SHORT-WAVE RECEIVERS

June 13 1925 15 Cents

RADIO WORLD

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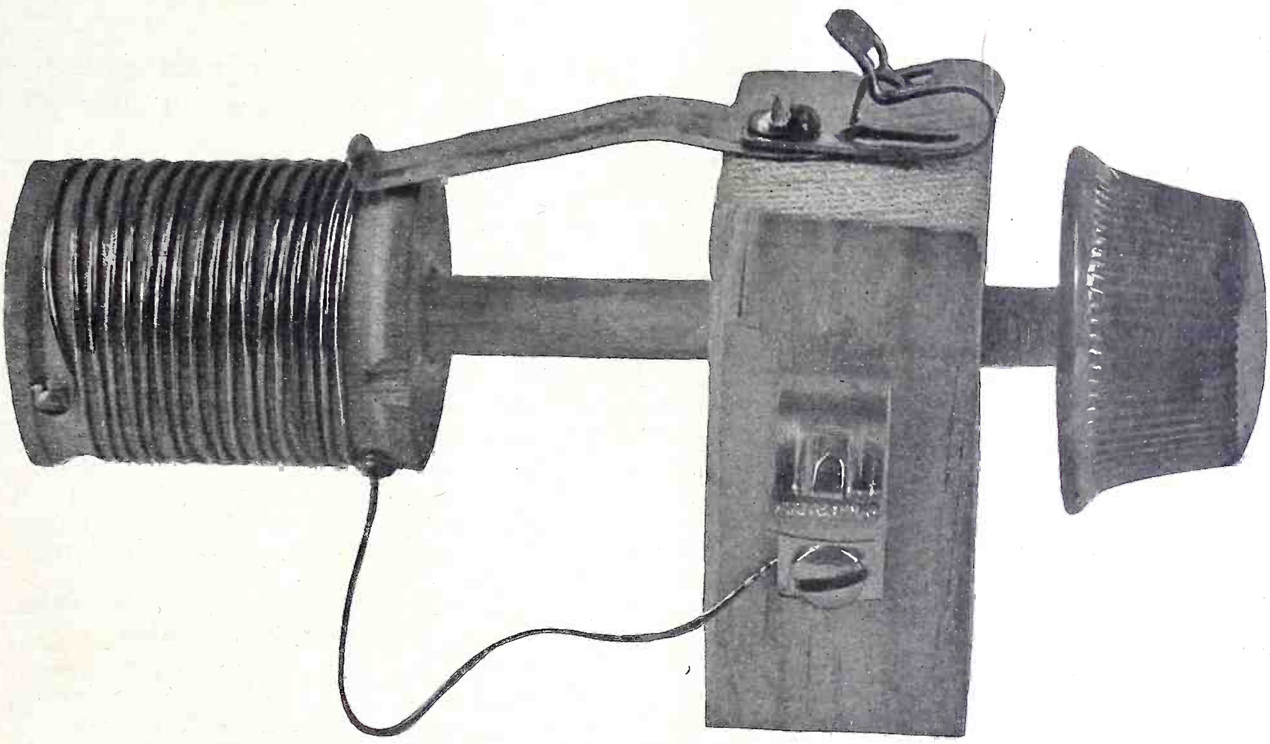
155-168

A LOW-LOSS NEUTRODYNE

USING AC FOR LIGHTING TUBES AND FOR PLATE

HOW TO MAKE A PUSH-PULL RHEOSTAT



A PUSH-PULL RHEOSTAT (Fig. 7) such as can be made at home quite easily. See page 5. (Hayden Photo)

VARIOUS USES FOR A WAVE METER

ANALYSIS OF A STORAGE BATTERY

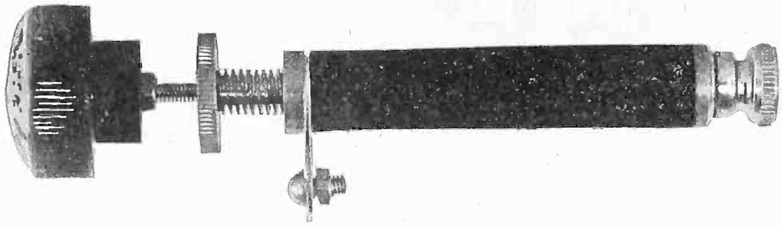
MATCHING 3 COILS FOR "DIAMOND"

NOW you can get it for the first time in America

Used in eighty per cent of all receiving sets in Great Britain

The "BRETWOOD"

Pulls in inaudible stations



Eliminates tube noises

Range 300,000 to 10,000,000 ohms

Variable Grid Leak

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The Bretwood Variable Grid Leak used in a detector tube circuit, strengthens weak signals, makes DX easier, eliminates tube noises and internal howling, due to incorrect leakage from the grid of the tube.

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VOLUME SEVEN OF

RADIO WORLD

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Simple Short-Wave Circuits

By Herbert E. Hayden

Photographs by the Author

THE standard forms of the 3-circuit tuner are serviceable for short-wave work. Either the inductive tickler may be used or the tuned plate. (Figs. 1 and 2). In fact, variable condensers utilized in regular reception for the broadcast band may be pressed into service, including even the .0005 mfd. variable. The general utility of your present apparatus, excepting the coils, puts short-wave experimenting within every fan's ready reach. A smaller capacity condenser is to be preferred, because tuning is made easier. But in any event there must be vernier control of any tuning or feedback device. The extra end-plate vernier arrangement must not be used, but only some kind of vernier that affords a higher ratio for turning the entire variable factor.

HERBERT E. HAYDEN

Granting that a .0005 mfd. variable condenser is to be used for tuning in Fig. 1, wind the coils with No. 22 double cotton covered wire, 5 turns constituting L1, 14 turns L2 and 14 turns L3. The tubing diameter for L1L2, the stator form, is 3" and that for the tickler is 2". Finer wire may be used on the tickler, in which case fewer turns would be required there, say 10 turns of No. 26 single silk covered.

If an existing 3-circuit coupler is to be converted into use for short waves, the form diameters must be taken as they are and turns put on accordingly. As the forms will be 3", 3½" or 4" diameter, there are only two inductance differences. For 3½" use two turns less, for 4" three turns less than those prescribed. The tickler to match the larger size for stators will be 2¾" diameter in most cases, and the turns would be two less than those previously given.

For the conversion of an existing coupler, remove all the wire now on it. This is done by unscrewing the nuts on the binding posts to which the wire terminals are connected. See Fig. 3 in the pictorial layout on page 4 (next page). In Fig. 4 the tickler form is shown free of wire and the secondary winding has been allowed to spring off, prior to total removal.

Get some pigtail wire, as that will make an efficient primary. Lacking that you may use the same kind of wire as will be employed on the secondary, i.e., No. 22 double cotton covered. Pigtail wire makes a pretty job, but as it may not be of the insulated kind, spaced winding will be resorted to, grocer's cord being wound between turns, with the same motion with which the actual wire is applied. Fig. 6 shows the cord about to be put in place after one of the primary coil terminals is anchored. Four turns of this wire will suffice for the primary, but if the double cotton covered wire is to be used five turns will be better. The binding posts are restored, so that the primary's beginning and end are connected thereto.

The secondary consists of 14 turns and is anchored in the same fashion.

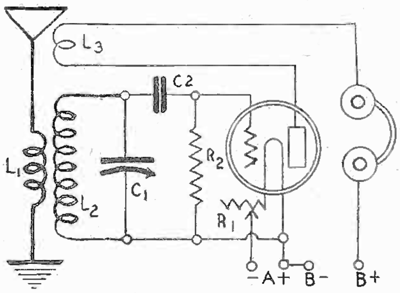
I used the pigtail wire for the tickler, also. (See Fig. 7.) It was space-wound with black cord, hence the spacing is not so clear to view. The total number of turns on the tickler (a 1¾" diameter) was 11, there being 6 on one side of the shaft hole, 5 on the other. The coil in a set, with a .0005 mfd. condenser, is shown in Fig. 9, while Fig. 8 portrays the final fastening of the tickler setscrew to keep the tickler in alignment (avoiding lateral play) while this form is rotated in actual operation.

