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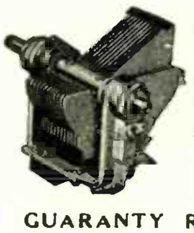

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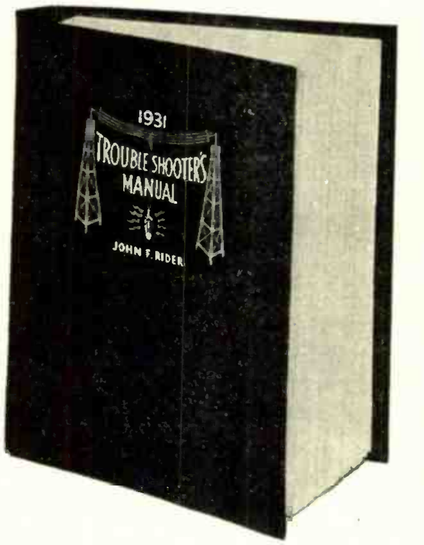

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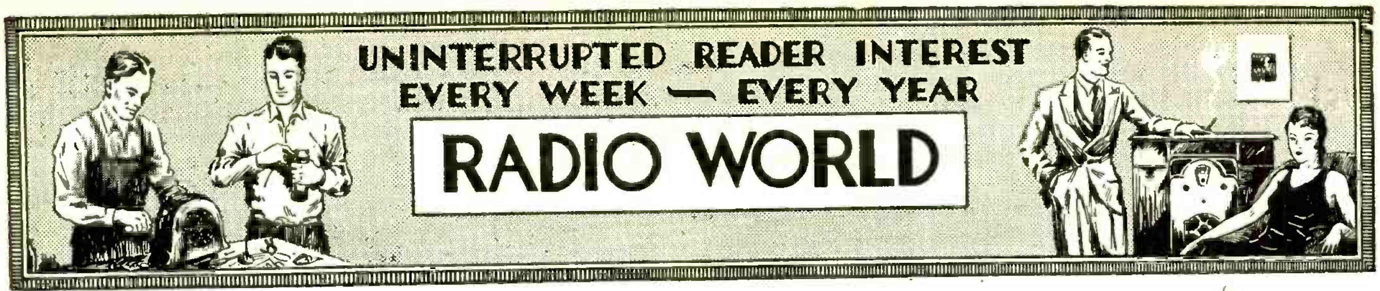

Vol. XIX No. 7 Whole No. 475
May 2d. 1931
[Entered as second-class matter, March 1922, at the Post Office at New York, N. Y., under act of March, 1879]
15c per Copy, $6.00 per Year

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Short-Wave Coverage Without Plug-in Coils

By J. E. Anderson
TECHNICAL EDITOR

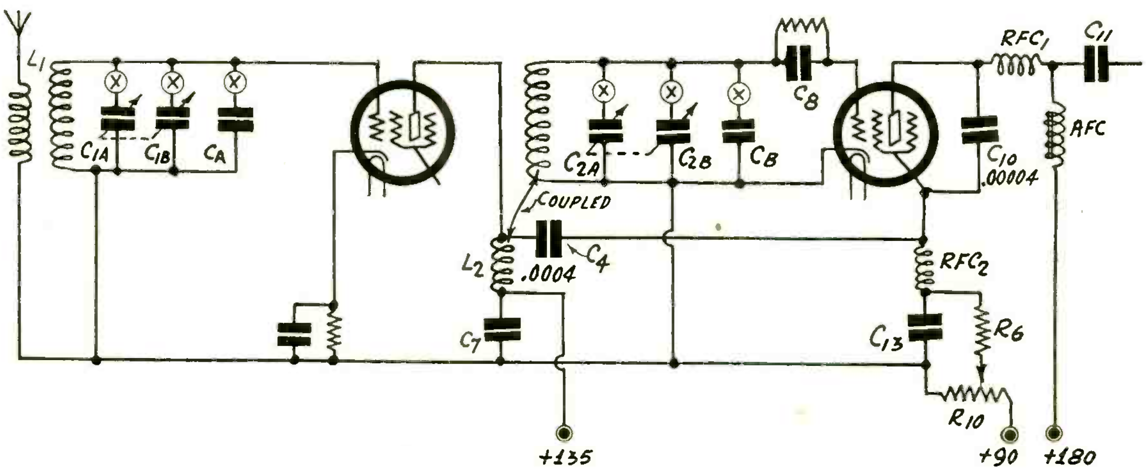

FIG. 1
Two tubes of the Universal Super-Wasp receiver showing how the wave length range is extended by cutting in more condensers. A special switching arrangement is used.

SHORT-WAVE receivers and converters are designed in most cases for plug-in coils to cover the entire range of frequencies. The reason for this is that a circuit can be made simpler in this manner, and very often more efficient. But some users of short-wave equipment object to plug-in coils. They want push buttons or switches accessible from the front panel. It makes no difference if such devices reduce somewhat the sensitivity of the circuit. Since the ultimate consumer demands means for changing the tuning range of the circuits which do not involve plug-in coils it devolves on the engineers to solve the problem in some other manner and to do it with as little loss in the sensitivity as possible.

Several methods are available. First, it is possible to cut in or out fixed condensers of different capacities across the tuning condenser, leaving the inductances in the circuit the same all the time. Second, it is possible to change the inductances by means of switches, either by putting the variable condenser across different number of turns of wire or by short-circuiting a part of the coil. Third, the inductance may be varied by means of a variometer. Fourth, coils of different inductance may be permanently mounted and arranged so that any one may be connected into the circuit by the throw of a switch. Fifth, these methods may be combined in various ways to accomplish the same purpose.

Advantages and Disadvantages

The first of these seems to be the simplest, for it involves only the closing of a switch to cut in an additional condenser across the given inductance coil. But this has many disadvantages. As the ratio of L to C becomes small the sensitivity decreases rapidly so that only for the highest frequency range would the circuit be sensitive. For the lowest frequency range, when the largest fixed condenser is across the coil and the tuning condenser, the circuit would be relatively insensitive.

Not only does this effect enter but the other windings on the coil, in case there are any, would not be suitable for more than one frequency range, or two ranges, at most. For example, if there is a primary on the coil it would do for one frequency range or possibly two ranges. However, in this respect the first, or parallel capacity method, is superior to some of the other methods cited.

The first method is illustrated in Fig. 1, which represents the first part of a short-wave receiver with two tuners in which the frequency range is changed by connecting more condensers across the variable condenser and the coil. This method is used in the Universal Super-Wasp.

The Pilot engineers have worked out a very ingenious switching arrangement by means of which the proper capacity selection may be made in both tuned circuits. The circles with the crosses indicate the switches, which are of the cam type. There are three of these circles associated with each tuned circuit, indicating three positions of the cam switch and three ranges of the tuner. But there are actually seven positions and seven ranges. A single knob controls the two cam switches.

Tapped Coils

The second method mentioned above is illustrated in Figs. 2 and 3. In Fig. 2 the coils are tapped and the stators of the condensers are moved to the different taps. The entire coils are used all the time, but only a portion of each is tuned when the higher frequency ranges are to be covered. The transformer then really is an autotransformer with the primary tuned. This has a certain advantage in that when the ratio of the inductance to the capacity is small there is a high stepup of the voltage, so that there is little difference in the sensitivity for the different ranges. However, the arrangement is subject to the difficulty that the untuned portion of the coil may have a natural frequency of its own which may give rise to interference. But this is small. The main difficulty, which is common to all tapped coils, is that the leads to the switch from the taps will invariably be longer than is desirable and therefore losses may result, or undesired couplings.

In Fig. 3 part of the coil is shorted by means of the switch. In this case the untuned portion of the coil is not functioning when it is shorted, as it was in Fig. 2. It would seem that shorting a portion of a coil would introduce tremendous losses which would render the circuit inoperative when only a portion of the coil is

(*Continued on next page*)

A New Method for

Extra Tube Is Required, So That Switch

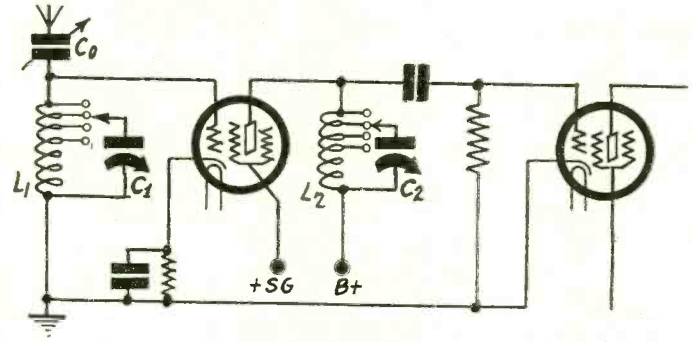

FIG. 2

Tapped coils are used in this short-wave circuit for changing the wave-length range and the condenser is so connected that the part of the coil not tuned is used to step up the voltage.

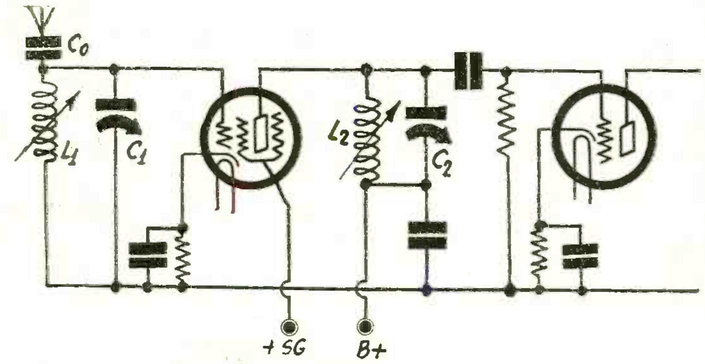

FIG. 4

The tuning range of a short-wave receiver or converter may be extended by the use of variometers as in this circuit.

(*Continued from preceding page*)

tuned. It has been found experimentally, however, that in many instances the losses are less when turns are shorted than when they are left open. When they are shorted a circuit is formed in which the resistance is negligible and the inductance comparatively high, so that the current that flows is extremely minute. When the turns are left open the current in these turns and the distributed capacity across them may be very high and so the losses are comparatively large.

An Advantage of Tapped Coils

When a tapped coil is used the tuning condenser may be small and the inductance comparatively large. Thus the ratio of inductance to capacity will be large and the sensitivity high. This effect may be greater than any disadvantage due to losses in the coils.

The third method of changing the frequency range of the tuner is illustrated in Fig. 4. There are two tuned circuits, L1C1 and L2C2, in each of which there is a variometer for varying the inductance. This arrangement suffers from several disadvantages and it has no advantage not shared by the other methods. Since the coil is a variometer its inductance is continuously variable and therefore it is not practical to calibrate the condenser dial. To do so it would be necessary to have definite stops for the variometer so that it could not be set at any other points. Of course a dial might be put on the variometer, when the condenser could be calibrated for a few selected settings of the variometer.

The main advantage of the variometer is that as the inductance is decreased the resistance of the coil does not decrease in proportion. It remains fixed, approximately, and therefore the ratio of the inductance to the resistance decreases as the inductance is decreased. Therefore the selectivity of the circuit for the high frequency ranges will be very poor, where it should be greater. The ratio of the inductance to the capacity is also decreased as the inductance is reduced, since the condenser capacity does not change, and therefore the sensitivity will not be good for the higher frequeny ranges.

Coils Permanently Mounted

The fourth method suggested is illustrated in Fig. 5. Here we have three different radio frequency transformers any one of which may be connected to the first tube by means of the two switches Sw1 and Sw2. The switches, of course, may be controlled by a single knob. While only the coupler between the antenna and the first tube is shown in this figure, the arrangement can be extended to the coupler between the first tube and the next in the same manner. Three more transformers would be needed, and two more switches, one of which is shown connected to the plate of the first tube and marked Sw3. The three leads running from this switch would be connected to the primaries of the three transformers while the other ends of the primaries would be connected to B plus.

The fourth switch would pick up the secondaries and the switch arm would be connected permanently to the grid of the second tube and the stator of the second tuning condenser. The remaining terminals would be grounded. The second two switches could also be mounted on the same control as the first two if desired.

This arrangement is not limited to tuned radio frequency circuits but can be applied to oscillators as well and is therefore applicable.

Points in Favor of Permanent Coils

When coils are arranged as in Fig. 5 each coil can be wound with primary and secondary for best results for the particularly frequency range of each. It is not necessary to compromise with the primaries, but each can have the proper number of turns and proper coupling. This is not possible when tapped coils are used, and it is for this reason that the circuits reproduced herewith for the tapped coils do not have primaries, derict coupling being used.

The disadvantages of the permanent coils is that there will be long leads to contend with, those from the switch points to the high potential terminals of the coils. To minimize the undesired effects of long leads the coils should be placed so that the leads from the smallest coils are the shortest, because when these are used the frequency will be the highest and hence the stray coupling will be greatest. Shortening the high frequency leads will reduce the bad effects.

Plug-in Arrangement

The only difference between the arrangement in Fig. 5 and that calling for plug-in coils is that in Fig. 5 the switching is done with regular switches mounted on the panel while with plug-ins the switching would be done by moving the coils. As far as the circuit arrangement is concerned, however, the plug-in arrangement is much simpler. The switching arrangement is more convenient from an operating point of view.

In Fig. 6 we have the circuit of a short-wave converter in which

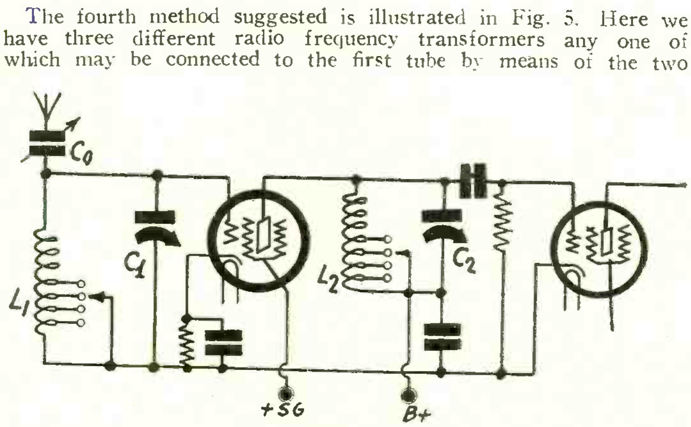

FIG. 3

In this short-wave circuit tapped coils are used but turns are only shorted out of the tuning coils to increase the frequency range of the circuit.

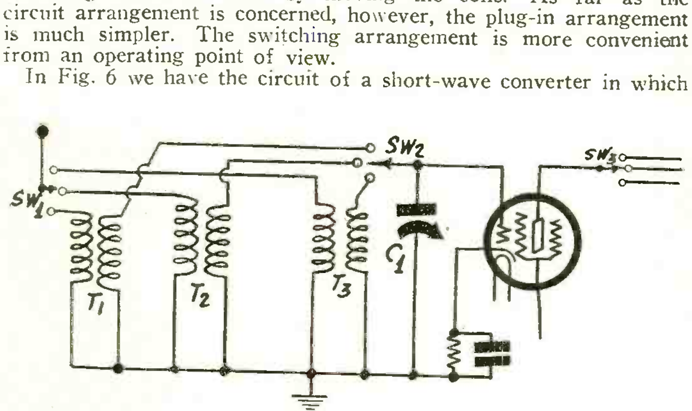

FIG. 5

In this short-wave circuit coils of fixed inductance are used with switches provided so that any coil may be selected in the circuit. This is a good method.

