill, 302 White St., Decatur, Georgia.
L. S. Grant, 2807 East 27th St., Brooklyn, N. Y.
Walter Wnuk, 835 Crescent St., N.E., Grand Rapids, Mich.

FINANCIAL REPORTS

Westinghouse Electric and Manufacturing Company—For the first quarter of 1934 orders totaled $20,100,000, or 57% more than in the same period in 1933. The manufacturing output in March, 1934, was higher than for any month since December, 1931. There is an optimistic feeling regarding the business outlook for the months immediately ahead.

Power Transformer for a BIG SET



INSTEAD of using undersized, overheating, inefficient power transformers for a big set, why not use a cool-running, efficient transformer and pay the little extra? The Reliable transformer, Model 104-SP, will work an 18-tube set. Provides also the voltage for a 25Z5 rectifier.

Primary = 115 v., 60 cycles
Secondary X = 14 amp., 2½ v., ct.
Secondary Y = 6 amp., 2½ v., ct.
Secondary R = 5 v., ct.
Secondary HV = 400-0-400 v., 200 ma.
Secondary Z = 25 v., 0.6 ma.
Lug terminals at bottom
Price, $3.95
Shipping weight, 13 lbs.
Immediate Delivery

RELIABLE RADIO CO.
145 W. 45th St., New York, N. Y.

EARLY SHIPMENT!

PUSH-PULL AUDIO TRANSFORMER

Here is an unshielded audio transformer of the highest quality. Both its windings are center-tapped. Hence it may be used as an input transformer coupling from a single plate into two grids in push-pull, or, it may be used as a push-pull interstage transformer coupling push-pull plates to push-pull grids.

This transformer was made up to special order by a company well known for its excellent transformers of all type. This particular transformer has been used in various circuits and also as a replacement transformer in sets, with uniformly satisfactory results.

Type K Push-pull Audio Transformer, $1.10

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143 WEST 45th ST., NEW YORK, N. Y.

NEW PRICES

TROUBLE SHOOTER'S MANUAL, Nos. I, II and III

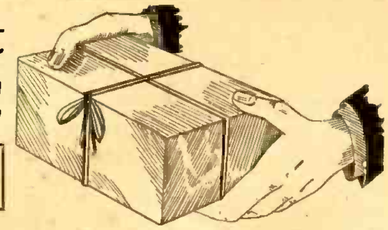
Having assembled 2,000 diagrams of commercial receivers, power amplifiers, converters, etc., in 1,200 pages of Volume No. 1 of his Perpetual Trouble Shooter's Manual, John F. Rider, noted radio engineer, has prepared Volume No. 2 on an even more detailed scale, covering all the latest receivers. Volume No. 2 does not duplicate diagrams in Volume No. 1, but contains only new, additional diagrams, and a new all-inclusive information on the circuits covered.

Volume No. 3 (Recently issued). Order Cat. RM $7.50
Volume No. 2—Perpetual Trouble Shooter's Manual, by John F. Rider, Shipping weight 6 lbs. Order Cat. RM-VT @ $6.50
Volume No. 1 (8 lbs.). Order Cat. RM-VO @ .$7.50
Rider's Trouble Shooter's Manual, No. IV. Brand new, up to 1934..$7.50

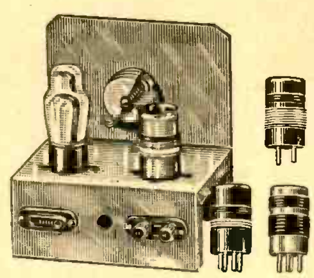
We pay postage in United States on receipt of purchase price with order. Canadian, Mexican and other foreign remittances must be in funds payable in New York.

RADIO WORLD
145 West 45th Street New York City

Select the Gift You Want from An Inviting Array!