The completed coil is shown in Fig. 10.

The coil described is for use in constructing the circuit shown in Fig. 1. One stage of audio may be added, if greater earphone volume is required, but it is not necessary. The constants of the other parts are: C2, a fixed grid condenser, .00025 mfd.; R1, a rheostat to match the tube used; R2 a grid leak which, if fixed, should be about 2 megohms, although a variable leak will come in handy here; B battery voltage, usually 45.

In Fig. 2 the circuit is fundamentally the same, but instead of the rotary tickler

(*Continued on page 28*)



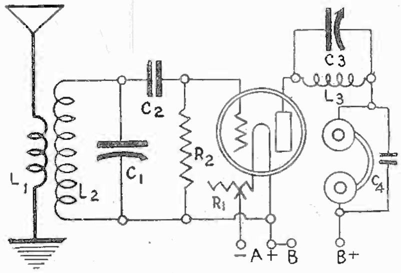
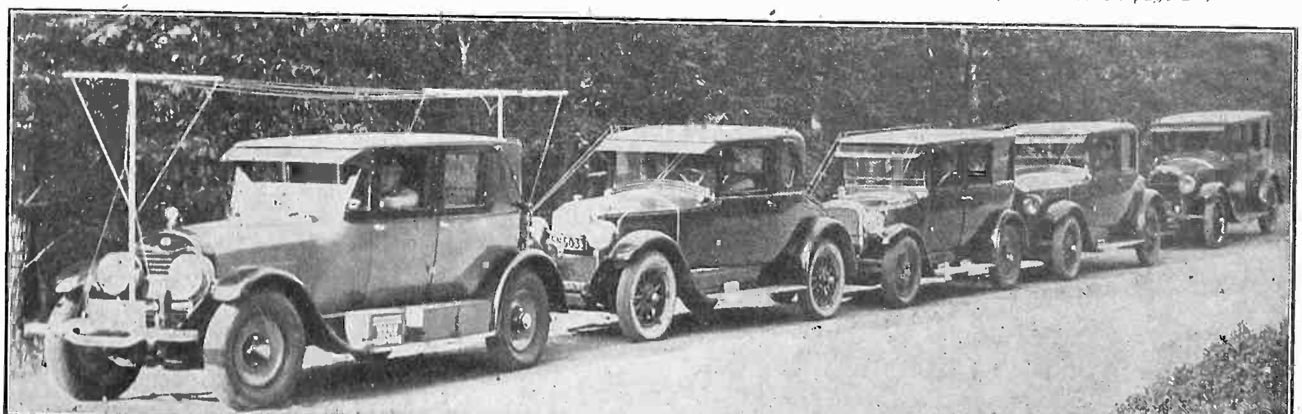
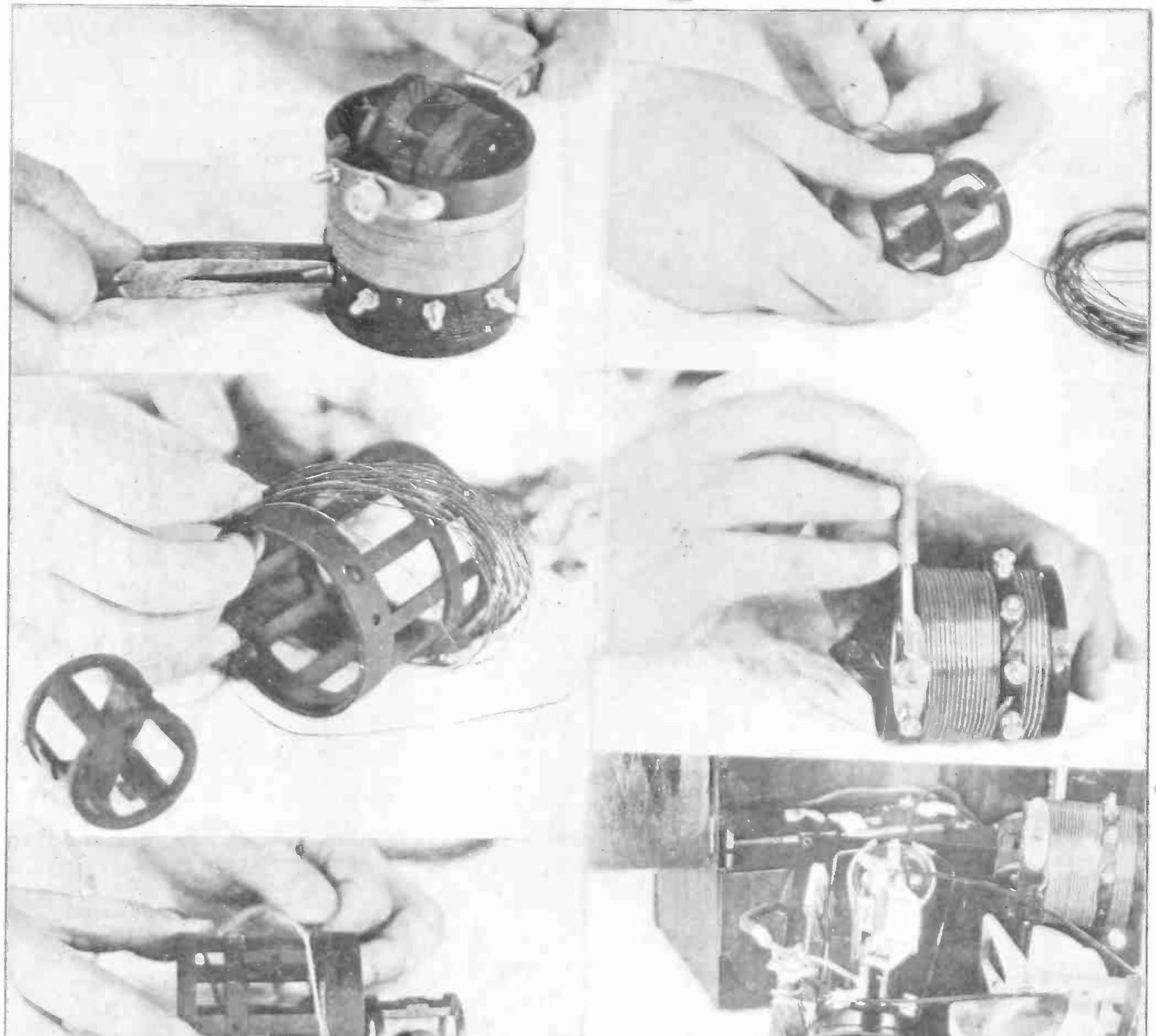


FIG. 1, top, the inductive tickler regenerative set, known as the 3-circuit tuner, employing aperiodic primary. This hookup works well on short-wave work, as does the other, Fig. 2, which embodies a fixed coil in the plate circuit. This plate coil, L3, is tuned by a variable condenser to obtain regeneration through the internal capacity of the tube.



AUTOMOBILES now travel in fleets, each car equipped with a short-wave transmitter and operating in conjunction with WAHG and WBOQ, Richmond Hill, N. Y. The transmitters operating on a wavelength of 20 meters are mounted on these cars, which visit sports meets. The transmission on the low wave is picked up on a standard type receiver. Instead of plugging into the loud speaker, the microphone receives the audible signal for rebroadcasting on 316 or 236 meters. The auto at left is a transmitter, the others quality testers. (International Newsreel)

Coil for High-Frequency Work



FIGS 3, 4, 5 and 6, at left, top to bottom. At right, same order, Figs. 7, 8, 9 and 10. See page 3.

A Simple Push-Pull Rheostat

By A. C. G. Force

EVERY radio fan finds himself piled up from time to time with all sorts of broken parts of apparatus, such as switches, condensers, sockets and rheostats. As many experiments are performed on the breadboard a rheostat may be made quickly and easily. There is no mystery about a rheostat.