Avoiding Plug-in Coils

Makes One or Other Oscillator Active

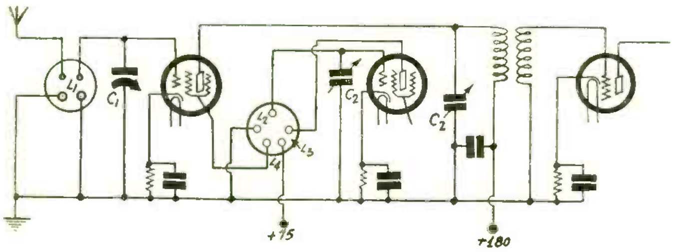

FIG. 6

Plug-in coils is the most popular with radio engineers and the least popular with the fans. This shows the connections of a typical converter wired for plug-in coils.

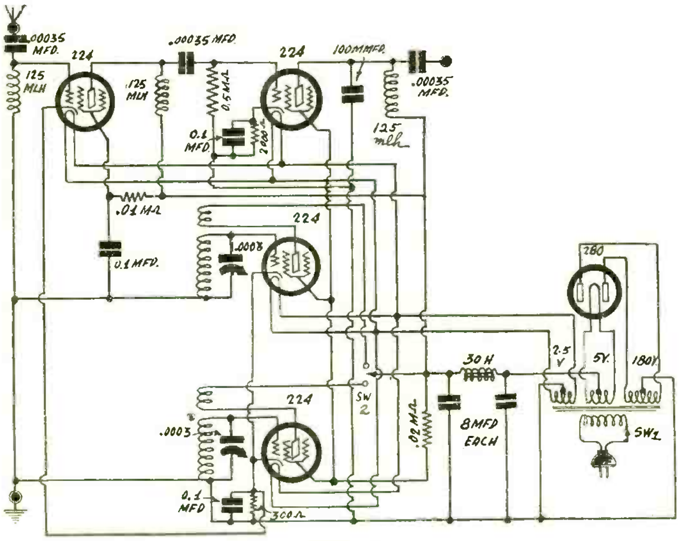

FIG. 7

Here is a method of changing the tuning range of a short-wave receiver or converter that requires a minimum of change. The oscillator tube and socket is repeated for each tuning range and only the plate return is moved.

plug-in coils are used for both the radio frequency transformer and the oscillator. The circle containing L1 is the socket for the radio frequency transformer looking from the tap and it shows the arrangement of the coils terminals and their relation to the first tube and the tuning condenser. The circle containing L2, L3 and L4 is the socket for the oscillator coil and it shows the connections to the two tubes involved as well as the oscillator condenser. The arrangement in Fig. 5 can just as well be used for the oscillator as for the radio frequency circuit, but if the same system of coupling the modulator and the oscillator is used it would be necessary to provide a third winding on each coil and to provide an extra switch. Of course, it is possible to select a method of coupling the oscillator and the modulator which does not involve a winding. For example, a common resistor could be used between the two tubes.

It was suggested above that both the coils and the condensers could be varied in steps to extend the tuning range, or to provide more tuning ranges. This can be done by connecting condensers in parellel as well as in series, although the series connection is not so satisfactory.

A New Method

A method of extending the tuning range without the use of plug-in coils which has not yet been used is suggested in Fig. 7. Two oscillator tubes are provided in this case, but only one is active at a time. To make the change from one to the other it is only necessary to switch the plate return lead from one tube to the other. The two pick-up coils, one on each oscillator coil, are connected in series. They may be so connected whether they are connected in the cathode lead or the screen grid lead of the modulator.

Of course this method calls for a certain duplication of parts not called for in the other circuits. But it is only a socket and a tube for each tuner and for each range. Since it is only the oscillator that is critical, and a condenser large enough to permit short-wave coverage with only two coils, is practical, just one more socket and one more tube are needed.

[Other Illustration on Front Cover.]

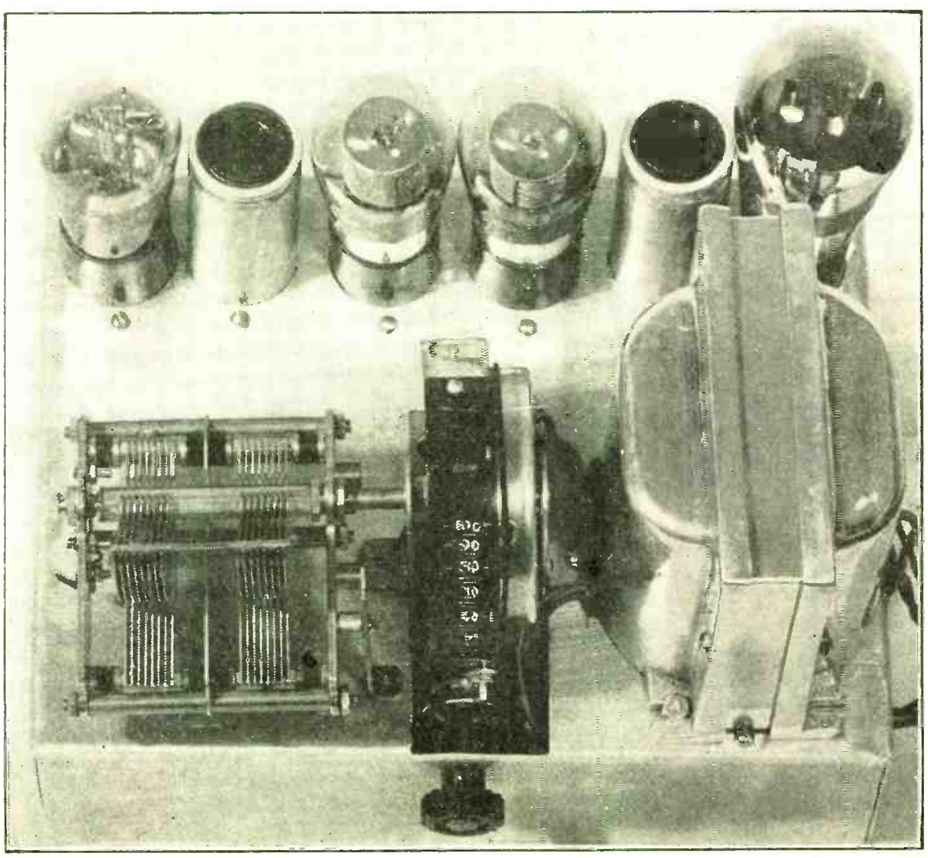

FIG. 8

The short-wave converter diagrammed in Fig. 7 was built of de luxe parts, as shown in the photograph. The two cylinders sticking up are the 8 mfd. electrolytic condensers, of the inverted type.

All-Wave Convenience

By Brainard Foote

TO most radio listeners, broadcasting is the sum total of radio. Covering their own sets from zero to one hundred on the dial, it never occurs to them that they are actually getting only a very small section of radio, after all!

But this is the case! And here's the evidence: Radio in general usage for all purposes runs from about 10 meters to about 15,000 meters. Expressed by frequency, this means from about 30,000 kc to about 20 kc. In other words, we have a range from one end to the other of the radio spectrum of about 30,000 kc.

Broadcasting runs from about 200 meters to about 550 meters, or, from 1,500 kc to 545 kc. By subtraction, you realize that broadcasting takes up less than 1,000 kc. So broadcasting is really only a small part of the possible radio wavelengths that can be received.

Great Deal Beside Code

The air is filled with radio waves that your set is unable to receive. While a majority of these other transmissions is in code, there is a great deal going on that you can get, understand and enjoy.

What are these other forms of radio? First comes short-wave broadcasting. The regular chain programs are used, for the most part, with duplicated transmissions on the higher frequencies (short waves), so that advantage may be taken of the peculiar ability of short waves to cover tremendous distances both continentally and to other nations. Of course, we can receive programs from foreign countries on short waves, while such programs naturally lack the steadiness of local broadcasts, nevertheless many enjoy tuning in on G5SW, London at 7:00 p. m. Eastern Standard Time and hearing London's midnight time signal, and other similar reception experiences.

A second group of stations is the experimental stations, of which there are a great many, conducting interesting test programs. Then there are amateur 'phone stations carrying on conversations constantly with other similar stations near and far.

The television stations operate increasingly nowadays, principally around 100 meters. And numerous other stations may be heard. Code communication is of interest to some, and on short waves particularly there seems no limit to the distances that can be covered.

Different Coils Switched in

The general plan that has been followed is that of having a set of different size coils to cover the different bands. For instance one coil is inserted for 100 to 200 meters, another one for 50 to 100, etc., utilizing the same condenser in the set for the detailed tuning between such points.

While the plug-in coil system works well, it is regarded by some as quite a lot of trouble to make the changes, because it is necessary to reach inside the set, poke around and get the prongs into the special sockets properly.

Now come a newer systems, whereby the set is fully fitted out with a number of coils of varying sizes, already mounted in place, or tabbed inductances. A specially designed switch, controlled by a knob on the front of the set, may connect any coil in circuit. With this method, a mere flip of the knob is all you need to jump from the 20-meter band all the way to broadcast wavelengths.

Changes from Plug-ins

There are certain technical disadvantages to having a number of coils mounted in the set, but the decided gain in handiness is believed to offset this. I have used the plug-in coil system a great deal, but have recently constructed a set with the switch method and certainly prefer it.

Still another method has been tried utilizing the variometer principle, which enables a single coil to cover a very large section of the radio range by a relative change in the position of two halves of the coil.

At least one manufacturer already has a set on the market operating on a wave-changer system, which responds to all the regular broadcast stations, but in addition, can be changed by a mere movement of the wave-changer knob to any one of a number of other wave groups to receive the shorter wave (high frequency) stations.

This development is an important one, and to be welcomed as a decided contribution to radio usefulness and pleasure.

Performance Depends Largely on Detector

THE detector tube may be a critical spot in a set and the results you get may depend to no little degree upon the correct operation of the detector tube. One reason for the importance of the detector action is the audio frequency amplification which follows. Any slight irregularity about the detector is augmented enormously by the remainder of the set.

Quiet detector action is dependent to a considerable extent on the character of the tube. If the elements are not tightly mounted slight vibration will cause bell-like sounds or possibly a microphonic roar. If contacts to the socket and the associated wiring are imperfect scratching sounds will result, whether the tube is lighted from a storage battery or from the electric socket through the power transformer.

The grid leak plays a most important part and scratching sounds are sometimes due to poor contact inside the grid leak or to a defective resistance material or to a carbonizing of the material. A new leak may be tried to show whether the leak in use is in good condition. The resistance value of the grid leak should be relatively low (1 or 2 megohms) for general broadcast service. But for short-wave and long distance reception, a higher resistance leak, 3 to 7 megohms, is believed to result in louder reception. However, too high a resistance is used when receiving strong signals, the tube is temporarily blocked or choked and reception stops momentarily until the excess electricity has time to leak away through the grid leak.

To reduce hum, the wiring of the detector tube should be as short as possible. This is especially important with the grid circuit. The grid condenser and leak should be very close to the socket so that the merest bit of wire is needed to make the grid connection. All other wires should be well spaced away from the detector grid and plate wires in order to avoid hum caused by direct induction.

The suggestions given are, of course, of little value unless the detector tube is a good one. Get it from a reliable dealer who tests tubes carefully.

The operating voltages of the tube should be correct, especially as regards the current for lighting the filament. Too dim a filament results in poor tone quality, and too bright a filament greatly shortens the life of the tube. The plate voltage is seldom critical—about 45 is all right—except with the 200A tube, where a definite value is best.

Where negative grid bias or power detection is used, test for various values of biasing resistor. About 20,000 ohms is usually included for a 227 tube with 180 volts on the plate, but some set manufacturers use 12,000 ohms. The resistor should be by passed with a large condenser.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

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E. S. Foster, 1314 S. Edith St., Albuquerque, New Mex.
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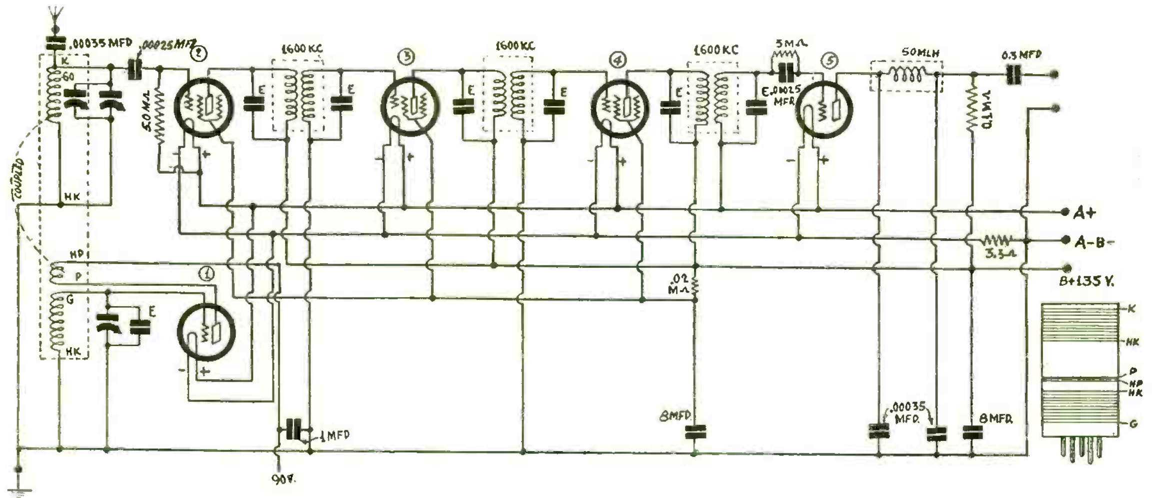
Frank R. Moore (Radio W9 B.V.B.), 1502 S. 35th St., Milwaukee, Wis.
William A. Plohr, 272—38th St., Pittsburgh, Pa.
Charles E. Christman, Box 191, Mill Valley, Calif.
Theo. R. Adams, 1032 E. 46th St., Chicago, Ill.
Luther Shaffner, Lowry City, Mo.
Ralph Miller, 550 S. Duke St., York, Pa.
A. Bardia, 701 West 179th St., New York City.
A. Yukner, P. O. Box 184, Ellwood City, Pa.

Battery SW Tuner

Three 232 and Two 230 Tubes Used In a Sensitive Circuit

FIG. 2

A curve for measuring inductance, based on .0005 mfd. capacity permanently across the tested coil. The curve in Fig. 1 may be used for obtaining the capacity for the inductance measurement.



*[Here is the diagram of the battery-operated counterpart of the AC short-wave tuner described last week, issue of April 25th.. The coil data are completed and apply to both models.—*EDITOR.*]*

Greater Leeway

With forms of 1¾-inch diameter more leeway is present, because fewer turns are required, due to the larger diameter, and the forms besides are 2½ inches high. The shield for the 1¾-inch diameter coil should be 3 inches in diameter, and about 3½ inches high.

Under no circumstances should tin cans be used.

If the coils are not to be shielded, more or less wire would have to be put on the secondaries.

With proper coils, either factory-made or home-made products, and with the circuit properly balanced, there will be no difficulty in receiving many foreign stations, as well as a horde of American short-wave transmissions. The smallest coil or coils may not produce any results at night, but will do so in the daytime, as short waves in this frequency region are not for night-time reception, the absorption being too great in the ether at night.

Connections

The connections are: Ground post of tuner to ground post of set, aerial post of tuner to aerial removed from set, plate output lead of tuner to P spring of set's detector or power amplifier's input, B plus to B plus 180 volts, obtained from set or power amplifier, or from three series-connected 45-volt B batteries with B minus to ground.

European stations should be tuned in by schedule. A list of stations, with hours on the air for all time zones in the Western Hemisphere, was published in the March 28th issue, with additions in the April 4th issue. Tuning for Europe in the hit-or-miss manner is not generally productive of satisfactory results.

This separation is as great as such a coil form would permit, and in general the separation for the other coils should be as great, as the small length of the form is the limiting factor, greater rather than less separation being preferable.