Kit for One-Tube Short-Wave Set



AMID the present furor over direct reception of short-wave foreign stations you don't want to be left, nor need you be, for a one-tube set will give you results that will amaze you. We offer the complete kit of parts for a one-tube battery-operated receiver (less 30 tube, less batteries, less earphones), and give you a clear wiring diagram, and at the same time welcome you to our list of yearly subscribers, whereby you will get in RADIO WORLD the short-wave data, including frequent station lists, that will enable you to improve your tuning technique and glory in thrilling foreign-station "catches." Coverage, 13 to 200 meters. Here's what your gift will consist of:

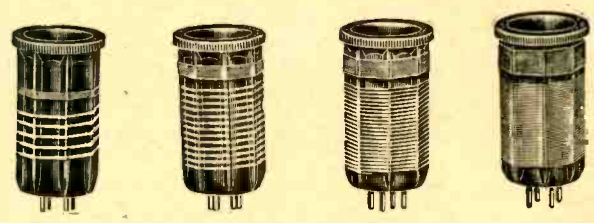
One punched chassis metal.
One punched metal front panel.
Four small-diameter plug-in coils (not the large ones shown below).
One 50,000-ohm potentiometer.
One 10-ohm rheostat.
One switch.
One 0.0005 mfd. fixed condenser.
One output binding post assembly (for phones).
One battery cable.
One dial.
Two knobs.
One tube socket.
One coil socket.
One Hammarlund 0.00014 mfd. tuning condenser.
One 0.0001 mfd. grid condenser.
One 5.0-meg. leak.
One 0.0001 mfd. adjustable series antenna condenser (adjust with screwdriver at rear for keenest response once on each hand).

(Two ½-volt dry cells, 10c type, 22.5-volt B battery, 30-tube and phones not supplied.)

Order PR-SCK and remit $6.00 for one full year's subscription (52 issues, one each week) and kit of parts will be shipped promptly, small transportation charge collect.

DE-LUXE SHORT-WAVE PLUG-IN COILS

For the expert short-wave enthusiast precision type plug-in coils, wound on special forms, of special silver ribbon wire, prove valuable. Coverage, 12 to 200 meters, using 0.00014 mfd. The four-prong coils illustrated reveal the special precaution of ribbed forms, so that the wire will touch only a minimum amount of the form, to reduce losses to a minimum. Diameter, 1.25 inches. Order PR-FPBC and send $4.00 for a 32-week subscription for RADIO WORLD. Postage prepaid.



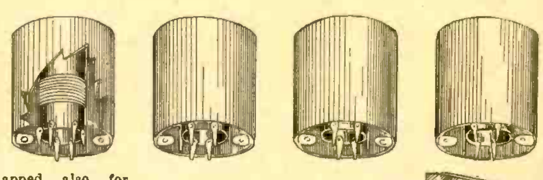
Often an expert short-wave set constructor or operator desires precision coils for use as interstage couplers to a regenerative detector. It has been found by vast experimenting that the three-winding coil is far superior for this purpose than the two-winding coil with any of the makeshifts, like choke and stopping condenser. We offer a set of four 6-prong, 1.25-inch diam. coils (otherwise same as the four-prong illustrated at left). Ask for PRE-SPBC and send $6.00 for a full year's subscription (52 issues, one each week). Mailed postage prepaid.

The precision type, silver-ribbon-wound plug-in coils are obtainable as gifts in either the four-prong or six-prong varieties.

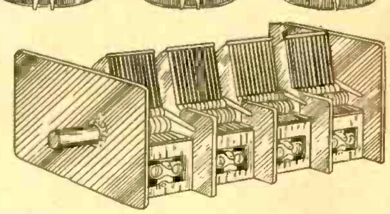
SPECIAL!

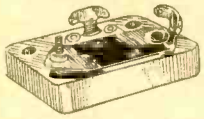
Both sets of coils (four 4-prong and four 6-prong) free with a $9 subscription, 78 issues. Order PRE-FPSPBC.