All metals conduct electricity. Some do it a great deal better than others. Silver, for instance, is a good conductor and in fact is the standard, outclassing other metals for conductivity, but aside from its great cost it would not be practicable for a rheostat as great lengths would be required to get enough for a resistance regulator as is shown in the following table:

Metal	Specific Resistance in Microhms	Specific Conductivity
Silver	1.609	100.
Copper	1.642	96.
Gold	2.154	74.
Iron (soft)..	9.827	16.
Lead	19.847	8.
Germ. silver.	21.470	7.5
Mer'y (liq.).	96,146	1.6

The heart of the little rheostat is the resistance wire and the finger contact that moves over the spaced turns of the rheostat thereby making contact with them one at a time, and consequently adding or subtracting resistance to the A battery circuit.

Remove the resistance wire from the curved form of the old rheostat and straighten out carefully with a pair of pliers (Fig. 1). Next grasp both ends of the wire firmly and draw it back and forth around an iron pipe or some other fixed support. This will take the kinks out and make it easy to handle. Next get an ordinary spool and after fastening one end of the resistance wire to the edge of the spool with a No. 0 wood screw, wind the wire around the spool, carefully spacing the turns about 1/64" and don't let go of the wire. (Fig. 2).

When you get to the end, fasten under the edge of a second screw and leave about 3" for connection.

A close up of the completed winding appears in Fig. 3. This is glued to a ¼" dowel stick as shown also in Fig. 3. This can be done before the winding is started or afterward.

Next secure a little block of wood 1" thick by 2x2". Drill a ¼" hole through this (Fig. 4). Now take an old switch arm and bend it back a little as shown in Fig. 5. This is then mounted on the little block of wood as shown in Fig. 7. Notice how the two binding clips are used.

Now mount the spool so the switch arm passes over the turns. Bring the end of the wire to a second binding post which has been mounted on the side of the block. In some cases it will be necessary to make a more flexible connection to the spool, using a piece of telephone cord or braided pig-tail. It depends on how heavy the resistance wire is.

The rheostat can easily be mounted on a panel (Fig. 6) by drilling the panel and fastening the wooden block against the rear of the panel by means of a wood screw which holds it firmly. About 20 turns gives a 6-ohm resistance.

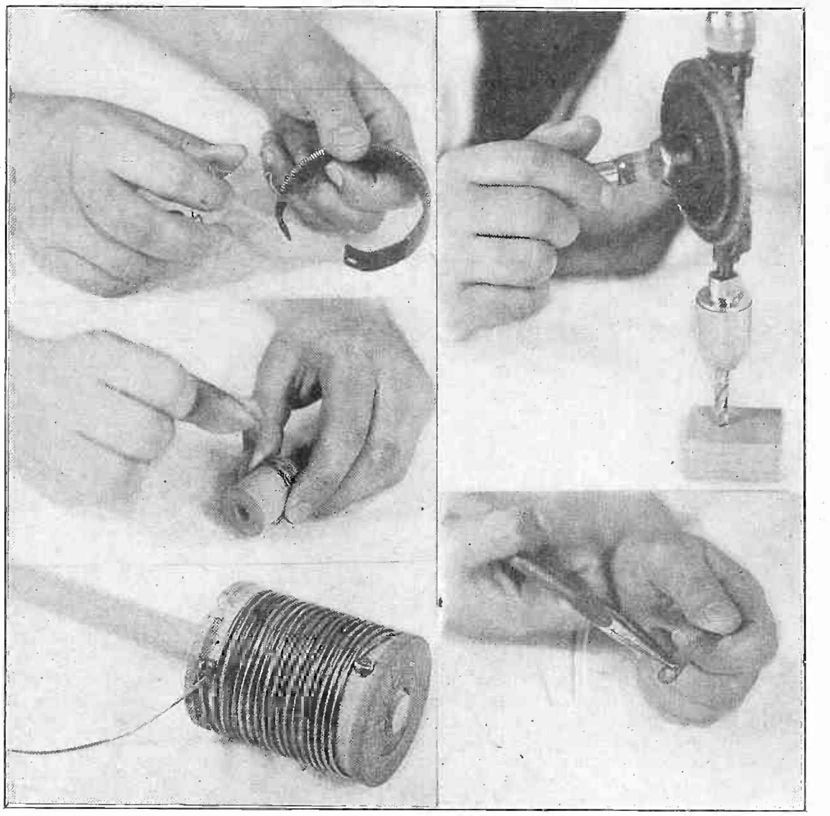


FIG. 1, top left, removing resistance wire from an old rheostat. Fig. 2, on an ordinary spool wind this wire. The completed winding is shown in Fig. 3, bottom left. Cut a block of wood 1" thick and 2" square (Fig. 4, top right). Drill a ¼" hole, to insert a dowel stick, take an old switch arm, bend it back a little. See Fig. 5. (Hayden).

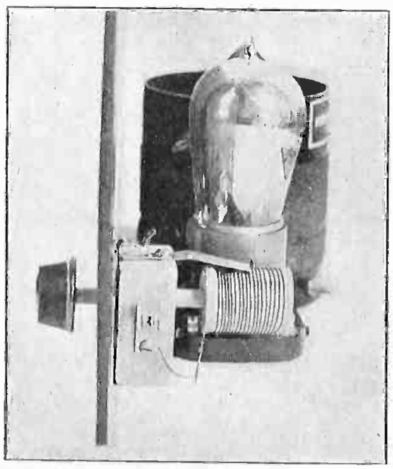


FIG. 6, the rheostat mounted on the panel. (Hayden)

Two Class B Waves for Each State is New Plan Being Pushed

THE need for legislation limiting the number of broadcasting stations has prompted considerable thought and study of the subject by officials of the Government having control over such matters. In connection with it there has arisen a point which is providing considerable controversy and which may cause a serious row. If authority is given to the Secretary of Commerce by Congress to limit the number of broadcasting stations, how would the existing wavelengths be distributed? Would an equal number of wavelengths be given to each state, or would the quota of each state depend on population?

At the present there are 96 wavelengths for class B stations, or enough to allow two to each state. Some officials of the government believe equal division by state would be an easy solution. Those who are now favoring the allotment of an equal number of wavelengths to each state point out that it is the only fair way of doing it. Those favoring a distribution according to population assert that cities like New York and Chicago should be allowed more wavelengths than other places because of superior entertainment and educational facilities.

Officials of the Department of Commerce are now engaged in the study of a legislative program to deal with radio matters which will probably be submitted by Secretary Hoover to the next national radio conference. If the radio conference approves the program, the Commerce Secretary probably will recommend it to the consideration of Congress.

Roxy Theatre to be the Biggest

S. L. ROTHAFEL, better known as Roxy, is to have his own $6,000,000 moving picture theatre at Seventh Avenue and 50th Street, New York City.

While Roxy was broadcasting for the Rotary several weeks ago, a fund of $15,000 was raised for crippled children and on another occasion a fund was raised for war veterans. Discussing his own theatre, to be ready in 1926, seating 6,000, the world's largest movie house, Mr. Rothafel said: "I owe it all to radio."