LIST OF PARTS

Coils

Four shielded plug-in coils
Three shielded 1,600 kc. transformers with tuned primary and secondary
One 50 milihenry shielded RF choke

Condensers

Two 100 mmfd. Hammarlund equalizing condensers E (six are in the transformers)
Two .00025 mfd.
One 60 mmfd. variable condenser
One two-gang straight frequency line .0003 mfd. condenser, with bracket
One condenser block, three 0.1 mfd. condensers in block (interconnect three reds)
Three .00035 mfd. fixed condensers
Two 8 mfd. electrolytic condensers with brackets
One 1 mfd. bypass condenser

Resistors

One .02 meg. (20,000 ohm) pigtail resistor
One 0.1 meg. (100,000 ohm) pigtail resistor
One Electrad 6 ohm adjustable filament resistor (to constitute 3.3 ohms)
Two 5.0 meg. grid leaks (one pigtail, one plain)

Other Parts

One metal chassis with socket holes punched
Five UX sockets
One National velvet vernier dial
One front panel
Three grid clips
Four binding posts, with three sets of insulating washers
One shaft type switch
Two knobs
One battery cable

A SW Converter for DC

By Adam Olcott

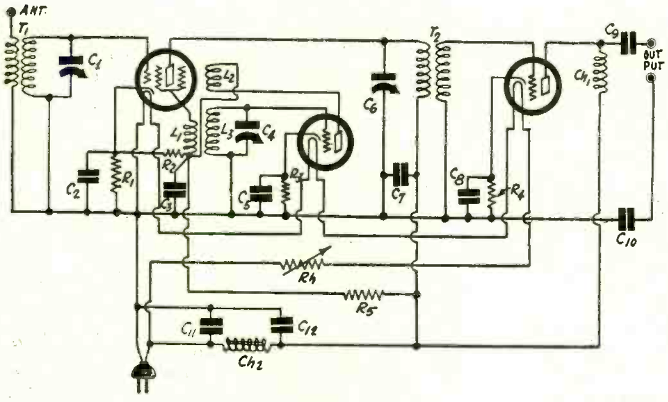


FIG. 1

The circuit of a short-wave converter utilizing the new 6.3 volt heater tubes and deriving all its voltages from a DC line.

[*This is the second and concluding installment of an article on a three-tube converter utilizing the new 6.3 tubes and designed for operation on a 110 volt DC line.*—EDITOR.]

ONE of the conditions for achieving a high efficiency in a short-wave converter when utilizing a screen grid tube as first detector or modulator is that the coupler following the tube will put a high useful, resistive load on the tube. The most suitable is a tuned circuit adjusted to the intermediate frequency, or the frequency to which the broadcast set is adjusted. Little can be gained by adjusting the grid bias for highest detecting efficiency if the plate circuit is not adjusted to take advantage of the properties of the tube.

Intermediate Tuner

C6 serves two functions. First, it is a by-pass condenser in the plate circuit of the modulator, and in this capacity it makes the first tube more sensitive as a detector. Second, it serves as a tuner for the primary of the intermediate frequency transformer T2, and in this capacity it makes the converter many times more sensitive than it would be if direct or untuned coupling were used.

The intermediate tuner should cover the same frequency band as the broadcast receiver so that any frequency to which the broadcast receiver can be tuned can be selected for the converter. Now it is desirable to use a midget condenser for C6, one just like either C1 or C4. But this will not cover the broadcast band. Hence a tap should be put on the primary of T2 so that only a part may be selected for the higher broadcast frequencies.

Design of Coil

If the coil and the condenser are to reach 550 kc, the inductance of the primary of T2 must be 418 microhenries. This is given by 103 turns of No. 30 enameled wire wound closely on a diameter of 1.75 inches. The tap on this coil should be placed at the center turn. The secondary of T2 should have about the same number of turns as the primary and may be put on a form that fits snugly inside or outside of the form holding the primary. If no form is available, several layers of waxed paper may be wound over the primary winding and then the secondary may be wound over the paper. The wire for the secondary may be the same in size as that for the primary, or it may be finer.

When using the tap the plate return should be moved from the end of the coil to the tap. The tap and the low end of the primary may be connected to two small binding posts placed conveniently on the sub-panel and the lead to the battery may be terminated in a lug for making switching convenient. This arrangement is preferable to a regular switch arrangement, but if a switch is desired it may be used. It should be of the single pole, double throw type.

Antenna Coil

The antenna coil is wound on a tube base type of form which has a diameter of 1.25 inches. For the largest coil 40 turns of No. 28 enameled wire should be used. Eight turns of the same size wire will do for the primary, and these turns should be wound at the low voltage end of the secondary. It is not necessary to cut the wire but to put on 48 turns, putting a tap eight turns from the antenna end. The connections of the terminals should be as follows: The P prong on the base should be connected to the end of the secondary and the G prong to the opposite end. The tap should be connected to both F prongs. The socket should be wired into the set correspondingly. That is, the P on the coil socket goes to the stator of the tuning condenser C1 and to the cap of the tube and the G prong on the socket goes to the antenna binding post. The two filament prongs are connected to the ground or B minus lead in the set.

If greater selectivity is desired in the antenna tuner fewer than 8 turns may be used on the primary and the turns may be placed farther away from the secondary turns. But, as a rule, this reduces the sensitivity.

One more antenna coil will be needed to cover the short-wave band, and this coil should be wound with 12 turns of No. 22 enameled wire on the same type of form as the larger coil. The primary for this coil should be 3 turns, but more or fewer turns may be used according to whether greater sensitivity or greater selectivity is desired. The terminal arrangement, of course, is the same for this as for the larger coil since both will be plugged into the same socket.

The Oscillator Coil

The three windings on the oscillator coil are wound on the same size form as the antenna coil except that the form must have five prongs in the base. That is, the form should be of the UY type. The form is made possible by the fact that the plate return of the oscillator and the screen return of the modulator are connected to the same prong. The larger of the two oscillator coils should have 26 turns of No. 30 enameled wire for L3, 18 turns of the same size wire for L2, and 5 turns for L1.

The smaller of the two oscillator coils should have 8 turns for L3, 5 turns for L2, and 2 turns for L1. This coil may be wound with No. 22 enameled wire.

The terminal arrangement for the oscillator coil is as follows: the G prong on the socket connects with top end of L3, which should be near the top of the form. The ground end of L3 should be connected to the K prong on the form. The plate return end of L2 should be connected to Hp, the heater prong next to the P prong. To this prong one side of the pickup winding L1 should also be connected. The plate end of L2 should be connected to the plate prong of the form and the remaining terminal of L1 should be connected to Hk, the heater prong next to K. The pick-up winding may be placed either above L3 or below L2.

Arrangement of Terminals

It is, of course, necessary to wire the oscillator coil socket to match this terminal arrangement. The G on the coil socket goes to G on the oscillator socket, the P of one to the P of the other. The K of the coil socket goes to ground, the Hk goes to G on the first tube and Hp goes to B plus or to R5.

Reception Improves on Short Waves

Radio transmission conditions, particularly on the short waves, have exhibited a great improvement in the past few months, according to listeners in Great Britain, South Africa and countries of Europe. Whether this is due to diminution of sun spots, according to one school of observers, or is simply an atmospheric freak, has not been determined.

WGY has recently received a highly favorable report from A. E. Bear, of London, a member of the International Short Wave Club, and for several years a reliable observer during radio propagation tests by General Electric radio engineers. Mr. Bear's observations cover the period from February 14th to March 20th, 1931, inclusive, and were made nightly at 11:00 p. m. Greenwich Meridian time, which corresponds to 6:00 p .m. eastern standard time.

Standards Bureau to Enlarge

By Dr. John H. Dellinger

Chief, Bureau of Standards Radio Section

Under the terms of an act recently passed by Congress an extension will be made in the Bureau of Standards' facilities for radio research. The act authorized the Secretary of Commerce to acquire for the Bureau of Standards a parcel of land in the vicinity of the District of Columbia not in excess of 200 acres, and to construct thereon buildings and facilities or experimental researches in the propagation and reception of radio signals. The act further authorizes the Secretary of Commerce to construct upon land now owned by the Government in the vicinity of the District of Columbia, buildings and equipment for an experimental radio transmitting station.

This contemplates the establishment of two field stations, one for radio reception experiments and one for radio transmission. These facilities are required because of the inherently large-scale nature of radio experimentation. The Bureau's radio work has been greatly hampered by the lack of a transmitting station at a distance from the Bureau, since any transmissions carried on produce destructive interference to the Bureau's radio measurement and standardization work. For a different reason a remote and large area is necessary for reception experiments.

In order to study the behavior of radio waves as received and in the medium through which they are transmitted, it is ncessary that delicate measuring instruments be used and that the waves be received in a location free from obstacles which would disturb the incoming waves.

The Bureau's radio service to the public along two principal lines will be considerably expanded by the new facilities.

The first of these is the transmission of standard radio frequencies. Radio is unique in that the primary radio standard can be made simultaneously available to every one in the country. By sending out signals of standard frequency controlled by the primary standard maintained by the Bureau it is possible for all who wish to tune in and make direct use of the standard.

An improved transmitter will be located at the new transmitting location, and it is hoped to send out signals of standard frequency continuously. This will be of the utmost value to radio stations of all kinds which can thus readily determine whether they are on the correct frequency. Interference will be minimized by this procedure.

In addition, it is possible that broadcast stations may be directly controlled by means of the incoming signals. This offers a possibility of synchronizing broadcasting stations so that a number may operate on the same frequency.

The other principal service which can be expanded by means of the new facilities is the study of radio wave transmission. Low power and temporary equipment which have been used in the past will be replaced by a suitable transmitter and proper receiving and recording apparatus. The suitability of radio waves of various frequencies for transmission over desired distances, the accuracy of radio direction finders, and knowledge of such limitations of radio as fading and "static," depend upon large-scale investigations of radio wave transmission.

One of the most valuable of the means of studying the behavior of radio waves is the direct measurement of the height of the Kennelly-Heaviside layer by means of radio waves reflected from it. This layer is a region of ionized air from 50 to 100 miles above the earth which determines the carrying power and behavior of all high-frequency radio waves. The determination, as nearly continuously as possible, of the height of the Kennelly-Heaviside layer is expected to furnish the best possible index of the conditions determining radio wave propagation.

Economy of Filament Current

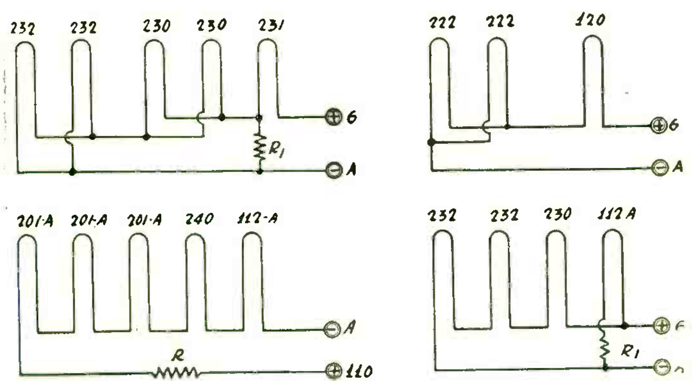


Fig. 1

Four different combinations of filaments arranged to make the filament circuit in each case as efficient as possible

HEREWITH are four different combinations of filaments of tubes designed to economize on filament current. In the upper left circuit are five 2-volt tubes connected in series parallel across a 6-volt battery. Each tube gets 2 volts and the correct current. Since the 232 and the 230 tubes require the same current, namely, 60 milliamperes, these may be conected in series, two and two in parallel. The 231 takes 130 milliamperes so that if its filament is connected in series with the others it is necessary to provide a shunt to allow for the difference of 10 milliamperes. The voltage drop across this resistance will be four volts. The resistance value of R1 is obtained by dividing the voltage drop by the current, or 4/.01, which gives 400 ohms.

In the right upper figure two 222 filaments are connected in parallel and then connected in series with a filament of a 120 tube. For these tubes it is all right to allow twice as much current for the 120 as for each of the others so that it is not necessary to allow for any differences as in the case of the preceding circuit. Also, it is all right to allow three volts for each tube. Hence the series may be connected across a 6-volt battery.

In the left lower figure are five filaments, each drawing .25 ampere and each requiring 5 volts. Hence all may be connected in series. The total drop across the five will be 25 volts. Now if this series be put on a 110 volt DC line it is necessary to connect a resistance R in series to take up the difference between 110 and 25 volts. The difference is 85 volts and the current is .25 ampere. Hence R should have a value of 340 ohms.

In the right lower circut we have combined three 2-volt, 60-milliampere tubes with one 5-volt, .25-ampere tube. Since the three small tubes take the same current and 2 volts each they may be connected in series and then connected across a 6 volt storage battery. The remaining tube must be connected across the battery directly but it should have a ballast resistor of 4 ohms in series with it to drop the difference between the battery voltage of 6 volts and the filament terminal voltage of 5 volts.

Pentode Output Tube Solves Battery Receiver

RCA Radiotron Company, Harrison, N. J., has announced a new pentode tube for use in battery operated receivers, particularly those using tubes of the RCA-232 and RCA-230 types in the other stages. This new tube is designated as the RCA-233. It is not interchangeable with any other existing type of tube.

CHARACTERISTICS OF RCA

Filament voltage	2.0 volts
Filament current	0.260 ampere
Plate voltage	135 volts
Screen voltage	135 volts
Plate current	14 milliamperes
Screen current	3 milliamperes
Plate resistance	45,000 ohms
Mutual conductance	1,400 micromhos
Amplification factor	63
Load resistance	7,500 ohms
Undistorted power output	650 milliwatts
Maximum overall length	4-11/16 inches
Maximum diameter	1-13/16 inches
Base	UY
Socket	UY

Distance in Daylight

By Anthony

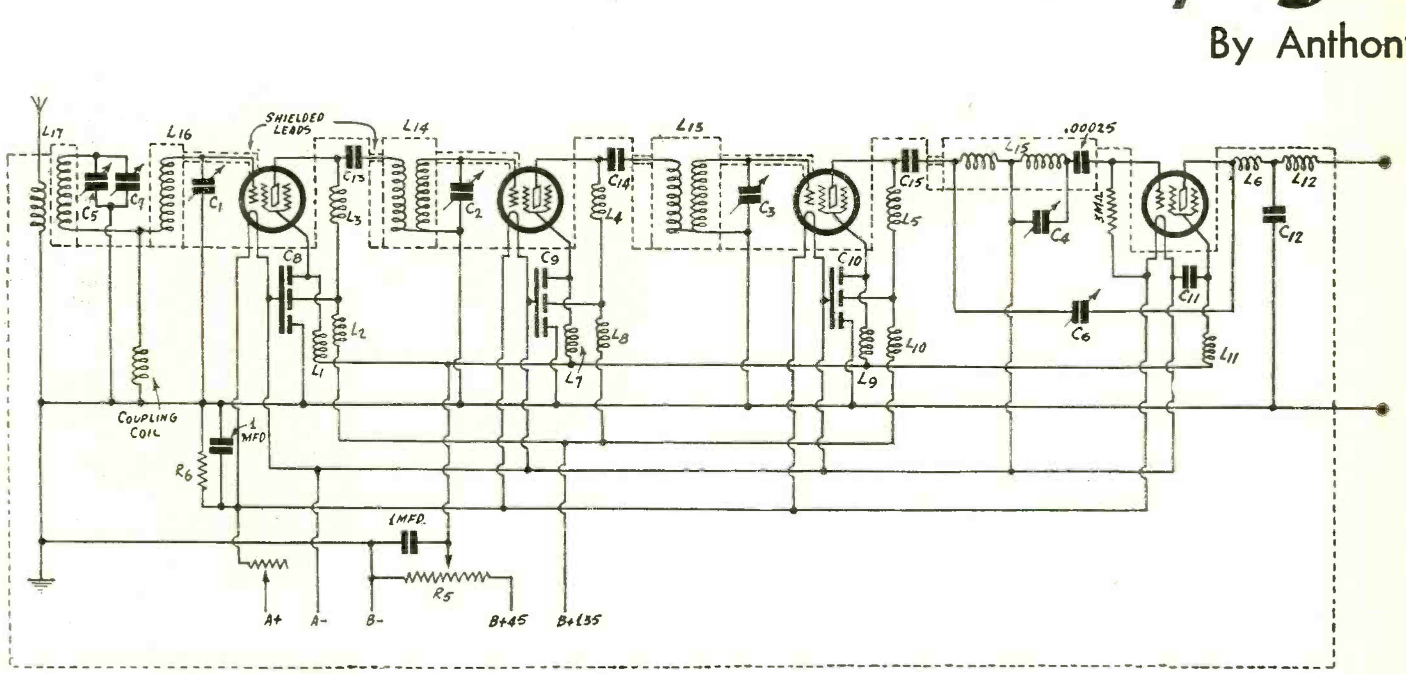


FIG. 1

A real DX-getter, using the 2-volt tubes. The antenna coupling is adjustable. Five tuned circuits and regeneration.