DUAL-BAND TUNING UNIT



FOR broadcast eception, plus coverage to higher than 4,000 kc, thus yielding a total span of 540 to higher than 4,000 kc. We have an exceptionally precise combination, consisting of three r-f coils, one of which is used as antenna coupler, and one oscillator coil, also the necessary four-gang condenser and the correct padding condenser (Hammarlund adjustable type). The tuning coils for the r-f level have secondaries tapped so that the condenser stator may be switched from full inductance to just enough inductance to pick up the broadcast band where the full inductance left off. The oscillator coil is appropriately tapped, also, for this purpose. A four-pole, double-throw switch would be required (not furnished). Coils aluminum shielded, 2-1/16" outside shield diameter by 2.5 inches high. The four-gang condenser is very compact (5 x 2.25 x 2.75 inches). All material is specially made for this premium offer and is of highest calibre.





Order Cat. PR-BCTU-465 for use with 465 kc intermedates, and enclose $7 for 14-month subscription (60 issues, one each week), and four-gang condenser, four coils, and 350-450 mmfd. padding condenser, but no switch, will be sent, small transportation charges collect.

Same as above, same terms, except oscillator is for 175 kc and padder is 850-1,350 mmfd. Order PR-BCTU-175.

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RADIO WORLD, now in its thirteenth year, offers the super advantage of very latest news of circuits, tubes and station lists, covering ultra frequencies, short waves and broadcast waves. RADIO WORLD is written and edited by experts whose daily laboratory work is reported in the authentic columns of this first and only national radio technical weekly. Knowledge gained from RADIO WORLD enables you to improve the performance of the sets you build or service. 15c. copy. $6.00 yearly (52 issues); 26 issues, $3.00; 13 issues, $1.50; trial subscription, 8 issues, $1.00.

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Here is a dry electrolytic self-healing condenser of 8 mfd. capacity which will give long, hum-free service in power supplies. The condenser is intended for use with an operating voltage of 400 volts, or slightly over, but will withstand a peak voltage of 600.

Type D Condenser, 49c

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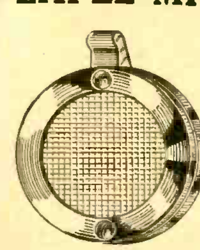
LAPEL MICROPHONE



A single-button carbon-granule lapel microphone, impedance 200 ohms, requiring 4.5-volt excitation, of good frequency characteristics, and both handy and inconspicuous. Outside diameter, 1⅜ inches. The case is chromium-plated brass. The excitation may be provided by introducing the microphone in a cathode circuit carrying around 20 to 25 milliamperes, or a 4.5-volt C biasing battery may be used. Net price, $2.95.

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$50,000 SPEAKER CLEARANCE SALE!

SPECIAL - SALE - FEATURE
Farrand INDUCTOR DYNAMIC

- The Ideal Short Wave Receiver Speaker:
- Eliminates Hum and Line Noise:
- Draws Less Current:
- Absolutely Genuine Farrand:
- Compact in Size:
- Brings in the Very Weak Short Wave Stations:

Do not confuse this model with the various similar types on the market, posing as Farrands. This is the true Farrand Inductor Dynamic. Its adaption to Short Wave Radio Receivers has proven a popular step. The most inaudible stations are brought in with remarkable clearness without the customary noise and hum of regular dynamic speakers. Has two magnets parallel to each other with a bracket placed between them to facilitate mounting. Overall 9".

$3.95

BOSCH SPEAKER CABINET

Will accommodate any magnetic or dynamic chassis up to 10" in diameter. A beautiful walnut cabinet artistically and expensively finished. It was built by one of the foremost manufacturers of cabinets. Grill contains a gold bronze cloth for contrasting color scheme.

Dimensions 12½" high, 12" wide, 10" deep.