The Low-Loss Neutrodyne

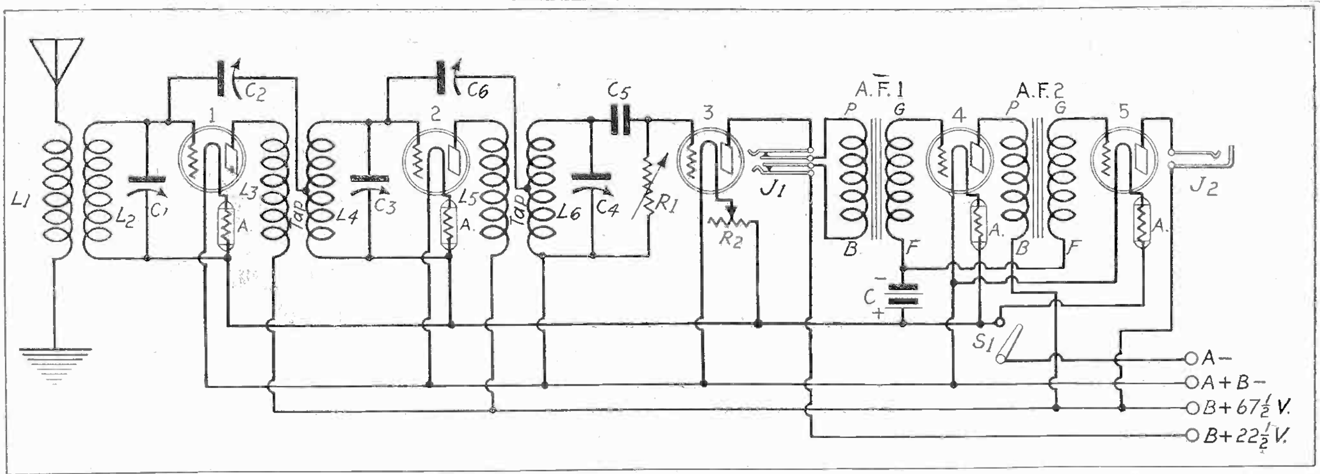


FIG. 1, the circuit wiring of the Low-Loss Neutrodyne. The coils L1L2, L3L4 and L5L6 are basket-weave. The neutralizing condensers are C2 and C6. A C battery is used to bias the audio tube grids. S1 is a master switch, push-pull or toggle. One rheostat is used (R2 in the detector circuit). A represents ballast resistances. They, like the rheostat, should be in the negattive A battery lead, as shown.

By Neal Fitzalan

WITH the many circuit diagrams available today, some of which are very efficient and some of which are not, the layman gets confused when he starts out to get a circuit which is simple and still workable. The uninitiated may tackle the Neutrodyne (along with old-timers) with assurance of success. When this set is built on low-loss lines it is a charm. It is simple to neutralize and easy to operate. The Neutrodyne has received some "booing," but this came from the people who didn't take the pains to build the set properly, and also those who used poor and inefficient material.

This set is a cinch to log and settings don't change, except if you have a poorly insulated antenna, when during the damp weather the insulators get wet and start to leak, thereby broadening the tuning and unstabilizing the set also.

The Principle of the Set

All the neutroformers are wound seriatum on one low-loss form (Fig. 1) for the basket-weave type. The panel of the set is the same as that of the standard Neutrodyne, that is, it has the conventional three dials, one rheostat, a filament switch and the two jacks. You, therefore, can purchase a drilled panel that was originally designed for the Neutrodyne and use it for this set without going to the trouble of drilling the holes and also making the engraving.

Purchase of Parts

Three low-loss straight-line frequency condensers are used for tuning. The five sockets should be of the porcelain base type. The neutralizing condensers are variable from .000015 to .000019 mfd., and are very easy to adjust. The resistance connected across the grid and filament of the detector tube is a variable grid leak. The grid condenser is a .00025 mfd. (mica). J1 is a double-circuit jack, and J2 a single-circuit jack. Five UV201A tubes are used. Make sure that when you purchase the tubes that the prongs do not shake and also test the tube in a set and see if it is noisy, as this is a cause of a lot of trouble in Neutrodyne receivers.

Changing around of tubes will help a great deal in making the set work efficiently. A filament switch, a terminal strip, a 6-volt storage battery, two 45-volt B batteries and a 4½-volt C battery are needed. The resistances A are Amperites, type 1-A.

Panel Data

If you desire to drill the panel, the following data are given: 6½" from the left of the panel and 3½" from the top of the panel drill a hole for the first dial, which is a 4" dial; 6½" from this hole and 3½" from the top of the panel drill a hole for the second dial; 6½" from this hole and 3½" from the top of panel drill the hole for the final dial. All the holes are 3-1/16" in diameter. 6½" from the left of the panel and ¾" from the bottom drill a hole for the first jack, J1, the diameter of the hole being ½". In the same line and 13" from this hole drill a hole for J2, also ½" in diameter. 3" from the right of panel and 2" from the bottom drill a hole for the rheostat, the diameter of the hole depending on the type of rheostat being employed. Going back to the left-hand side of the panel, 3¼" from the left and 1½" from the bottom drill the last hole for the switch, the diameter of the hole being ½". For the baseboard a few holes are drilled according to your own discretion.

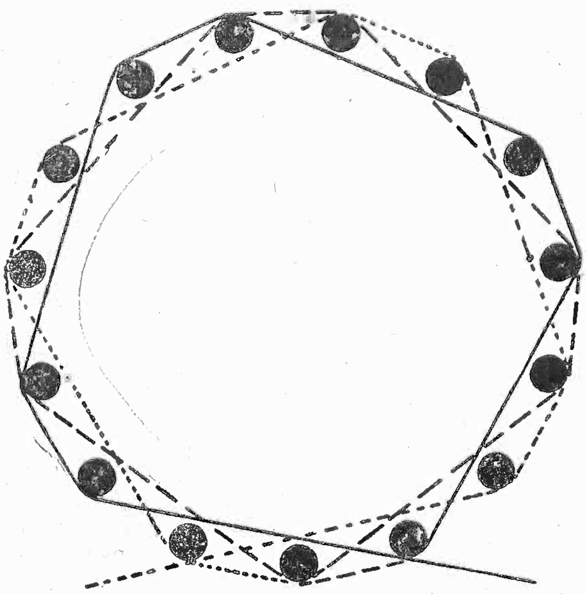


FIG. 2, template for basket-weave form. Take a 4" square block of wood, drill 3/16" holes as shown. Insert 3/16" dowel sticks, each cut to 4" length. These are at right angles to the wooden base. The sticks may be glued in place. Using No. 18 DCC wire, wind under two turns, over two, under two, over two, etc. Right to left, the solid line represents the first turn, the dotted line the second, the dash line the third.

How to Wind the Coils

The coils are wound in basket-weave fashion. L1L2, if desired, may be made in a continuous winding. Using No. 22 DCC and a 3" diameter form, with 15 dowel sticks equi-distant on the circumference, wind 10 turns for L1 and 50 turns for L2. The division of the two winding is denoted by a tap. Both the ground and the A minus are connected to this tap. That affords conductive coupling of the aerial to the grid. For conductive coupling L1 is wound separately and so is L2. The two other transformers, L3L4 and L5L6 are wound with 10 turns of the same kind of wire for the primary, and 50 turns secondary, tapped at the 15th turn for the connection to the neutralization condensers.

The single winding on the aerial coil works very well, but a little more selectivity will be obtained by following the diagram as shown in Fig. 1, with the two windings separate.

The coils are wound "under two and over two" (Fig. 2). When the winding is finished the coil may be raised about 1" from the form and cord inserted in a wave form through the inside length of the winding and knotted for security, or

Panel Layout of Neutrodyne

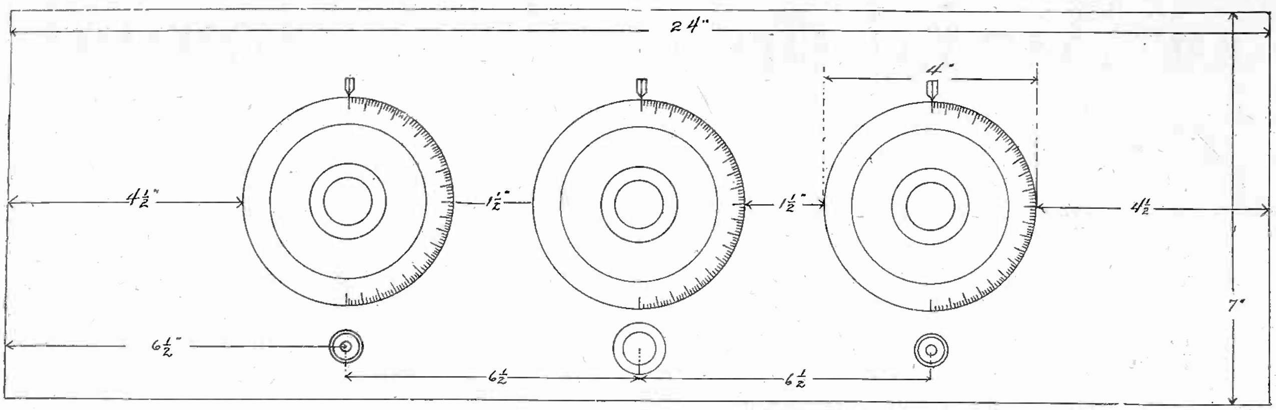


FIG. 3—Front panel layout of the Low-Loss Neutrodyne. The switch may be inserted in the left-hand corner or right-hand corner of the panel.

the cord may be employed in any other fashion for support.