HOW many of you have sat in the full light of the afternoon sunshine and listened to broadcasting stations nearly a thousand miles away?

If you are a service man you know that you, at one time or another, have encountered a hypercritical customer who is never satisfied with the performance of any set he buys. No matter how expensive or elaborate the set, the customer never will acknowledge satisfaction, but will complain of lack of ability to penetrate in daylight or early evening through powerful locals for outside signals, and very frequently comparing the results from this viewpoint with those obtained from the three tuber built some years ago. Nor does it avail to explain that present-day congestion of channels, and presence of high-powered locals, offer much different conditions.

Is it manifestly impossible completely to satisfy such a customer? No, indeed. What he wants is a set that is sensitive and selective to the utmost permissible degree, and that goal can be achieved in a battery model or an AC design.

Growth of the Circuit

A group of radio enthusiasts sat in a small office in the midst of the towering skyscraper section of downtown New York on a recent Saturday afternoon and listened at will to stations all over the Eastern half of the country, forty-two out-of-town stations, to be exact, from Chicago to Toronto. One of them was a hockey enthusiast. The nearest station broadcasting a game he was interested in was WTAM, Cleveland. So he heard his hockey game, and it ended well before 5 p. m.

This reception is not at all unusual for that coterie who have for the past four years been following the experimental work of E. Bunting Moore. Five years ago he foresaw that the necessary increase of power among the broadcasting stations would make distance a forgotten thing for ordinary receivers. He started working on the development of a receiver which would have the necessary knife-edge selectivity and high gain to keep the far-away broadcasters rolling in, almost regardless of the power and proximity of locals.

His first year saw the Everyman 4. Next came the Moore-Daniels. Last season, the Moore Super DX came out. Now he has designed the Da-Lite-R tuner, the battery-operated circuit of which is shown in Fig. 1 and illustrated in the photographs.

No Cross-Modulation

One great asset of the receiver is its freedom from modulation of the carrier waves of distant stations by local signals, recognized as double tuning, or recurrence of local stations on other bands. This elimination of cross modulation is accomplished by the careful arrangement of constants and the extremely small antenna coupling actually used.

The panel shows one more knob than the conventional one-dial, two-knob layout of commercial receivers. The extra knob is for a selectivity control. For normal use there are the usual single tuning control and volume control. Employing these two only, the receiver will be found superior in both sensitivity and selectivity. When the other two knobs are brought into play, the tremendous reserve amplification and penetrating power of the set are brought into action, permitting such feats as the reception of WGN and WLW through WOR, with WOR only a mile from the point of reception. A Chicago user reports the ability to get all the New York stations.

Special Antenna Coupling

The antenna is coupled to the receiver by an aperiodic primary, so designed that as far as resonance is concerned any antenna more than a few feet in length constitutes an effective short circuit. The use of this feature entirely eliminates the usually necessary compensating for changes in antennas.

This primary is adjustable by a knob on the panel to vary the inductive relation to a circuit tuned by the first section of a five-gang condenser, providing exact quantitative control of the input to the receiver, varying from 0 to approximately 7.5% in coefficient of coupling. This tuner circuit is in turn loosely coupled to another

Addition to Shor

The original list was published March

5,165	58.0	PMY	Bandoeng, Java	7:40-10:40 A.M.	6:40-9:40
5,165	58.0	FYR	Lyons, France		
4,750	63.12	G2GL	S.S. "Homeric"		
4,610	65.00	G2IV	S.S. "Majestic"		
4,610	65.0	KIO	Kauhuku, T. H.		
4,410	68.0	OKIMPT	Prague, Czechoslovakia		
4,000	75.0	PKIAA	Weltevreden, Java	7:40-10:40 A.M.	6:40-9:40
3,750	80.0	F8AV	Nogent, France		
3.610	83.0	......	Moscow, U.S.S.R.		
3,400	86.0	HB9XD	Zurich, Switzerland		
3,440	87.51	WSBN	S.S. "Leviathan"		
3,155	95.0	PK2AG	Samerang, Java	7:40-10:40 A.M.	6:40-9:40
1,604	187.0	W2XDD	Portable		
1,604	187.0	......	Ornskoldsvik, Sweden		
1,596	187.9	WRBC	New York, N. Y.		
1,596	187.9	WKDT	Detroit, Mich.		
1,596	187.9	W7XP	Seattle, Wash.		
1,584	189.4	W10XAL	Portable		
1,584	189.4	W10XAO	Portable		
1,560	192.3	......	Scheveningen, Holland		
1,544	194.3	W2XDA	New York, N. Y.		
1,530	196.0	......	Karlskrona, Sweden		

With a Battery Set

Swale Waring

tuned circuit which supplies energy to the grid of the first screen grid amplifier, the two tuned circuits providing a very selective filter with a flat top.

Shielding is more than ordinarily complete, even the plate leads and grid leads being run inside of grounded conduits. All lines supplying power to the tubes contain individual filter circuits, so that the electrical isolation of each stage is complete. Biasing voltages are chosen throughout with careful reference to maximum amplification and input conductance.

Phase Displacement for Stability

Stabilization of oscillatory effects due to inter-element capacity in the tube (appreciable even with screen grid tubes) is accomplished by the use of the Chronophase system in each output circuit, where by combining a high shunt impedance with the proper values of resistance and coupling capacity a slight phase displacement between input and output circuits is established, avoiding feedback without affecting the amplification obtained.

A unique feature of the tuner, and one to which much of its amplification is attributable, is the use of a regenerative power detection circuit employing a screen grid tube. The input circuit, of the detector is arranged to form a modified Hartley oscillator circuit, with the plate coupling capacity controlled by a knob on the panel, permitting the introduction of a very small amount of adjustable stabilized feedback at this point.

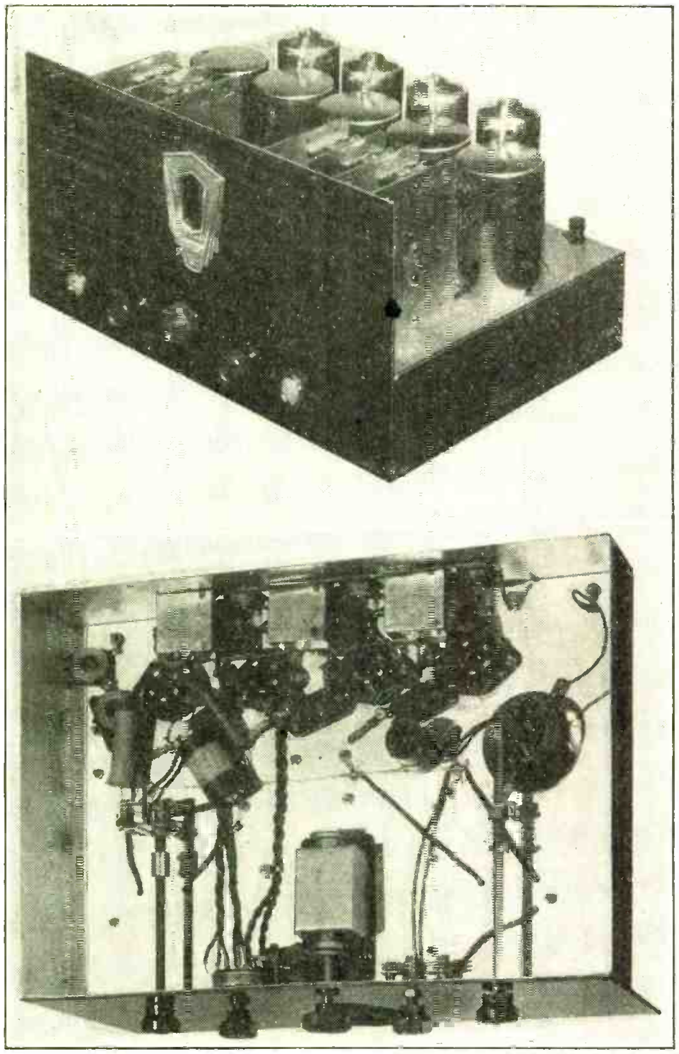
The RF transformers are so designed that this feedback, effective in this circuit only, is evenly distributed over the entire broadcast band, and need be readjusted only for the weakest signals. The screen of the detector tube is at the same potential as the screens of the RF amplifier tubes, and like them, connected to the arm of a potentiometer giving exact control of amplification and regeneration simultaneously, and which, used as a volume control, is the only auxiliary knob for operating the set.

The output of the detector contains a filter designed to confine all radio frequency impulses within the detector circuit. The output of the receiver can be fed into any amplifier having an input impedance in excess of 200,000 ohms, and supplying plate current to the detector tube at the plate of the tube at the potential of 100 to 125 volts at 350 microamperes.

Careful Shielding

It will be noticed that from antenna binding posts to output posts the circuits are well shielded, even the caps of the screen grib tubes and the leads from the coils being individually encased in conduit. The last edge of selectivity is directly attributed to this, for on very near local stations in some localities the gain of the amplifier would be sufficient to bring up the microscopic pick-up of these tiny exposed sections of wire to sufficient volume to give very comfortable room volume, but when the shielding is applied, the signal vanishes.

Thorough shielding of this type also isolates the individual stages



FIGS. 2 AND 3
Side view and bottom view of the DX battery-operated tuner that uses four 232 tubes.

to much better advantage, permitting the gain per stage to be increased appreciably without causing oscillation.

A feature is the uniformity of the response to weak signals, and selectivity over the entire band. The control of amplification provided, and the great care used in the design of the radio frequency transformers, have resulted in a receiver which has the same selectivity in the "graveyard" between 1,400 and 1,500 kc as at the other end of the band.

What One User Got

Here is one of many letters from builders of the battery model set telling of the fine performance:

My radio set is working as well as any radio can work.

Last night I pulled in three stations from across the Atlantic: London, England, at about 45 on dial and so loud that I had to cut down volume: Algiers at about 47 on dial with good room volume, and another station which I believe was Italy. Did not get the call letters nor could I get any English, but Rome was mentioned quite often, also Naples.

This is quite a record for reception in the broadcast band to make from my location, as the location is far from perfect.

Of course New York, Hartford, Atlantic City, etc., I can get any time during the day.

RORT. F. PEACH,
Port Morien, C. B., Nova Scotia, Can.

[List of parts of the battery model, and data on the AC model, next week.]

-Wave Station List

8th, with additions in the April 4th issue.

A.M.	5:40-8:40 A.M.	4:40-7:40 A.M.	3:40-6:40 A.M.	Daily
				Phone
				Phone
				Phone
A.M.	5:40-8:40 A.M.	4:40-7:40 A.M.	3:40-6:40 A.M.	Daily
				Phone
A.M.	5:40-8:40 A.M.	4:40-7:40 A.M.	3:40-6:40 A.M.	Daily
				et al.
				Fire Dept.
				Fire Dept.
				Police and Fire Depts.
				NBC
				NBC

Characteristic Curves

High Amplification and

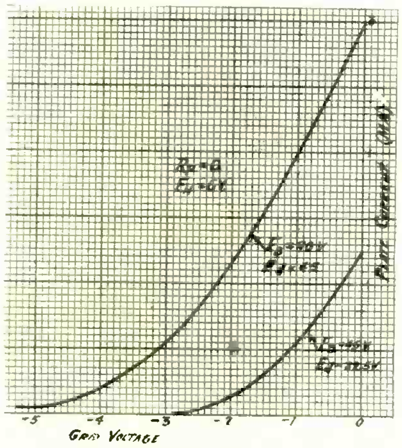


Fig. 1

Two grid voltage, plate current curves for a sample RCA-236 screen grid tube without load resistance in the plate circuit. The curve should not be regarded as average for this type of tube

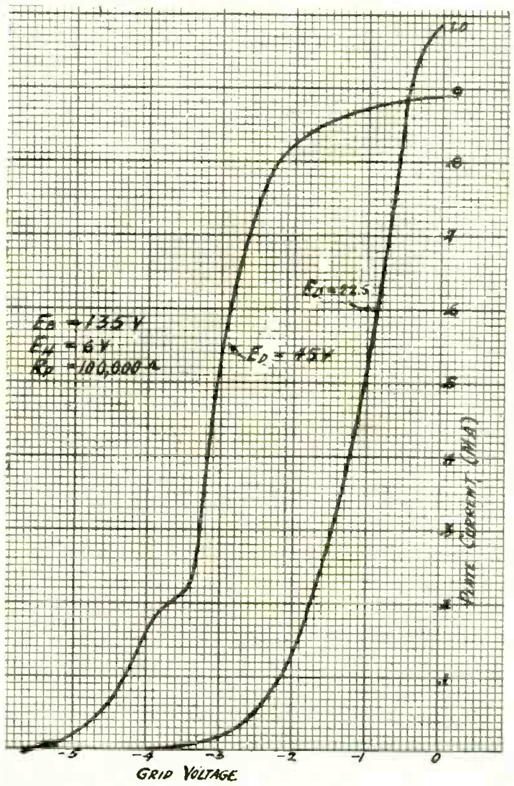


Fig. 2

Two grid voltage, plate current curves for a sample RCA-236 screen grid with a load resistance of 100,000 ohms in the plate circuit. These curves are not average for the 236 type tube

IN the April 18th issue we published for the first time the characteristics of the new 6.3 volt heater tubes. At that time no characteristic curves were available and at this time no average characteristic curves are available on any of these tubes. However, we have a few curves for the 236 screen grid tube taken on one sample tube. Curves for the other tubes in this series will be published as soon as they become available.

The plate current, grid voltage curves for a 236 tube are reproduced in Fig. 1. For both curves the plate load resistance was zero except for the resistance of the milliammeter used for observing the current, and the effective voltage across the heater terminals was exactly 6 volts. The heater current was 0.286 ampere.

The lower curve was taken with 45 volts on the plate and 22.5 volts on the screen. As will be noted, the highest current at zero bias is 1.25 milliampere and the curve drops to zero when the grid bias is about 3 volts. The upper curve was taken with 90 volts on the plate and 45 volts on the screen, the other conditions remaining the same as before. The highest current now is 2.98 milliampere and the current drops to zero about 6 volts on the control grid.

Mutual Conductance

These curves are not very useful in determining the functioning of the tube in a circuit since they only give the variation of the plate current with grid voltage when there is no load in the plate circuit. However, we can determine the mutual conductance of the tube at any desired grid bias on either of the curves. The mutual conductance is the change in plate current for a change of one volt on the grid. If we use milliamperes for current we multiply the current change by one thousand to get the mutual conductance in micromhos.

Let us determine the mutual conductance at one volt bias on the upper curve in Fig. 1. If we take the currents at 0.5 volt more and less than one volt we get the average mutual conductance between these voltage limits, which we may call the mutual conductance at one volt bias.