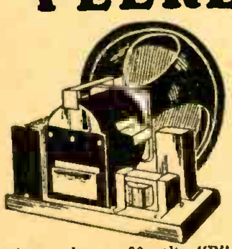
Price **$1.75**

JENSEN
Model D-7, A.C. DYNAMIC

Widely used as an additional speaker in many homes, as well as on public address systems. Will handle an enormous amount of volume without distorting or rattling. Equipped with a 280 rectifier tube. The speaker measures 12½" high, 11⅜" wide, and 7 7/32" deep. Baffle opening required, 10". Supplied complete

A.C. Model with tube. **$9.95** D.C. Model **$7.95**

PEERLESS
A.C. and D.C. DYNAMIC SPEAKER CHASSIS



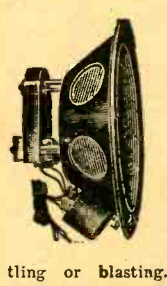
Adaptable for the most powerful amplifier. Equally suited for use with any receiver employing the average type of audio amplification system using as low as 90 volts "B" current. D.C. model has a 1,000 ohm field and a pushpull output transformer; A.C. model used a dry rectifier system with a hum condenser for minimum A.C. hum.

Dimensions—12" high, 8" deep.

A.C. Model. Price. $8.95 D.C. Model. Price. **$6.95**

6 Volt. Price.............................. $7.95

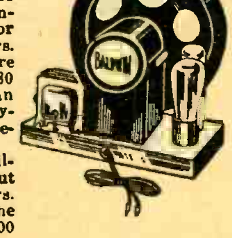
Limited Quantity!
R. C. A. MAGNETIC CHASSIS



This chassis is the identical one used in the R.C.A. 100A-100B and 103 Speakers which list for as high as $35.00. Note built-in output transformer which permits use of 450 volts without distortion, rattling or blasting. Generous oversized magnet. The thick armature is accurately centered, the sturdy metal frame is lined with a special self-baffling fabric, greatly improving acoustic properties of this sensational speaker. Note the corrugated surface of the cone, an exclusive feature—enhances perfectional reproduction qualities considerably; most compactly made; 9" outside diameter, 4½" deep overall.

Price **$2.75**

Baldwin A.C. and D.C. Dynamic Speaker Chassis

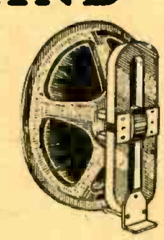


The tremendous power handling capacity of this speaker makes it suitable for use in modern console receiving sets or for power amplifiers. The A.C. models are equipped with a 280 rectifier tube and an 8 mfd. dry electrolytic condenser to reduce A.C. hum. D.C. models are available with or without output transformers. Field resistance of the D.C. model is 2500 ohms.

(A.C. Model, complete. with tube.) Price **$5.95**

(D.C. Model with output transformer.) Price **$4.25**

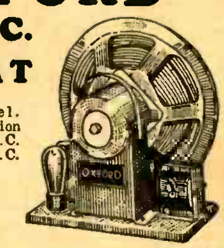
FARRAND
12" MODEL INDUCTOR DYNAMIC



The 12" models have two magnets standing upright, with a bracket on the bottom to ease mounting. Dimensions of the 12" model: 12" high and 6½" deep. (12" Model)

Our Price **$5.95**

OXFORD
A.C. and D.C. CONCERT

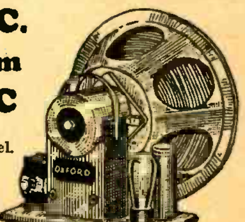


11½" concert model. Three point suspension balanced cone types. A.C. uses 280 rectifier. D.C. models have a field resistance of 2,500 ohms. Output transformer may be had for single or push pull output tubes.

A.C. with Tube.............................. **$5.75**

D.C. Model $4.50

OXFORD
A.C. or D.C. Auditorium DYNAMIC



14" auditorium model. Takes a baffle with a 12½" opening. Oversize frames with extra gauge wire in the field coil, which gives the speaker higher field strength and permits greater energization. D.C. model has a 4,000 ohm field which can be energized from the power packs of amplifiers or from 110 volt D.C. line.

A.C. with 280 Tube.......................... **$9.95**

D.C. Model $7.95

All orders are F. O. B. New York, and subject to prior sale. Terms: A deposit of 20% is required with every order. Balance may be paid on delivery. Deduct 2% if full amount is sent with order.

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