The coils are removed from the form after this lacing is completed. L1L2 is mounted on the baseboard at least 2" in back of C1, the coils' axes parallel to the baseboard (windings at right angles to baseboard). For this purpose two dowel sticks may be used, re-inserted at two adjacent holes in the winding, using two 2" hard rubber or brass right angles, secured to the baseboard and to the dowel sticks. L5L6 is mounted in the same way. L3L4 is mounted with its axis perpendicular to the baseboard, the more conventional fashion. Thus adjoining coils are at right angles to each other and magnetic interplay is successfully avoided. This is simpler than the condenser-mounted scheme, requiring such exacting angle-mounting (57.3 degrees).

The Baseboard Layout

Place all the instruments in their respective places, taking care that the RFT are all near their own sockets, so as to have very short leads and thereby save some energy which can just as easily be kept in the set instead of it escaping. Be sure and mount the grid leak right on top of the socket, to conserve. This applies to the neutralizing condensers also.

The Wiring of the Set

Bring the beginning of the wire of L1 to the Ant. post of the terminal strip and the end of the coil (this being the 10-turn primary) to the ground. Connect the beginning of the secondary coil L2 to the stationary plates of the condenser, C1, to the grid post of the socket, and to one end of the neutralizing condenser, C2, the end of C2 going to the 15th-turn tap on the coil, L4. The beginning of the coil, L3, goes to the plate post of the first tube socket, the end of this coil going to B plus post (67½ volts) on the strip. The end of L2 goes to the rotary plates of the condenser and also to the negative side of the A battery, and to one end of Amperite. If you desire to obtain volume and a bit less selectivity, connect the end of L1 to L2. The beginning of L4 goes to the grid post of the second tube and also to the stationary plates of the condenser C3 and also to one end of the neutralizing condenser, C6 (this is the second one), the end of L4 going to the rotary plates of C3 and to the end of the Amperite which in turn goes to the A minus. The beginning of L5 goes to the plate of the second tube and the end goes to the same place the end of L3 went to, that is the B plus 67½ volts. Bring the end of the second neutralizing condenser to the 15th turn of 16, the beginning of the coil goes to one post of C5 and also to the stationary plates of C4. Bring the end of the coil to the rotary plates of C4 and also to the post of the leak, and finally to the A plus and B minus post of the terminal strip. The left-off terminal of the grid leak goes to the left-off terminal of the C5, which in turn goes to the grid post of the detector socket (the 3rd tube). Note that all the Amperites are placed in the negative lead of the A battery and the detector rheostat is placed in the negative lead, to same, the only difference here being that the grid return is put to the positive side of the low potential line instead of the negative as was done with all the grid returns of the other tubes.

The C battery is inserted in the F leads of the AFT, which go to the minus side of the C battery, the positive side of the C battery going to the switch, eventually to negative A battery.

The set is designed for earphone use only to facilitate tuning, otherwise always for speaker use. If earphone service on regular reception is desired, insert another switch (between the filament side of S1) and the battery side of the audio Amperites). Then you can shut off the audio tubes when the two others are going. Put this extra switch on panel.

How to Neutralize the Set

Neutralization is a simple process to follow out, but it takes a little time to get it just right. Put a small piece of paper between one of the filaments of the second tube from left and the spring on the socket. Push the filament switch out and light the tubes, then tune in a loud local station. If you hear the least undertone of a signal, there is some inter-stage coupling present. Adjust the small neutralizing condenser until this signal disappears. The same procedure is followed out with the first tube (extreme left). Both settings are left permanently and should never have to be touched, except if the set is jarred or the antenna is changed or the ground is changed, which may change the apparent capacity of the tubes through the interchanging of current from the coils, and which in turn will change the capacity effect of the neutralizing condensers. The signals should come in without any clicking or howling.

LIST OF PARTS

Three radio-frequency transformers.
Three .0005 mfd. variable condensers.
Two neutralizing condensers.
Four Amperites, type 1 A.
One 20-ohm rheostat for the detector.
One grid leak (variable preferred).
One .00025 mfd. fixed grid condenser.
Two AFT, both of same ratio.
One double-circuit jack.
One single-circuit jack.
Five UV201A tubes.
Five porcelain sockets.
Two 45-volt B batteries.
One 6-volt storage A battery.
One speaker.
One pair of phones.
One C battery (4½ volts).
One or two filament switches (see text).
One 7x24" panel.
One 7x24" cabinet.
Three 4" dials.
Nuts, screws, connecting wire, etc.

New Broadcasters

WASHINGTON.

SIX new class A and one new class B broadcasting stations were licensed by the Department of Commerce while one station was transferred from class A to B. The new stations follow:

CLASS A

Station	Location	Meters	Watts
KFVS	Cape Girardeau Battery station, Cape Girardeau, Mo	224	50
KFWH	F. Wellington Morse, Jr., Chico, Cal.	254	100
KWKC	Wilson Duncan Studios Kansas City, Mo.	236	100
WBRC	Bell Radio Corp., Birmingham, Ala.	248	10
WIBL	McDonald Radio Co., (portable) Joliet, Ill.	215.7	250
WJBI	H. M. Couch, Joliet, Ill.	214.2	100
CLASS B			
KTCL	American Radio Tel. Co., Inc., Seattle, Wis.	305.9	1000
CLASS A TO B			
WHAR	F. P. Cook's Sons, Atlantic City, N. J.	275	500

NEXT WEEK

"THE 2-TUBE LOUD SPEAKER PORTABLE"

By Herbert E. Hayden

SPLENDIDLY ILLUSTRATED

Interchangeable Use of Loop or Aerial on 2-Dial Diamond

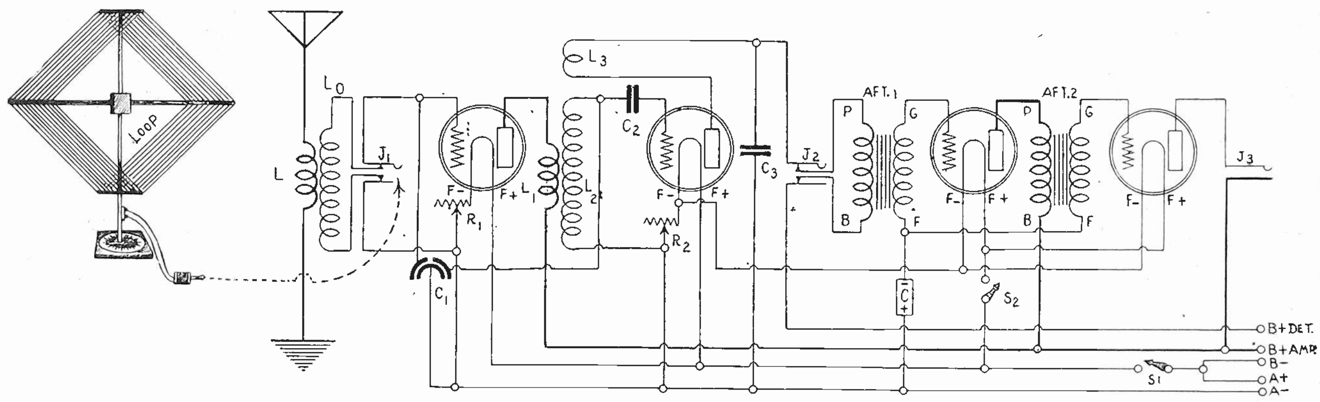


FIG. 1—The wiring diagram of The Diamond of the Air as a 2-control set, with option of loop or aerial operation. L0 and L2 must be matched and the loop must be matched with them, too. Various methods of accomplishing such matching are discussed in the text.