At 0.5 volt bias the current is 2.475 milliamperes and at 1.5 volts it is 1.55 milliamperes. The difference between these two is 0.925 milliamperes and therefore the mutual conductance at 1 volt bias is 925 micromhos. The table of characteristics previously published gives the mutual conductance for 90 volts on the plate, 55 volts on the screen, and 1.5 volt bias as 850 micromhos. For other combination of voltages the mutual conductance is given as 1,050 and 1,100 micromhos. If we take the mutual conductance on the upper curve in Fig. 1 at 0.5 volt, that is, between zero and one volt, we get 980 micromhos. These values agree well with the listed values.

Tube in Resistance Circuit

Curves taken with a resistance load are more useful as they show the amplification that may be expected when the tube is used in this type of circuit when all the operating voltages are shown. In Fig. 2 are two such curves taken on the same 236 type tube when the load resistance is 100,000 ohms. The voltage in the plate circuit for both curves in this graph was 135 volts and the screen voltage for the left hand curve was 45 volts and that for the right hand curve 22.5 volts.

The left hand curve is mainly useful in showing how not to operate the tube in a resistance coupled circuit. There is no region of grid bias where amplification without much distortion can be obtained. The optimum point seems to be where the grid bias is 3 volts. The tube is supposed to be operated with a bias of 1.5 volts when the plate voltage is 135 volts and the screen voltage is 67.5 volts. But even when the screen voltage is as low as 45 volts there is practically no amplification at 1.5 volt bias but considerable detection. When the screen voltage is 67.5 volts, the amplification is even less.

It should be remembered that the plate voltage should be 135 volts, not the voltage in the plate circuit. In order to get an effective voltage of 135 volts on the plate when there is a 100,000 ohm resistance in the plate circuit it is necessary to boost the applied voltage to a much higher value, or by the amount of drop in the plate load resistance. The difference between the voltage in the plate circuit and the effective voltage on the plate is not often recognized, but allowance must be made for the drop in the load resistance if the tube is to function properly.

Lower Screen Voltage

When the screen voltage is reduced to 22.5 volts the curve is more favorable for high and distortionless amplification. Consider, for example, the point where the grid bias is one volt. The plate current is .515 milliampere. Let us assume that we have a signal voltage of amplitude 0.25 volt. At 0.75 volt the current is 0.666 milliampere and at 1.25 volt it is 0.4 milliampere. The difference is 0.266 milliampere. If this is multiplied by the plate load resistance of 100,000 ohms we get the output voltage produced by a change of 0.5 volts in the grid circuit. It is 26.6 volts. Therefore the amplification is 26.6/0.5, or 53.2 times.

At 1 volt bias the course of the curve is somewhat uncertain

# of a Sample 236 Tube

Detecting Efficiency Indicated

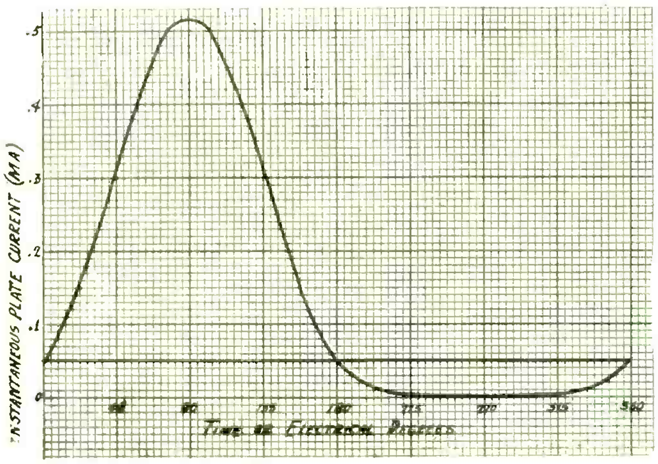


Fig. 3

This curve shows the instantaneous values of plate current during one cycle of input voltage when the tube is operated as a detector with 100,000 ohms in the plate circuit and 2.5 volts on the grid. The values were obtained from the right hand curve in Fig. 2. The signal voltage amplitude assumed to be 1.5 volts

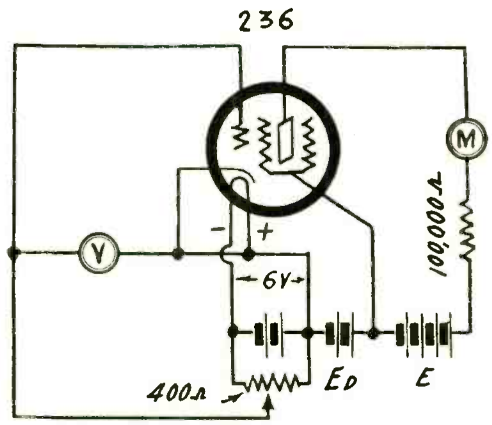


Fig. 4

This is the circuit used in taking the curves in Figs. 1 and 2 on the sample 236 screen grid tube. When the curves in Fig. 1 were taken the 100,000 ohm resistance was short-circuited

due to the effect of the screen voltage and its approach to the value of the effective plate voltage. Hence it would be better to adjust the circuit so that the bias is 1.25 volts. At this point we have for the same signal an amplification of 44 times. for at 1 volt the current is .515 and at 1.5 it is .295 milliamperes, a difference of .22 milliampere, which gives 44 when multiplied by 100,000 ohms and divided by 0.5 volt. Although the amplification is less the distortion is also likely to be less at this point. Even with an amplification of only 44 we need only a signal amplitude of 0.2 volt to load up a 237 heater tube following the resistance coupler.

Grid Bias Resistor

Suppose we want to provide the grid bias by means of a resistor in the cathode lead, what should the value of this resistor be to give a bias of 1.25 volts under the conditions represented by the right hand curve in Fig 2? At 1.25 volts the plate current is 0.4 milliampere. If we assume that the screen current is one third the plate current, the total current in the bias resistor will be 0.533 milliampere. Hence to cause a drop of 1.25 volt we need a resistance of 2,340 ohms. If we wish to make the bias one volt we have to take the current at one volt, which is 0.515 plus the screen current, a total of 0.686 milliampere, and therefore we need a resistance of 1,458 ohms. It is clear that we may use any value between 1,500 and 2,500 ohms. A 2,000 ohm resistance is standard and that is suggested.

It is plain from the shape of the curve at the higher bias values that a high detecting efficiency may be obtained under the conditions represented in the right hand curve in Fig. 2. Any bias between 2.5 and 3 volts is suitable for detection. We can compute the necessary grid bias resistance in case the tube is to be self-biased as a power detector. Let us assume the grid bias to be 3 volts. The plate current is 0.018 and the total current is 0.024 milliampere. Hence to cause a drop of 3 volts we must have a resistance of 3/.000024, or 125,000 ohms. This seems unreasonably large since it is larger than the plate load resistance, but that is how it works out.

Less Bias on Tube

The detecting efficiency is also very good at a bias of 2.5 volts. Indeed, it may be better in view of the fact that the amplification of the detected signal is greater at this point. The plate current at 2.5 volts is 0.05 milliampere and the total current through the bias resistor will be 0.0667 resistor of 37,500 ohms. A 50,000 ohm variable resistance is recommended for this case.

If the grid bias for detection is adjusted to 2.5 volts, the signal amplitude may at least be 1.5 volts. The plate current will then vary between 0.515 and zero milliampere and the amplitude in the positive direction will be 0.465 and that in the negative direction 0.05 milliampere. Thus the rectification is very good.

In Fig. 3 is a curve representing one signal cycle of rectified current obtained graphically from the right hand curve in Fig. 2, assuming an operating bias of 2.5 volts and a signal amplitude of 1.5 volts. The heavy horizontal line at 0.05 milliampere represents the current at the operating bias. The curve shows strikingly the rectification in the tube.

Test Circuit Used

In Fig. 4 is shown the test circuit used in taking the curves on the screen grid tube. The voltmeter V connected between the control grid and the cathode indicates the actual bias on the grid. The battery Ed supplies the screen grid voltage and this and battery E the plate voltage. The 100,000 ohm resistance is connected in the plate circuit in series with the milliammeter M. When the curves for no load were taken the 100,000 ohm resistance was short-circuited and a different milliammeter was used, one having a greater range.

Since the grid bias voltages in this case were always less than 6 volts, the heater battery was used to provide the bias. This was made possible by connecting the cathode to the positive terminal of the storage battery and by connecting the negative of the plate battery to the same point. A 400 ohm potentiometer was connected in shunt with the battery and the slider connected to the negative terminal of the voltmeter V and to the control grid. Thus it was possible to get any desired voltage on the grid between zero and 6 volts. This dual use of the battery can be employed only with a heater tube in which the cathode is independent of the filament circuit.

Free Grid Potential

When there is no grid return on the tube, that is, when the grid is free, the plate current always assumes a certain value depending on the plate and screen voltage. This indicates that the grid has a free potential. In the case of the right hand curve in Fig. 2 the free grid plate current was 0.5 milliampere. On the curve we note that this corresponds to a grid voltage of 1.02 volts. Thus the free grid potential is about one volt. For the left hand curve the plate current for a free grid was 0.865 milliampere, and this corresponds to a potential of 1.25 volts. The free grid potential changes slightly with the screen voltage.

If no grid return is provided in the circuit and if the signal voltage is impressed on the control grid through a leak-proof condenser, the circuit should amplify just as well as if the bias is provided in one of the regular ways, provided that the free grid potential is correct for amplification. On the right hand curve in Fig. 2 the free grid potential practically coincides with the best bias for amplification. Of course, there is no certainty that the actual grid potential will vary properly about the free grid potential when a signal is impressed through a leak-proof condenser. But the free grid potential is an interesting side light on the properties of the tube.—J. E. ANDERSON.

How to Measure Cap

Precision Type Shielded Coil,

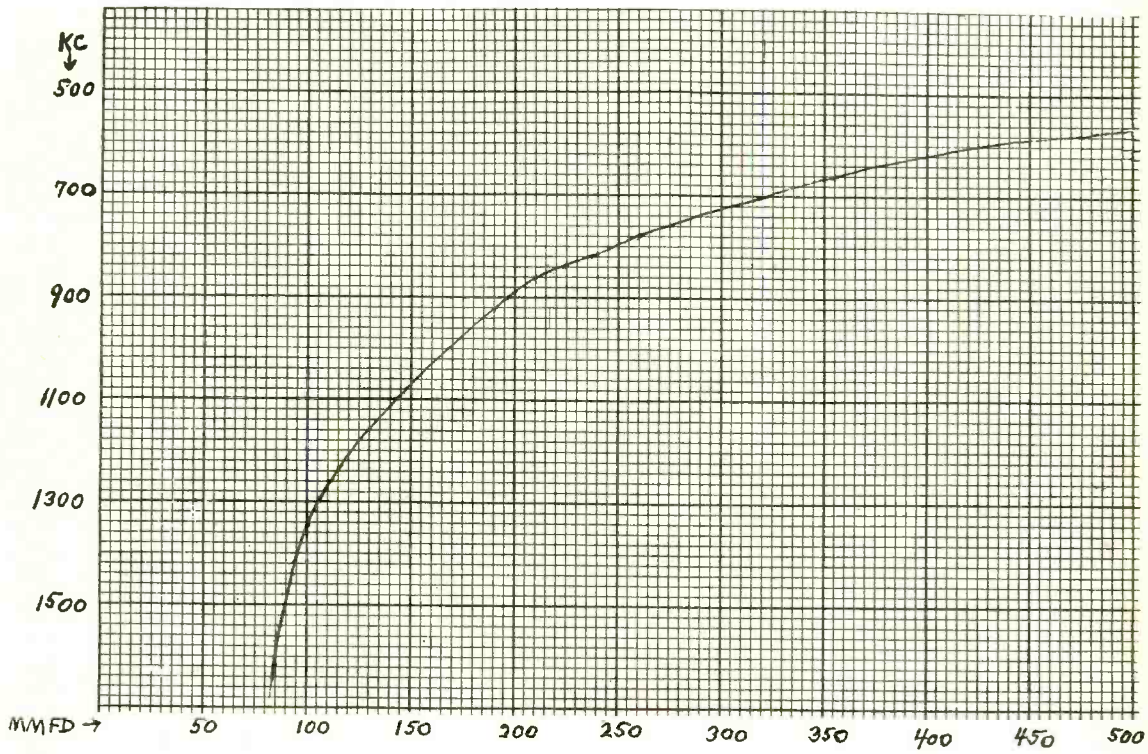


Fig. 1
A curve showing the relationship between capacity and frequency, using a given precision type radio frequency transformer in a stated aluminum shield. The resultant inductance of the shielded coil was 160 microhenries

THE curve in Fig. 1 shows the relationship between capacity and frequency, when using a precision type radio frequency transformer, in a given shield. The coil was wound on 1¾ inch diameter natural bakelite, threaded for an 85-turn secondary, on which was wound No. 28 enamel wire. The primary, separated from the secondary by ⅛ inch, was wound in a slot and consisted of 25 turns of No. 30 single silk covered wire. Use of different sizes of wire would not materially alter the frequency and capacity results.

The shield was of 1/64 inch wall, and cylindrical, with 3 inch diameter and 3½ inch height.

Inductance 160 Microhenries

When the shield was on the inductance was 160 microhenries, and when it was off the inductance was 200 microhenries. Therefore the coil would not be properly proportioned for use with a .0005 mfd. condenser, as intended, if the shield were omitted. The inductance, with the shield off, would be suitable for a condenser of .00035 mfd. maximum capacity. However, only an unshielded coil would permit coverage of the full wave band, with .00035 mfd., hence, for practical use .0005 mfd. is preferable. Some condensers, however, have a maximum capacity of less than .0005 mfd. but more than .00035. It is impractical to cover the wave band in shielded tuned radio frequency circuits where the maximum capacity of the condenser is less than .00046 mfd.

The curve is for the shielded coil for .0005 mfd. capacity, and it can be seen that the wave band is covered, for 1,500 kc., the highest frequency, comes in at 90 mmfd., while the lowest frequency, 550 kc., comes in at 497 mmfd. These capacities in microfarads are .00009 and .000497, respectively.

The curve was obtained by cutting the coil-condenser circuit in the first stage of a tuned radio frequency receiver (Balkite, A5), using a service man's adapter. Antenna was connected to one side of the primary, ground post of the set to the other side of the primary, and grid and ground to the secondary. It is imperative to ground the secondary; otherwise the readings will be different from those shown in the curve.

Case of the Trimmer

The adapter has removable U-shaped brads, one brad for each of the five connections: heater, heater, cathode, grid and plate. Only the grid brad was removed, and a lead from the stator of the test condenser connected to the proper opening. Thus the coil-condenser combination in the receiver was out of circuit and the test combination was substituted. The condenser used in the test was a precision calibrated type. As the curve indicates, it had a straight line capacity variation. The indication is the circular slope in the higher frequency (lower capacity) ranges.

Since the test circuit was cut into a receiver, the readings are lower than the real capacity present, by the sum of the capacities of the wiring and the tube elements. But this difference is small and may be neglected. It would not amount, normally, to more than 5 mmfd.

There was no trimming condenser across the calibrated condenser; therefore, if the capacity of a condenser is to be measured in a receiver, the trimmer connection should be removed; otherwise, you would be measuring the capacity including the trimmer. If the intention is to do just that, of course, the trimmer should be left in. In any event, the measurement obtained will be that of the actual capacity, whether the trimmer is in or out, since the same given amount of capacity, however arising, will produce the same frequency of resonance with the precision coil.

Measurement by Substitution

The lowest capacity you can check up, by using the curve, is 85 mmfd., while the highest is 500 mmfd. It can be seen that the coil is so designed as to give leeway at the higher frequencies for more capacity, such as would be introduced by a trimming condenser.