By Herman Bernard

Associate, Institute of Radio Engineers.

THE simplest way to construct The Diamond of the Air as a 2-control set is to make a definite choice in advance as to whether loop or aerial will be used. That requires matching the secondary of the 3-circuit coupler and either the loop or the secondary of the radio-frequency transformer in the aerial circuit. Also that necessitates abiding by your former choice and many would like the option of interchangeable use of loop or aerial. It is safe to assume that if an experimenter can match two coils he can match three, although more work is involved and some difficulties must be expected. Granting that the double condenser used is a good one, and for given settings does not vary more than trivially as to comparative capacity, success is almost sure to result.

The Extra Condenser Method

Lacking any special apparatus for measurement, but granting only the presence of a spare variable condenser around the house, the following procedure may be followed:

Do the filament wiring, place the coils in position, as well as the double condenser, but do not permanently connect the coil terminals. The coil data and placement of parts were discussed in the May 23 and 30 issues of RADIO WORLD, which contained the full constructional details for the 2-control set where only loop or only aerial was to be used.

Now connect one section of the double condenser to the secondary L2 of the 3-circuit coupler. This is done by joining one coil terminal to minus A and to the rotor of the condenser, a common lead, and one of the stator posts to the grid condenser end of that secondary. The jack connections are not made until later. The remaining section of the double condenser is not used for the present. Now insert another variable condenser, connecting it in parallel with the secondary L0 of the aerial RFT. It would be better if this condenser were of the same capacity as the used part of the double condenser (.0005 mfd.) but this is not vital. A condenser of .00035 mfd. (17 plates) or .00025 mfd. (13 plates) will do. Now tune in a local station that is within the wavelength range of the condenser-coil combination in the aerial circuit. If the testing condenser is less than .0005 mfd. the higher wavelength stations, say above 450 meters, may not be reached, due to insufficient capacity in the condenser, in conjunction with the fixed inductance of L0. Suppose a station is tuned in at 405 meters. Note the dial setting of the part of the double condenser that is being used. The circuit at this stage has three controls, the test condenser, the half-section of the double condenser, and the tickler. If a dial is used, having 100 divisions, covering 180 degrees (one-half) of the circle, and rotates counter-clockwise, then 405 meters should come in at about 50. 455 meters at about 60, and at the lower reaches, 233 meters at about 15, 273 at about 20, 316 at about 28 etc. Exact correspondence with these figures is not necessary.

Mark down the readings for the half-section of the double condenser and of the readings of the test condenser.

Condenser Connections Shifted

Switch the leads of the coils, so that the test condenser tunes the secondary of the 3-circuit coupler, and the same stator section of the double condenser used heretofore tunes the secondary of the aerial coupler. Now what are the readings? All the strays to be encountered in the finished circuit—save one—are present now, and the test should show where you are at.

Suppose that the test condenser now shows lower readings than it did when in the other part of the circuit. That shows the LC (inductance and capacity) in the coupling part of the circuit, ignoring the capacity of the tuning condenser, is greater than the LC in the aerial circuit. This is to be expected, although the opposite may be true in some instances. Do not depend on the reading of one station alone. Try stations on the upper, lower and intermediate wavelengths. Record the readings. Do not be surprised if the readings show variation at the upper waves but seem to be exactly the same as previously on the lower waves. This would be due to relationship of capacity to frequency, whereby a greater capacity change is required on the higher waves to occasion an equal change in frequency, hence a fraction of a division on the dial, for low waves, might not be noticed, although a considerable frequency change exists.

There will be no necesity for dealing with fractions of a turn, hence take off one turn from the secondary that gives a lower dial reading than when attached to the other coil, and renew the test. If the trouble still continues, remove another turn. Finally, the point will be reached where resonance will be achieved at readings the same as those obtained when the condensers were reversed. There you will stop. It is understood that approximately the same number of turns were on both secondaries, otherwise too small an inductance on one would result, due to the test, in too small a one on the other, and the broadcast band would not be covered. Consult the guiding dial readings given above, as when they are true, even within a couple of divisions, and a .0005 mfd. condenser is used, the whole band should be safely within reach.

Must Have Good Condenser.

The condenser itself is a point of importance. A good plan indeed is to use now that half of the condenser which has been ignored up to the moment. This is easily accomplished by moving the connection from the stator of the section now in use to the binding post on the other stator. Now note the readings. They should be identical with those for the other half of the condenser.

The reading of the testing condenser is useful only to show, as far as possible, the relative capacity. Some differences may be occasioned by the uneven variation in capacity in the test condenser and the double condenser, so settings of the test condenser need not be considered very important. As for the double condenser, it will function well if the above precautions are taken, so long as its two sections vary evenly as to capacity, and the greatest difficulty in manufacturing these double condensers in quantity is to effectuate such capacity matching.

Matching up the Loop

As for the loop, that is matched with the other coils by selecting the secondary of the 3-circuit tuner for the test, placing he test condenser back in that circuit, and using one of the stators of the double condenser, so that the previously determined readings will be obtained, when that section is hooked up to the loop and the RFT secondary cut out. For this purpose a home-made loop preferably should have more inductance than needed. If an 18" square loop is wound

Picture Diagram of Diamond with Three Matched Coils

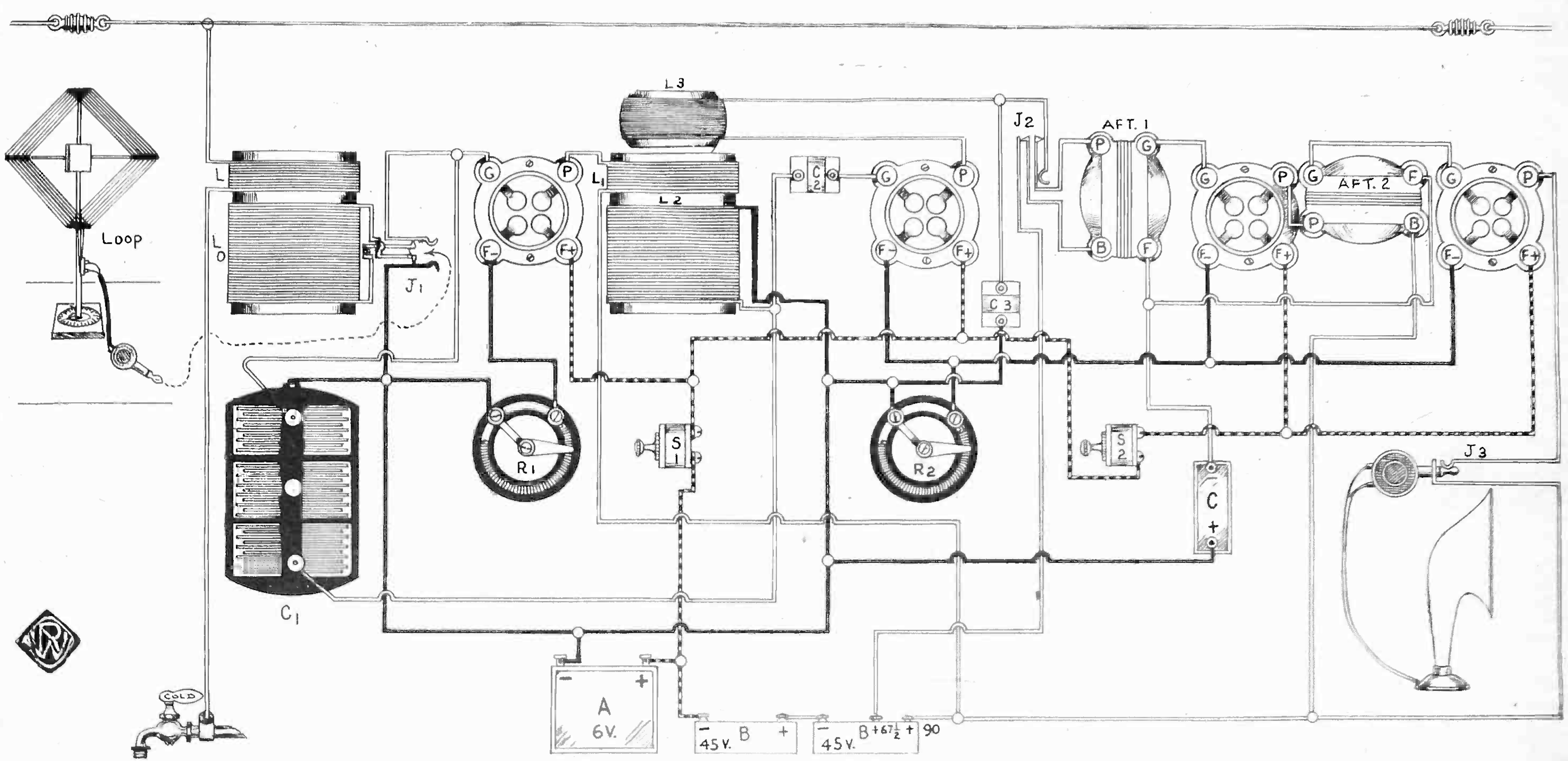


FIG. 2, wiring diagram of The Diamond of the Air as a 2-control, loop and outside aerial set.

Matching of Coils Explained; Three Methods Are Given

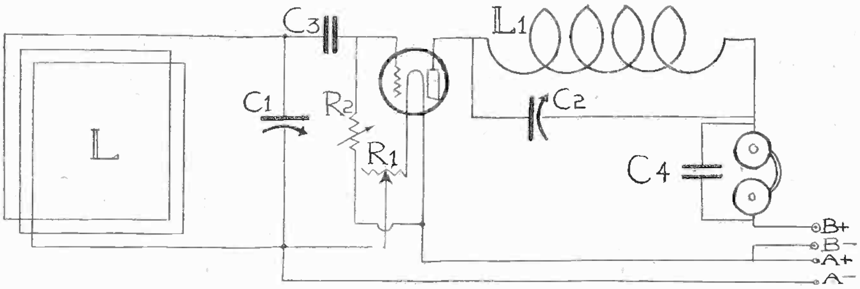


FIG. 3—A 1-tube loop set that brings in local stations. The range is about 50 miles, often much more. It is a good circuit to use to calibrate C1 as against inductance L, which is the loop. C2 is .0005 mfd., L1 is 45 turns of No. 20 DCC wire on a 3½-inch diameter. C4 is .002.

of No. 20 double cotton covered wire, turns ¼" apart, twenty-five turns should be put on, which will be too much, but the reduction process can be followed, and when the correct inductance is obtained the experimental terminal of the loop is made final and soldered to a binding post on the loop.

Those who will use commercial loops may find that a 3-tap loop will come out just right at one tap, although this is in the nature of a guess. A better commercial type for this purpose would be a collapsible loop, which has maximum inductance when fully extended, and which may be gradually collapsed, that is, lowered a fraction of an inch at a time, until the right condenser setting is obtained, and that altitude kept permanent. The total inductance is reduced in this manner. The method presupposes the loop has a greater total inductance at full extension than is absolutely required, so figure the coupler secondary closely, so that by no chance will greater inductance be required in the loop, a demand which cannot be satisfied without rewinding the loop.

Be sure you get a loop that is designed to be tuned with the particular type of capacity condenser you will employ, e.g., a .0005 mfd. instrument. If you have the loop and are to buy a double condenser, then select one of the correct capacity to tune the loop throughout the broadcas belt of wavelengths.

Use of Wavemeter; Second Method

Anybody possessing a wavemeter, or desiring to make one, may employ that in the matching process. Its use simplifies accurate work. The wavemeter would consist of 45 turns of No. 20 double cotton covered wire on a 3½" diameter tubing, shunted with a variable condenser of .0005 mfd. A few stations are tuned in on any set and the dial readings of the set tuning condenser noted. If there are more than one tuning condenser or other calibrated tuning control (such as a variometer) in the set, then simply use one of them as your guide. Having noted the readings, it is safe to accept these as representing the wavelengths to which the stations are assigned. The variations will not be great enough to make any worthwhile difference. Stations like WEAF, WBZ, KDKA and others that are known to adhere closely to their assigned frequency are to be preferred.

Now connect a high-frequency buzzer in the wavemeter circuit. Shunt the buzzer magnets with a 1 mfd. fixed condenser. The leads from the buzzer magnets come out to small set-screws. One of these terminals connects to one of the A battery terminals, say A plus, the other A battery terminal, A minus, going to the rotor of the variable condenser in the wavemeter. The stator plates of this variable condenser go to the third terminal of the buzzer, usually on extreme left. You can identify the magnet connections because the small leads coming out of them are visible. There is no tube in this wavemeter circuit.

While the batteries are connected as described the buzzer will keep on buzzing continuously and it is well to have the buzzer in a sealed box, so that you will not imagine you are hearing the note in the receiver later, when in fact you are hearing the buzzer direct.

Fan Lauds Lucidity of Hookup Articles by Herman Bernard

LET me congratulate RADIO WORLD on having as contributor, Herman Bernard, whose splendidly clear manner of writing and lucidity of detail are masterful. I am now interested in his newest circuit, The Diamond of the Air as a 2-control set (May 23 and 30).

GEORGE KIERNAN,
3965 LeMay Ave.,
Detroit, Mich.

Application of Wavemeter

Disconnect the ground lead from your set and run it through the coil, or just let the ground lead lay inside of the wavemeter coil, right up against it. The ground lead is then reconnected to the set. The wavemeter condenser has a dial on it and as the dial is turned on the meter note the point at which the buzz comes in strongest on the headphones or speaker attached to the receiving set. Granting that the condenser setting for one station, on the set, is known, the same wavelength will be recorded by the wavemeter when the wavemeter condenser is tuned so as to produce this loudest buzz in the phones. In that way, by using the settings of various stations of known frequency or wavelength, as established on the set dial, you can calibrate the wavemeter, and even draw a graph whereby you may know the settings all through the broadcast band, without actually tuning in more than half a dozen stations originally. With your wavemeter calibrated it is now an easy matter to run the ground end of a loop through the wavemeter coil (just passing it somewhere in the core and letting it lie there), restore the loop lead to the set, and produce coincidence of settings on the condenser tuning the loop and the other condenser of known settings in the circuit. In the way the RFT secondary may be matched with the coupler secondary. It would be more difficult to match the coupler secondary with the RFT secondary, but it could be done in the same way. This practice, indeed, may have to be resorted to by those not desiring to tamper with an existing loop. That is, the loop is taken for granted as the inductance standard and the two secondaries are matched thereto. Always in these matching processes individual condensers are used, even if one is a section of a double condenser. Thus you may set up a loop, connect a variable condenser in shunt, provide some regeneration method, tickler or tuned plate, and receive local signals sufficiently to get your condenser dial settings for the loop. (Fig. 3.) If up to this stage your wavemeter has not been calibrated, then you may do this by comparison with the loop condenser settings as representative of given wavelengths.

Always remember that the two tubes should be hooked up when the tests are made. It would be better to have the audio hooked up, too. It is not practical to match coils simply by themselves, i.e., outside the circuit. The matching process contemplates the inclusion of every element, known or unknown, that affects the dial settings, such as the capacity of the plate of the RF tube, which tends to give the 3-circuit coil's secondary a slightly greater natural period, by reason of its inductive receipt of the increase from primary, where it originated in the plate circuit; and the comparatively lessened natural period due to the absorption effect of the tickler. In some cases the same number of turns on the secondaries automatically will match up the two coils, due to the added plate capacity being equally offset by the lessened inductive value of the coupling secondary, on account of absorption. But for this happy event to occur it must be true also that the other uncertainties comes out even, that is, additions exactly counterbalance subtractions. There are stray capacities in any circuit, due to the internal set wiring, socket prongs, binding posts, etc., terminal strips, fixed condensers, as well as stray couplings and uncanny phase relations. Likewise the grid condenser itself may be regarded as having a tendency to lower the natural period of the secondary, in respect to grid, since it is a series-connected condenser.