With the trimmer in circuit the numerical readings of a set dial, with the precision coils as couplers, would be lower for 1,500 kc. and lower for 550 kc., whereby the highest frequency would come in nearer zero numerical setting, and the lowest frequency farther below the maximum numerical setting. That is why the lowest frequency was gauged for 497 mmfd., rather than having less inductance to lower the numerical dial setting for the highest frequency.

The method of measuring capacity is that of substitution. There are two principal measurements to be made; first, that of the maximum capacity of a tuning condenser, and, second, the capacity of a fixed condenser.

All you need to make either test is the tested condenser, the coil, the shield, and the adapter. Put the tested condenser across the coil's secondary, connect to the adapter as described, be sure antenna and ground are firmly connected, and then tune the broadcast receiver, which may be of the tuned radio frequency variety or a superheterodyne. If it is a superheterodyne plug into the modulator (first detector), or if the superheterodyne has tuned radio frequency amplification, plug into the first TRF tube.

Note the frequency of greatest response, which may be done satisfactorily by the ear test, and then refer to the curve. Sup-

acity and Inductance

Adapter and Curve Afford Solution

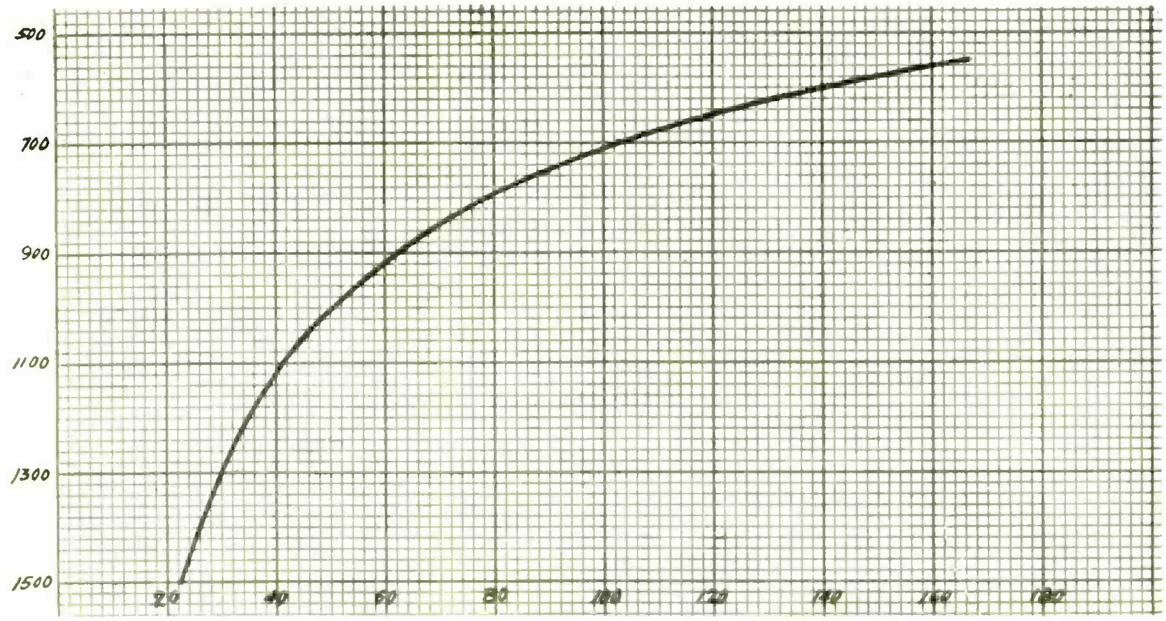


FIG. 2
A curve for measuring inductance, based on .0005 mfd. capacity permanently across the tested coil. The curve in Fig. 1 may be used for obtaining the capacity for the inductance measurement.

pose the frequency is 700 kc. Then the capacity is .000325 (322½ mmfd.).

The frequencies are shown on the perpendicular line (ordinate) while the capacity is shown on the horizontal line (abscissa). The capacity is 5 mmfd. per line, the frequency 20 kc. per line.

It will be noticed there is a kink in the curve, beginning at 225 mmfd. and ending at 270 mmfd. This actually showed up in the test. The curve is a faithful copy of the reading obtained, rather than being a smoothed-out misrepresentation. It is assumed the kink was due to mutual coupling effect between primary and secondary.

The ten stations used for obtaining the points from which the curve was drawn follow with their frequencies in kilocycles: WWRL, 1500; WHAP, 1300; WBEN, 900; WABC, 860; WHAS, 820; WGY, 790; WJZ, 760; WOR, 710; WEAF, 660; WMCA, 570.

Measuring Inductance

The inductance of a small coil can usually be measured with the aid of a fixed condenser of known capacity and a broadcast receiver that is sensitive enough to pick up a station on every channel provided the frequency of every station picked up can be identified. However, the inductance must lie within certain limits. When the condenser of known capacity is connected across the coil of unknown industance a circuit is formed which has a certain natural frequency of resonance. If this frequency can be found the inductance of the coil can be computed by the relation connecting frequency, capacity, and inductance. This equation may be written $L = .02534/CF^2$, in which L is given in henries, C in farads, and F in cycles per second.

This formula can be simplified if we use more conventional units. Let L be measured in microhenries, C in micromicrofarads, and F in megacycles. The formula then becomes $L = 25.340/CF^2$. The frequency is converted to megacycles by taking the number of kilocycles and moving the decimal point three places to the left. For example, 980 kc equals .98 megacycle.

A convenient value of the known fixed condenser is 500 mmfd. Let us put this in the second formula above. Then we get $L = 50.68/F^2$, L being expressed in microhenries and F in megacycles. Suppose we find that the natural frequency of the circuit formed of the inductance and the 500 mmfd. condenser is .750 megacycle (750 kc). If we put this in the third formula we obtain 90.1 microhenries. Again, suppose we find that the natural frequency of the circuit is .55 megacycle (550 kc). Then we get 167.7 microhenries for the inductance of the coil.

A grap of the formula $L = 50.68/F^2$ is reproduced herewith as Fig. 2. By means of this all computation is avoided, since the inductance may be read off the curve as soon as the frequency is known.

Now we come to the real measurement, the determination of the natural frequency of the circuit. We have several means at our disposal. We may use the circuit as a wavetrap in the antenna circuit of the receiver and tune in one station after another and note on which station the trap has any effect, or greatest effect, in reducing the signal. The frequency of that station is the frequency sought. To get the approximate value of the natural frequency the resonance circuit can be connected in series with the antenna, that is, connected so that the antenna is connected to one sid eof the fixed condenser and the antenna post on the set to the other side. A closer determination can be obtained by putting a few turns of wire around the form, as a primary, about ½ inch from the secondary, and then connecting these turns in series with the antenna.

Another way is to use the coil and the few extra turns as an input transforme rand then tune the set, noting which station can be received.

Of course, the best way is to employ a calibrated oscillator. If the tuned circuit under measurement is coupled to the oscillator coil the oscillation will stop when the oscillator is set at the natural frequency of the circuit. The frequency is then read on the calibration chart for the oscillator. The stopping of the oscillation can be detected with a pair of earphones for there will be a strong plop when it stops. It can also be detected with a milliammeter in the plate circuit. The plate current drops suddenly as the oscillation stops.

The Output Pentode

The Arcturus Radio Tube Company, Newark, N. J., has announced a new power output pentode tube, designated the Type PZ. This tube is of the filament type and has five elements, as the name indicates. Its characteristics are as follows:

Filament voltage	2.5
Filament current, amperes	1.5
Plate voltage	250
Plate current, milliamperes	32.5
Control grid bias, volts	16.5
Space charge grid voltage	250
Space charge grid current	7
Cathode grid potential, volts	0
Plate impedance, ohms	38,000
Transconductance, micromhos	2,500
Amplification factor	95
Power output, watts	2.5

Base, UY or five prong.
Max. diameter, inches, 2⅛.
Overall length.

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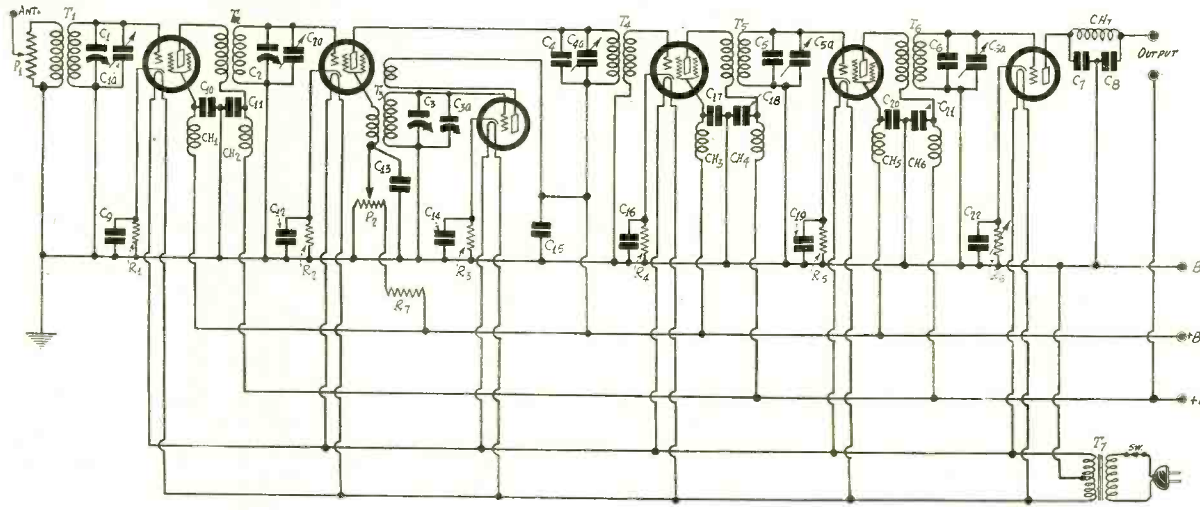


Fig. 914

A five-tube superheterodyne tuner and detector in which there is high selectivity in both the RF and IF frequency levels

Pentode Screen Current

IN the table of characteristics of the pentode power tube you give the screen current as 7 milliamperes. Does this current remain constant as the control grid voltage changes? If not, at what grid voltage is the screen current 7 milliamperes?—T.R.Y.

The screen current does not remain constant but varies in about the same way as the plate current over the operating range. The given screen current is for 250 volts on the plate and the screen and for 16.5 volts on the control grid.

* * *

Loudspeaker and Pentode

IS it safe to connect the loudspeaker directly in the plate circuit of the power pentode or is it necessary to use an output transformer or an output filter to remove the direct current component from the output?—E.S.D.

The plate current of the pentode power tube is 32.5 milliamperes. If the armature winding of your speaker can carry this current safely you don't need any filter. In other words, it depends on the speaker you have or intend to use. The plate current for this tube is about the same as that of a 245 power tube.

* * *

Short Antenna, Long Wave

IN your articles on the micro-ray system of communication you said that the wavelength was 18 centimeters and that the length of the antenna was only one inch. If the antenna vibrates so that its length is equal to one-half wavelength the length of the wave would be only two inches long; that is, only 5.08 centimeters. Is there a mistake in the article or how is the discrepancy explained?—A.B.S.

The length of a wave on an antenna is one thing and the length in free space is quite another. The length of a wave in free space is determined by properties of the ether and the length of a wave on an antenna is determined by the inductance and capacity per unit of length of the antenna. The length of a wave of given frequency in space is unalterable while that on an antenna for the same frequency can be changed by changing the inductance or the capacity per unit length of the antenna. The inductance of a straight wire antenna is not easily changed but the capacity can be changed easily.

* * *

Operation of Condenser Microphone

IT is my understanding that it is necessary to use a high resistance in series with a condenser microphone, and that this resistance must be extremely high if the frequency characteristic of the microphone is to be satisfactory. If I am correct why is it necessary to have a high resistance and why must it be very high in order to amplify all the frequencies equally?—S. C.

The condenser microphone is a tiny condenser which is charged to a high voltage by means of a battery. When sound waves fall on the diaphragm the capacity changes and so part of the charge is forced out or additional charge is taken on, depending on whether the change is a decrease or an increase. The charge cannot change without a current flowing in the external circuit. Since the capacity of the condenser alternately increases and decreases the current is alternating. This is the output current of the microphone and it must be made use of. If a resistance is connected in the external circuit the alternating current flows through it and a voltage difference is established across the terminals of the resistance. This is the output voltage which is impressed on the grid circuit of an amplifier tube. There is no other practical way of getting an output voltage than by a high resistance for a transformer or a choke would not have enough impedance to match that of the microphone, and besides, these would result in frequency discrimination. It is necessary to use an extremely high resistance for otherwise the voltage across the resistance would not be independent of the frequency of the sound that fell on the diaphragm.

* * *

A Superheterodyne Tuner

PLEASE publish a superheterodyne tuner comprising five or six tubes with two RF and at least three IF tuners. I prefer a circuit for AC operation.—N.L.Z.

You will find such a circuit in Fig. 914. It comprises one screen grid RF amplifier, one screen grid modulator, one 227 oscillator, two screen grid IF amplifiers, and one 227 power detector. Ample filtering is used to eliminate any feedback not desired. The volume is controlled mainly by a high resistance potentiometer in the antenna circuit of the set.

* * *

Fixed Frequency Oscillator

CAN the 800 turn duolateral coils you specify for intermediate frequency transformers be used for fixed frequency oscillators tuned to a frequency of 175 kc? I wish to construct such an oscillator as an aid in lining up my 175 kc. intermediate frequency amplifier.—B.W.E.

They can be used for this purpose. You will need two for an oscillator. If you tune only one winding of the oscillator couple the two coils as closely as the wooden cores permit. If you tune both windings it is not necessary to couple as closely.

* * *

Fine Variation of Resistance

WILL you kindly suggest a method whereby I may vary the resistance of a resistor of about 2,000 ohms by extremely small amounts? I should also like to know about methods of varying inductances and capacities by small amounts.—M.M.S.

There are many methods of varying a resistor by very small values. One is to connect a very large variable resistance across the one that is to be varied and then vary the large one by small values. For example, suppose we wish to vary a 2,000 ohm resistor by extremely small amounts. Let us connect a small rheostat, say one ohm, in series with a grid leak of one megohm and then connect this series across the 2,000 ohm resistance. The approximate value of the resistance combination is 1,996 ohms and the change that can be effected by means of the one ohm rheostat is only 3.99 millionths of an ohm. If you don't want to vary the resistance by such a small amount make the rheostat larger.

A small capacity can be varied in a similar manner. Connect a very large condenser in series with a small one and also connect a midget variable in shunt with the large one. An inductance can also be varied by the same principle. A small variable inductance is connected in series with a large one and then this series is connected in shunt with the one to be varied in small amounts. The connections of the coils are exactly the same as those of the resistors while the connections of the condensers differ.

* * *

Choice of IF for All-Wave Set

WHAT is the best intermediate frequency to select for an all-wave receiver that is to cover the broadcast band and all higher frequencies? Is it better to choose a frequency above the broadcast band or in it?—W.E.G.

There is no best frequency for any superheterodyne, but there are certain limitations. If the frequency of the intermediate tuner is in the band to be received there will be one region in the vicinity of the frequency selected where stations cannot be received without a lot of interference, and those frequencies very near the intermediate frequency cannot be received at all because of squealing. Hence, one limitation is that of the intermediate frequency should be lower than the lowest frequency to be received. That is, if the lowest frequency to be received is 550 kc. the intermediate frequency should be less than this, at least 50 kc. This means that a frequency of 500 kc. is all right. But on this frequency there is a great deal of ship traffic and there would be much interference. Hence, a frequency of about 480 kc. would be all right. A lower frequency also could be used. But there is another limitation. If the intermediate frequency be made low it will be difficult to receive extremely high signal frequencies because of interlocking of the tuned circuits. Perhaps a frequency of less than 250 kc. should not be used. If the lower limit of the receiver is to be 1,500 kc. an intermediate frequency of 1,400 kc. would be all right, provided that this frequency was free of broadcast interference at the locality of the receiver.

* * *

Receiving Long Wave Stations

I AM planning to build a superheterodyne such as that you described in the March 28th issue and I want to arrange it so that I can get the European stations in the 1,000-2,000 meter band as well as the American broadcast band. What changes are necessary in the circuit to make the adaptation? —W.R.T.

When the receiver is to tune from 2,000 meters down it is best to use plug-in coils for both the oscillator and the RF tuner. However, the intermediate frequency is nominally 175 kc. and the lowest frequency in the band to be covered by the tuner is 150 kc. Hence, it is necessary to lower the intermediate frequency below 150 kc. This, of course, can easily be done by connecting larger condenser across the windings of the intermediate frequency transformers.

* * *

Electric Clocks and Television

IF the 60-cycle frequency of an alternating current line is held closely enough to the frequency to make an electric clock keep accurate time will it be accurate enough to maintain a television receiver in synchronism with a television transmitter operated by another line the frequency of which is also held so as to make electric clocks keep time? If not, will you kindly state reasons?—T.C.B.

The two electric systems must be tied together if the two scanning discs are to run in synchronism. The electric clock test is not sufficient because the only requirement that the clocks keep time is that the average frequencies of two lines be exactly equal and equal to 60 cycles. There may be considerable variation in the frequencies from time to time just so they are high just as much as they are low. In television the frequencies must be exactly the same all the time, but they don't necessarily have to be exactly 60 cycles. Both may vary provided they vary the same way.

* * *

Loftin-White Amplifier

IS IT worth while to experiment with the Loftin-White type amplifier which you published last week? That is to say, is the quality of this circuit very much better than that of a transformer coupled amplifier so that it would pay to go to the trouble of building and adjusting it?—A.R.T.

Yes, it is worth while experimenting with it, but it would not be worth while to assemble it without the experimentation. It is necessary to effect the adjustment of the circuit experimentally and it will not work without the correct adjustment. Once adjusted it is capable of incomparably better quality than a transformer coupled circuit, and even better than a resistance coupled circuit. A circuit like this is practically necessary for television reception.

* * *

Excessive Screen Voltage

WHAT happens when the screen grid voltage in a resistance coupled amplifier is excessive? That is, what is the effect on the amplification of an excessive voltage on the screen?—S.W.S.

Distortion of the waveform. This effect is very great if the voltages on the tubes are not adjusted correctly. It is safe to arrange the circuit so that the screen current never exceeds one-third the value of the plate current. The simplest way to guard against excessive screen voltage is to put a high resistance in the lead to the screen and to connect the positive end to the same voltage as it would have if there were no plate load resistance. For example, if the plate circuit voltage is 180 volts the screen voltage should be 75 volts for a 224, provided there is no load resistance in the plate circuit. If there is a 250,000 ohm resistance in the plate circuit a similar resistance could be put in the screen circuit, or a resistance of somewhat lower value. As the plate current changes, and hence the effective plate voltage, the screen voltage also changes in the same direction. It is customary to specify 100,000 ohms in the screen circuit to prevent the screen voltage from becoming excessive.

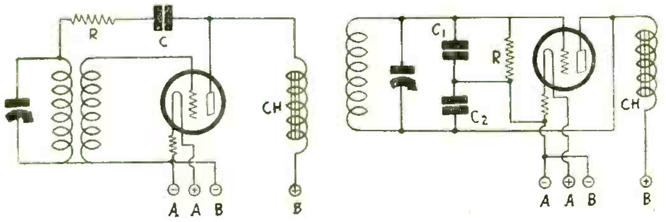


Fig. 915

At left is the circuit of an oscillator used when good wave form and high frequency stability are required. At right is the well-known Colpitts oscillator

* * *

Calibrated Oscillator

I INTEND to build a calibrated oscillator to be used for testing sets. Will you kindly publish a circuit diagram of one which will have good frequency stability as well as good wave form?—S.E.R.

There are two oscillators in Fig. 915. The one at the left is known for its high frequency stability and for its purity of wave form. It is suitable for both radio and audio frequencies provided that the components are chosen for the frequency range. For radio frequencies Ch should be a 50 millihenry choke and C should be a condenser of about .01 mfd. The tuning coil and condenser are of the same type as those used in broadcasting. The resistance R controls the feed back. The larger it is the greater the frequency stability and the purer the wave, but the less the output. It must not be chosen so large that the circuit will not oscillate all over the tuning range of the condenser.

* * *

Learning Code

WHAT do you advise as the best method for learning the radio code?—Z. G.

Now short-wave receiving is stirring up considerable interest in code practice! Here are some suggestions—join the code class of your local radio club or Y. M. C. A. or school; buy a code practice set, buzzer, key and battery, to learn the characters; get a phonograph record for code beginners and you can regulate the speed on your phonograph; rent a code learning outfit which sends mechanically.

A THOUGHT FOR THE WEEK

COLONEL Robert R. McCormick, publisher of the Chicago "Tribune," told the members of the American Society of Newspaper Editors, in session at Washington, that daily newspapers will have to look to their laurels if they are to compete successfully with radio and other forces of modern news gathering and presentation. Colonel McCormick is a war horse in newspaper experience and this advice, coming from him, points a moral. Radio has done many big things for modern civilization and if it acts as an incentive to publishers to turn out better daily papers—well, add one more to the score.

RADIO WORLD

Title Reg. U. S. Pat. Off.

The First and Only National Radio Weekly
Tenth Year

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

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

The Status of Television

THERE is a new flurry of interest in television, due to the operation of new transmitters and the expansion of existing ones, even to include sound synchronization.

Publication of the news of these endeavors impels many to inquire about television who otherwise would not give the matter a thought· The inquirers have never seen any demonstration of television, they are not aware that television is not receivable on broadcast sets at present, but the questions prove clearly the mental stimulus that precedes the creation of new markets. There is something even more fascinating in the prospect of seeing by radio than there was in the prospect of hearing by radio, while the combination of both sight and sound is distressingly alluring.

A fair report of the status of television must relate that while experimental receivers as developed by the important laboratories at enormous cost provide good results, crudeness marks the pictures that the public can see, using installations of mild commercial practicability now available. It is not contended by the manufacturers that anything approaching perfection is thus obtainable, but those interested in travelling with television from its practical infancy may get a kick out of the exhibitions.

The size of the frame or picture is small, contemptuously referred to as postage stamp size by more ambitious adventurers, but being likened to the size of a visiting card by more patronly critics. The illumination is of an orange hue, the familiar neon glow to those who read the signs of the times or have the tiny neon night lamps in the home. Smallness, a poor condition for contrast, and the awkward necessity of using motor-driven circular discs, and even changing discs because of different systems used by stations, and reliable reception over only a small area are some of the untoward considerations. Yet these should be viewed optimistically, as revealing progress, since there are more television stations on the air than ever, and that growth is the best assurance that the pace is quickening and that some time, no one knows when, commercially practical television will come along.

Stations are departing from their diversity of methods, and soon one may expect to find all the television stations using the same system. Recent changes to the system of 60 lines per frame, 20 frames per second, denote the trend to standardization. This is one of the most tangible encouragements, since if one disc is regarded as a nuisance, the necessity for several discs would appear to some as almost a calamity.

There is a great desire to get away entirely from the disc. It is large, ugly, cumbersome. The suggested solution is a special tube, of a type applied differently to other radio uses, and known as cathode ray oscillograph. The picture would appear on the plate of this tube, and could be enlarged and projected. At present absence of sufficient illumination and detail is a limitation to the enjoyment of projected pictures. Peep-hole observation of a 1½-inch square is about the average, with frequent lapses into indistinguishability.

Transmission from the station is determined by a scanning process, or method of dissecting the picture into shaded streaks, at a definite pace. To obtain any results it is necessary to match this pace at the receiving end. If both transmitter and receiver are on the same power line, synchronous motors will solve the problem. Otherwise speed control of the motor is necessary. Manual control is considered irksome. A signal can be radiated with the picture transmission, and the scanning device can be set so as to synchronize with this signal.

So we may look forward to scanning by a tube, perhaps even with white light, and confidently expect that projected pictures will be enjoyed from standardized transmitters, with sound accompaniment, to constitute radio movies. Full-length views of persons, with good definition, followed later—much later—by pickup of scenes for reproduction in their original activity, right in the home, are all reasonable expectations.

Meanwhile it behooves us not to be dissatisfied with progress already made, but delighted with the new interest that provides the mental and psychological prodding to laboratories, and to do a little investigating ourselves. Demonstrations are given. Some stores actually show television as it is today, on practical demonstration, while manufacturers get the assistance of customers, with the camaraderie that marks the radio amateur, to enable persons living near these customers to go to their homes for demonstrations.

See the thing at work and you will be able to judge the status of television for yourself. Perhaps then you would like to participate in its juvenile activities, not expecting any better results than those demonstrated.

Overdone Advertising

MANY remarks are passed about the increasing amount of advertising talk given in sponsored programs. The advertising agencies that are responsible for the scripts claim justification, and frankly state that broadcasting is a business proposition to their clients, and there must be a return for the money expended. This return, they believe, is enhanced by a generous supply of exultation about the products. Actual and prompt production of sales by sponsored broadcasts is desired, so merely goodwill advertising, as mention of the sponsor's name and product now and again, is deemed insufficient.

Another point raised is that under present economic conditions greater sales effort is necessary to keep up the volume of business, even though the greater turnover is more expensive, and the percentage of profit less. "Laying it on thick" helps business, they say, and is at least pardonable in view of lagging times.

If sponsored programs were to disappear, the broadcasting structure as now constituted would disappear, because of lack of an economic foundation. Nearly all persons who listen in have not the slightest idea of the enormity of the expense involved in broadcasting, either by the station or the sponsor of advertising programs. To sit delightedly in an easy chair and listen to the world's best voices and musicians, without directly paying any money for this, except defraying the cost of a set and its upkeep, is nevertheless purchased entertainment. It is paid for not directly in money, but directly in a certain amount of discomfort at overdone blurbs, and indirectly by buying products boosted on the air. An economist might figure out that you get your money's worth in buying the product, so all you are out, really, is the slight disturbance of equanimity caused by overzealous advertising.

There is, however, little that the American listening public would object to more than a tax on their receiving sets, and rather than endure that burden, which European listeners find acceptable, the Americans would sit through a great deal more of boosting.

The offense, if such it be, of saying too much about a product, or over-stating its virtues, although in succinct phrases, is not universal. Some sponsors are content, as the Stromberg-Carlson Company, with brief and occasional mention, not lacking in strength, however. Others, like Lucky Strike, and a recent more glaring imposition, the Gold Medal Company's exploitation of Wheaties, cast off restraint with almost a wild abandon. Lucky Strike has the saving factor of one of the steppiest dance orchestras on the air, but Gold Medal not only promises great celebrities of stage, screen and vaudeville, but brings on uncelebrated acts that repeatedly sing songs about the products.

In lieu of a tax, and in view of the times, it is just as well not to write letters to the stations or the sponsors or to the Federal Radio Commission, complaining about excessive time devoted to and exaggerated claims made on behalf of products the broadcasting is intended to sell. Nearly all of these energetic boosters put on a really good program, spend sometimes thousands of dollars a minute for their place in the sun, and if this turns the wheels of factories when it is vital that as many as possible be put to work or kept at work, action on our anguish may be reserved for a better day.

Let's declare a moratorium on the apologies the offenders owe us listeners. No moratorium ever being final, this means only that the day of reckoning is delayed, but not deleted.

NEW PROJECTOR GIVES PICTURE OF 2X2 FEET

Following rapidly in the footsteps of the motion picture art, the television technique is declared by the DeForest Radio Company ready to step out of the peep-hole stage. The latest developments make possible the projecting of a television picture on a screen for the entertainment of small theatre audiences, compared with one to six persons heretofore served by the usual televisor for home use.

The projector type televisor developed by the company's engineering staff in collaboration with the Jenkins Television Corporation, both of Passaic, N. J., comprises a special form of neon crater lamp in combination with a lens scanning disc.

Focusing Lamp

The lamp is arranged for ready adjustment so as properly to focus the extremely small source of light with relation to the lenses of the scanning disc.

The lenses serve to project individual spots of light on a screen, one following another, in forming the horizontal lines with which the incoming pictures are woven. The lens disc is driven by a large synchronous motor which keeps in step with the television transmitter when employed on a common AC system. The entire assembly is carried on an adjustable tripod on rubber tired wheels.

Pictures Called Pleasing

It is possible to project pictures measuring 2x2 feet with the television projector. The pictures are most pleasing, says the company, since the lens scanning disc provides sufficient diffusion to fade adjacent lines into each other, thereby getting away from the angular effects of the usual scanning system. Ample illumination is said to be provided for good pictures in a darkened room.

Announcer and Bride Back from Honeymoon

Mr. and Mrs. Edward K. Jewett, members of the National Broadcasting Company staff, who were married recently in New York City, returned to the studios after a brief honeymoon. Jewett is an announcer and Mrs. Jewett, the former Miss Grace Fisher, is a staff violinist. Frank Singiser, also an announcer, was best man.

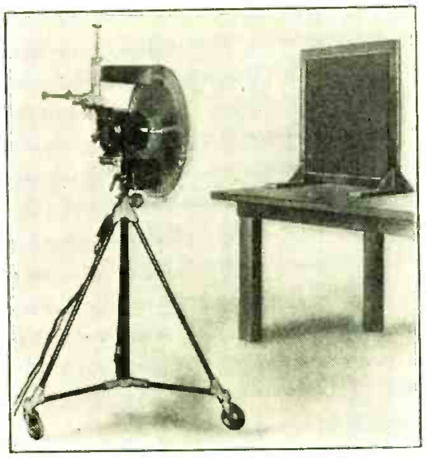
The couple met in the studio nearly a year ago when Jewett was assigned to announce several programs on which Miss Fisher was playing. Mr. and Mrs. Jewett will make their home in New York City and they will continue their work with the NBC.

* * *

Kenneth Niles, master of ceremonies on HKJ's Hallelujah Hour, was married to Naja Vladanova, Russian violinist, recently. Several months ago Eliva Allman of KHJ, Los Angeles, married Wesley Tourtellotte, the organist. Nadja and Wesley are heard together over KNX. Ken and Elvia work together for KHJ.

Five fly swatters, mounted on the ends of long sticks and rotated by an electric motor, makes a very satisfactory wind for a radio broadcast. Wintry blasts for the Empire Builders programs are produced in this manner.

A NEW SCANNER



Lenses are used for magnification in a new scanning disc for television projection on a small screen

TELEVISION SET IN PRODUCTION

The Short Wave and Television Corporation, Boston, Mass., produced 1,000 short-wave Baird television receiving sets for retail distribution within the radius of the twenty operating experimental television stations.

In addition to the completed short-wave television set, listing at $210, there is required a kit listing at $116.25.

The corporation was established with an authorized capitalization of $1,000,000. It took over the Short Wave and Television Laboratories Corporation for the purpose of entering the commercial field with Baird short-wave radio sets and Baird short-wave television sets.

Officers and directors of the company are: A. M. Morgan, Boston realtor, president; Butler Perry, of Boston, treasurer; Hollis S. Baird (not to be confused with the British Baird), inventor, director in charge of development; Douglas Rigney, formerly vice-president and treasurer of A. H. Grebe Radio Co., director, chairman of the executive committee; Frederick de Witt Shelton, director and Washington representative; Stewart Caton, sales manager; William Dubilier, technical adviser; Alexander Nyman, formerly assistant to the chief engineer of the Westinghouse Electric and Manufacturing Co., consulting engineer.

The corporation operates the television station W1XAU in Boston. Daily programs are presented each afternoon and evening.

SOUND EXPERT AT CIRCUS

Ray Kelly, sound effects expert, was found hovering about the animal cages of the circus at Madison Square Garden. Kelly was comparing the sound of real animals to his imitation roars, squeals, barks and calls. He said the comparisons were gratifying.

After five years at 78 Cortlandt Street, New York City, the Insuline Corp. of America moved to 23 Park Place. S. J. Spector, president, said: "We have a total floor space of 24,000 square feet, as compared with 12,000 in the former quarters."

VACUUM TUBE ORGAN ON AIR

A pipeless organ compressed into a box about the size of an orange crate, capable of the full volume of organs heard in cinema cathedrals, was heard recently from WGY, Schenectady, N. Y. It is a vacuum tube instrument developed in the laboratories of the General Electric Company, not as an organ substitute or in an attempt to find a new musical instrument, but solely to demonstrate the versatility of the newest member of the vacuum tube family, the Thyraton.

For a few minutes Betty Lee Taylor, organist of the Proctor R-K-O Theatre in Schenectady, demonstrated to the theatre audience the capabilities of the vecuum tube organ, and listeners tuned to WGY heard the program.

In the organ are eight Thyraton tubes which are made to produce eight different alternating current frequencies, related to each other as are the notes in the octave of the major scale in music. While only eight notes are used in the organ, the half-notes could be included as well as added octaves by incorporating an additional tube circuit for each additional note.

A toy piano, about the size of a two-pound box of candy, is provided as a keyboard. The organist in the theatre demonstration carried the keyboard about the audience, permitting patrons to play the instrument.

The output of the Thyraton tubes is connected to a loudspeaker. The sound is instantaneous with the depression of the keys.

Dual Purpose Sets Installed on 'Planes

Passengers in the Goodyear fleet of six non-rigid airships this summer will enjoy radio music as they fly, by just tuning in on their favorite station with the new receiving sets which have been installed in the ships.

By simply pushing a button, the pilot of the airship can tune his set in on the high wave length stations of the Department of Commerce, which are broadcasting weather reports every fifteen minutes for the benefit of aircraft everywhere.

In commercial operations in which the ships are engaged this will be a decided benefit because it will enable the pilot to travel around storm areas in making his commercial operations engagements away from the airship dock or base.

Tube Prices Reduced On Twelve Types

Tube companies recently reduced list prices on a dozen different types. The old and new prices follow:

Type	*Old Price*	*New Price*	*Reduction*
210	$9.00	$7.00	$2.00
224	3.30	2.00	1.30
227	2.20	1.25	.95
230	2.20	1.60	.60
231	2.20	1.60	.60
232	3.30	2.30	1.00
235	3.50	2.20	1.30
245	2.00	1.40	.60
247	3.00	1.90	1.10
250	11.00	6.00	5.00
280	1.90	1.40	.50
281	7.25	5.00	2.25

WOR FINDS DISC PROGRAMS SUIT WIDE PURPOSES

Differences of time in the United States are inimical to trans-continental broadcasting, and have been one of the main reasons for the development of the electrical transcription type of programs as well as for the success that form of broadcast has achieved in the comparatively few short months of its existence, says a statement issued by WOR, Newark, N. J.

"Obviously, it would be foolish to attempt to entertain children at 6 p. m. Eastern Standard Time, when they were in school in San Francisco," the statement continues. "It would be equally silly to attempt to broadcast a slumber hour program at 11:30 p. m., Pacific time, for the benefit of easterners who had long since gone to bed.

"The broadcasting period from 9 p. m. to 12 midnight, Eastern Standard Time, is the most effective broadcasting time in trans-continental broadcasting. These are known as preferential hours and they are at a premium since, theoretically at least, the whole population can be reached. For that reason there is room for another nation-wide chain and it explains why those now operating are so successful.

Double Broadcast Avoided

"One solution hit upon by a coterie of stations is the double broadcast. One of them goes on at 7 p.m., E.S.T., and another at 10, E.S.T., which is 7 p.m. Pacific Time.

"Electrical transcriptions eliminate the necessity of the double broadcast and have the additional advantage, the sound recorders argue, of eliminating the necessity of telephone lines, a big economic factor.

"The writer has done considerble investigating concerning the alleged public resistance to electrical transcriptions only to learn that it existed only in circles that had their own economic axes to grind. What the public demands is an entertaining program—a program that will sustain interest. How listeners get it is not even a secondary thought.

Precautions for Best Results

"Technically, the apparatus used in the modern sound recording studio is on a high plane. Cognizance of broadcasting studio practices has been taken by their executives. One sees that precautions have been taken to eliminate echoes or the ricocheting of sound from the walls which has an effect much like that caused when a person moves when a picture is being taken. Control boards are much the same as those used in major stations. So are the microphones and amplifiers.

"The result is that only those thoroughly familiar with recording can identify a transcription from a personal broadcast. And often they fail. Mechanically, there is no difference, because the same devices are used. Artists go through the same procedure in both cases. The disc, however, has one big advantage: It can be used again and again.

"Whether the disc will remain the ultimate form of capturing sound waves is a question that will be answered by future developments. It is known that the Western Electric engineers have been experimenting with film sound tracks for use in radio stations. But it has its problems, too."

Reflected Sound Track Invented

One of the novelties along the line of photographically recorded programs is the basis of the so-called Marlo patent, a development of Raoul Marlo, now script editor of WOR, Newark, N. J. Instead of film, he uses opaque paper which reflects the sound track rather than doing it with light shining through a transparent film.

The advantage claimed for the Marlo idea is that there would be no breaks in the continuity of the program, due to record changing, whether the program be of five minutes duration or an hour. He has solved the problem of putting a multiplicity of sound tracks on the paper. It has the additional advantage of being fireproof and does not have the element of destructibility associated with discs.

Another laboratory is endeavoring to record light variations on discs with the hope that when television arrives it will be possible to impress images as well as sound on them and to handle them in the identical way that electrical transcraptions are being distributed now.

Red Star at KDKA Warning to Aviators

The star of KDKA's new broadcasting station, located about 30 miles north of Pittsburgh, Pa., is an airplane danger sign perched on top of a 100 foot antenna pole.

Since KDKA is located within a few miles of two large landing fields—the Pittsburgh-Butler Airport and Rodgers Field—the Westinghouse Electric and Manufacturing Company have mounted this obstruction marker at the highest point in a barrage of antenna poles to warn low-flying aircraft.

The marker's distinctive ball of red light about three feet in diameter can be seen five miles on a clear night or three miles on a foggy night. It resembles a spread umbrella with six U-shaped neon tubes sloping downward from the center. The umbrella covering, made of metal, protects it from the weather.

If for any reason, one or more tubes should go out for a period of seven seconds, the use of an entirely new of electrical cut-out keeps the remaining tubes lighted.

Amateurs to Convene In New York City

The sixth annual convention and banquet of the Hudson Division, American Radio Relay League, will be held at the Hotel Pennsylvania, May 8th and 9th.

It is expected that Commander Byrd or other member of his expedition will be on hand to discuss with the radio amateur the difficult conditions which were encountered at Little America. A member of the technical staff from League headquarters at Hartford, Connecticut, will also be present to discuss the most recent improvements in the art of high frequency transmission.

New Corporations

Sole Radio Company—Atty. M. Miller, 11 Park Place, New York, N. Y.

C. H. Hyman Co., radio apparatus—Atty. A. D. Schneider, 63 Park Row, New York, N. Y.

Artsco Employes' Association, radio supplies—Atty. I. Goldenberg, 26 Court St., Brooklyn, N. Y.

Brown Electric Co., Wilmington, Del., radio equipment—Corp. Trust Co.

Multiplex Radio Service—Atty. S. V. Ryan, Albany, N. Y.

Lido Music Shop, radio supplies—Atty. M. Schrier, 51 Chambers St., New York, N. Y.

Republic Radio Tube, Inc., Newark, N. J., manufacture radio equipment—Atty. Nicholas Lavecchia, Newark, N. J.

They Say

WILLIAM D. TERRELL, Director, Radio Division, Department of Commerce: "Like most successful business establishments, the Federal Government, to handle its business efficiently and successfully, must be a good bookkeeper. It is quite likely that the average radio fan, even when not listening to Amos 'n' Andy or Rudy Vallee, gives no thought to the records the Government maintains so that they may hear this entertainment as far as the present stage of the art will permit without cross-talk and other man-made interference. To this end, the Radio Division of the Department of Commerce compiles statistics of the work carried on in its service. A thorough record of the work performed throughout the country is kept, showing the amount of measurements, examination of radio operators, investigations and kindred activities the Division accomplished."

Americans Meet for Madrid Plans

Washington

At the 1932 international conference on wireless telegraphy in Madrid, representatives of all leading countries will consider changes in the Washington conference agreement of 1927. The problems calling for attention at present include redistribution of radio wavelengths, the feasibility of widening the broadcast band, and all uses of radio telephony, telegraphy and television.

Officers of the American section are Wallace White, United States Senator from Maine, president; John W. Guider, vice-president; Paul M. Segal, secretary; Howard S. Leroy, treasurer. The executive council consists of Louis G. Caldwell, chairman; A. L. Ashby, general attorney of the National Broadcasting Co.; Thad H. Brown, general counsel of the Federal Radio Commission; J. H. Dellinger, chief of the Bureau of Standards, and William R. Vallence, of the State Department.

The section held a meeting here recently.

Shake-up in Pilot Engineering Staff

A complete reorganization of the engineering department of the Pilot Radio & Tube Corporation, of Lawrence, Mass., was announced by Charles Gilbert, vice-president and manager of plant operations.

Wayne W. Cowan, formerly in charge of the set department, is now chief engineer, replacing John Geloso, resigned. Mr. Cowan previously was connected with the Edison, Splitdorf and Kolster companies.

Kenneth Harkness, well known for the circuits bearing his name, is supervising receiver design, with the assistance of J. Leonard Montgomery, formerly with General Electric at Schenectady.

Extra Post for McDonough

At a meeting of the Board of Directors of the RCA Victor Company, Inc., J. R. McDonough was elected executive vice president. In addition to his work in his new capacity, Mr. McDonough will continue his duties as assistant to David Sarnoff, president of the Radio Corporation of America.

Quick-Action Classified Advertisements

7c a Word — $1.00 Minimum
Cash With Order

TRANSFORMERS—ABC 224, 227, 245, 280 tubes, $2.25. 1½, 2½, 5 volt; 2½ volt, 7¼ amp.; 7½ volt, 3 amp., 99c each; shielded $1.45. Shielded 2½ volt. 11 amp., $1.60. All center-tapped. Shielded 00035 coils, seven grid or three element, 65c; 4 coils, $2.25. Shielded 175 k.c. INF transformers. Send postage. L. Waterman, 2140 Kirby West, Detroit, Michigan.

PRINTING: 1000 BUSINESS CARDS $2.75 POSTPAID. Other printing reasonable. Samples free. Miller, (RW), Printer, Narberth, Pa.

ATWATER-KENT HORN UNIT, $1.95. For use in home or portable, 108-inch tipped cord; 1½ lbs. weight; size 3-inch height; 1-inch diameter. Guaranty Radio Goods Co., 143 West 45th St., N. Y. C.

"FORD MODEL 'A' CAR AND 'AA' TRUCK," by Victor W. Page, M.E. Revised and Enlarged Edition. $2.50. Radio World, 145 W. 45th St., N. Y. City.

"RADIO FREQUENCY MEASUREMENTS," by E. B. Moullin, M.A., A.M.I.E.E., M.I.Rad.Eng. A New and Revised Edition, 289 Illustrations, 487 and 12 Pages—Index. $12.50. Radio World, 145 W. 45th St., N. Y. City.

"A B C OF TELEVISION" by Yates—A comprehensive book on the subject that is attracting attention of radioists and scientists all over the world. $3.00, postpaid. Radio World, 145 West 45th St., N. Y. City.

"HANDBOOK OF REFRIGERATING ENGINEERING," by Woolrich—Of great use to everybody dealing in refrigerators. $4. Book Dept., Radio World, 145 W. 45th St., N. Y. City.

U. S. BROADCASTING STATIONS BY FREQUENCY.—The April 11th issue contained a complete and carefully corrected list of all the broadcasting stations in the United States. This list was complete as to all details, including frequency, call, owner, location, power and time sharers. No such list was ever published more completely. It occupied nine full pages. Two extra pages in the April 11th issue were devoted to a conversion table, frequency to meters, or meters to frequency, 10 to 30,000, entirely reversible. 15c a copy. RADIO WORLD, 145 West 45th Stret, New York, N. Y.

RADIO WORLD AND RADIO NEWS. Both for one year, $7.00. Radio World, 145 W. 45th St., N. Y. City.

SOUND PICTURES TROUBLE SHOOTER'S MANUAL, by Cameron and Rider, an authority on this new science and art. Price $7.50. Book Dept., Radio World, 145 W. 45th St., N. Y. City.

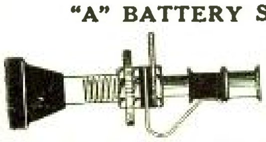
SHORT-WAVE NUMBERS OF RADIO WORLD. Copies of Radio World from Nov. 8, 1930 to Jan. 3, 1931, covering the various short-wave angles, sent on receipt of $1.00. Radio World, 145 W. 45th St., N. Y. City.

NEW VARIABLE MU TUBE

To remedy cross-modulation and cross-talk, without circuit changes, a new AC screen grid tube has been developed, the G-51. In AC circuits where the volume control varies the grid bias or the screen voltage, or in which there is an automatic volume control, the new tube works wonders. This is the sensational tube developed by Stuart Ballantine. Price, $3.80.

RELIABLE RADIO CO.
143 WEST 45th St., N. Y. City

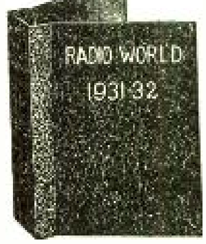
"A" BATTERY SWITCH



A push-pull switch for battery-operated sets. Made by Benjamin. Firm, sure contact, extremely long life. Price, 25c.

GUARANTY RADIO GOODS CO.
143 West 45th St., New York, N. Y.

FREE



ALPHABETICAL INDEX of Radio World articles which appeared in issues from March 29, 1930 to March 21, 1931 given away free with every purchase of a binder. Binder is made of fine brown Spanish fabricoid and will hold 52 issues of the magazine. Radio World and year 1931-32 stamped in gold on front cover. A free subscription to next year's alphabetical index March 1931 to March 1932 may be had instead, with every purchase of a 1931-32 binder. Alphabetical index contains index word, title as it appeared in Radio World, author, date and page.

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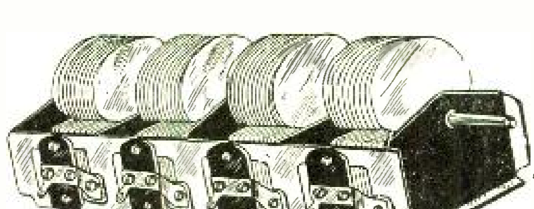

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Image inerference is discussed in detail and methods given by which it may be reduced.

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One section is given over to coil design fo the radio frequency tuners, the oscillator, and the intermediate frequency filter.

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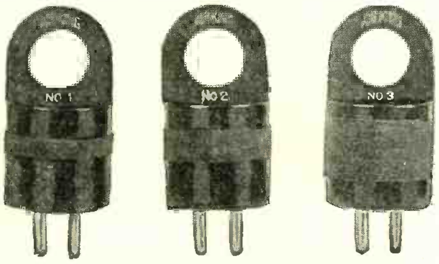

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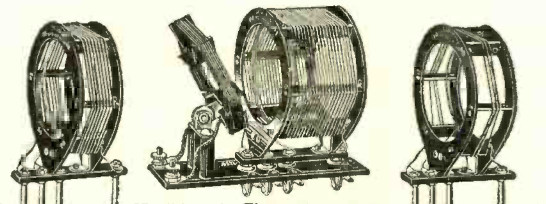

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