Matched Tubes Help, But Not Vital

It is a good plan to use the same kind of tubes throughout, and if it is possible, to get matched tubes. Such tubes are those whose mutual conductance and impedance are equal. This matching is done mostly for purposes of having tubes that have the same oscillatory constant, yet the present object of having equal capacities in the tubes is well met by this matching done for other purposes by the better grade of dealers in tubes.

Another consideration worthy of note is the aerial capacity. This may be regarded as 50 micro-microfarads, or about one-tenth the total capacity of the variable condenser. This data was taken from author's antenna system. The designations .0005 mfd. and 500 micro-microfarads are two ways of expressing exactly the same thing.

For those more advanced in the radio art it may serve some purpose to fix the inductance of the loop at 167 micro-

(*Continued on page 25*)

A and B Battery Eliminators for Alternating Current

[Part I of this series of three articles on devices for doing away with A and B batteries dealt with direct current line source and was published last week, issue of June 6. Part II, which follows, deals with alternating current lines. Part III, the conclusion, will be on AC also.]

PART II

By P. E. Edelman

Electrical Engineer.

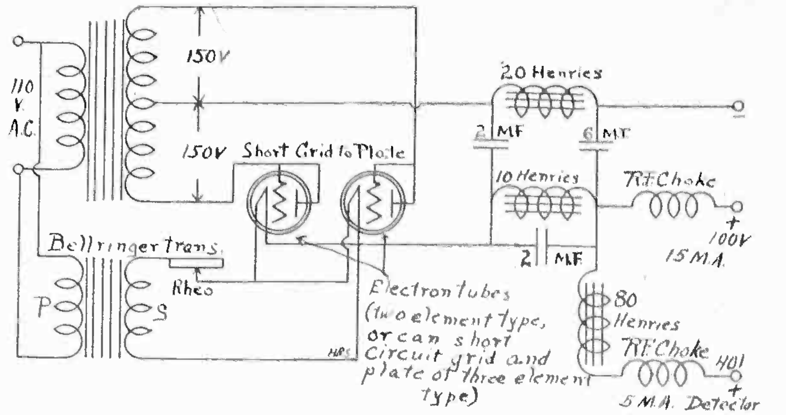


FIG. 1—The UV201As come into excellent use here for rectifying the AC for supplying B battery potential.

THE average lighting current is of the 110-volt, 60-cycle alternating kind. In some systems there will be strong harmonics and in others the harmonic frequencies will be negligible. The alternating current, as indicated by its name, changes back and forth in direction of flow. Electricity, however, is electricity, whether alternating or direct, and one form can be converted into the other kind.

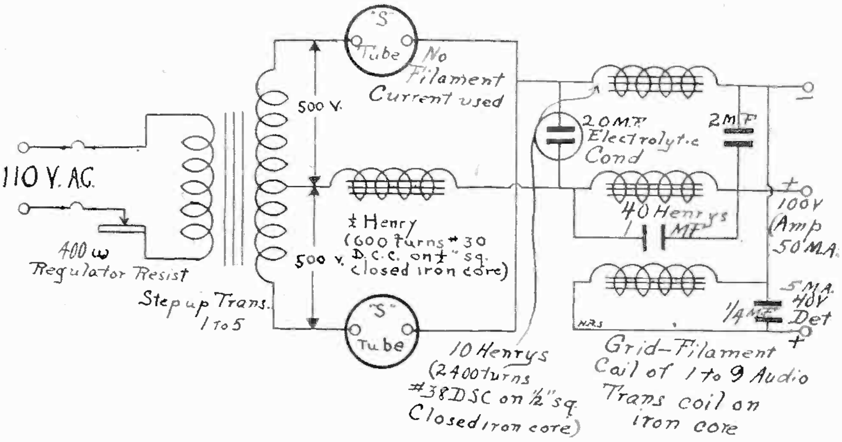


FIG. 2—How to use S tubes in the rectifier unit.

After conversion usually some form of filter circuit will be further required to smooth out all remaining noticeable hum.

Rectifier Methods

Rectifier methods are based on the use of either an electron or a chemical tube. Mechanical rectifiers are usually not suitable for ordinary use through a filter circuit. The chemical valves are of two general types, one using aluminum and lead plates in a solution such as borax, or ammonium phosphate, and the other using lead and tantalum plates in dilute acid. Rotary rectifiers are not considered here, as a rotary convertor is a better way to use rotary motion in conversion. Whereas for charging a battery a single rectifier suffices, it only uses one-half cycle, so that for radio plate supply current, a full-wave rectifier arrangement is desired. This can use both half cycles and its function is merely to direct or guide them for the same flow in the direct current flowing output side of the convertor. This can be done by use of two rectifier units properly connected or by use of four units. The four-unit method is best where electrolytic rectifiers of chemical variety are employed.

Filtering.

The rectified current passes through a filter made up of iron core coils and relatively large sized condensers. The function of such filter circuit is to smooth out the direct current supply via the time lag in the magnetic field collapse (in the iron core coils) and also to provide by-pass traps via the condensers for residual alternating current flow. The final result is a direct flowing current sufficiently quiet for use. Indeed this is the general method used in many transmitting radio telephone stations.

One advantage of alternating current source is the ease with which it may be stepped up or down in voltage and current capacity by use of transformers. Thus the use of tubes having large filament current drain becomes economical if a step-down AC transformer can be used. With direct current source, a series resistance is required and wastes much energy, since the same current must flow through the larger series resistance.

The rotary convertor method can be used on alternating current supply if the motor is an alternating current one. The generator unit can have a permanentic magnet field in small size output and must be of the self-excited type. Similarly the high-frequency convertor method using a vacuum tube might be employed. Also the use of specially constructed tubes with separate heater filmaments is entirely practical without use of convertor. For plate supply only, a thermopile with heater unit can be used for quiet operation. Then there are certain radio set circuits which permit direct use of alternating current for filament current supply, using middle tapped transformers.

Considering first, rectification, Figure 1, shows use of electron tubes as rectifiers. Two are required for full wave rectification. It is possible to use UV201A for this purpose by connecting the plate and grid of each tube together and using each as the plate. It is possible to make a makeshift rectifier of this kind from the No. 1158 Tungsol double filament headlight bulbs. Such bulbs have two filaments, 2 C.P. and 21 C.P. respectively. The 21 C.P. filmament may be carefully burned out by applying a twelve-volt storage battery to terminals, leaving the small filament and a clear terminal at bottom contact as plate. The heavy filament should not be all burned out, but left in two separated parts. Out of four samples, you may get two good ones this way, and usually the plate is then so small that a higher voltage must be applied via a step-up transformer, to say 220 volts or more, before useful amount of rectified current may be had in this manner. The use of 201A tubes, however, is quite practical aside from question of cost. Other rectifier bulbs are usually too large in size for practical use. Tungar bulbs are made for heavier current. S tubes have a life of about 3,000 hours, and use no filmaments, but are made to operate on higher voltages than required for receiving set operation.

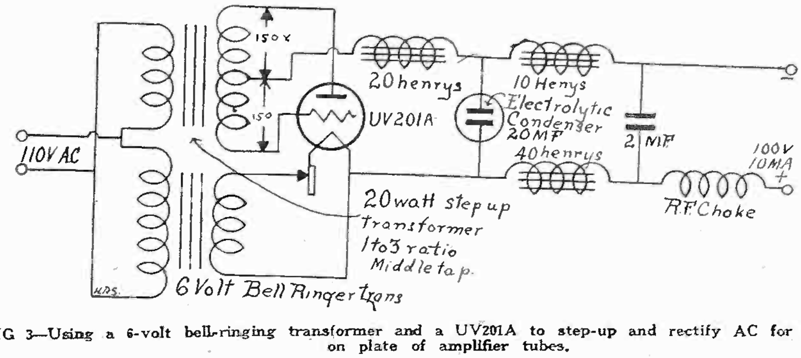


FIG 3—Using a 6-volt bell-ringing transformer and a UV201A to step-up and rectify AC for use on plate of amplifier tubes.

Storage Battery Analysis

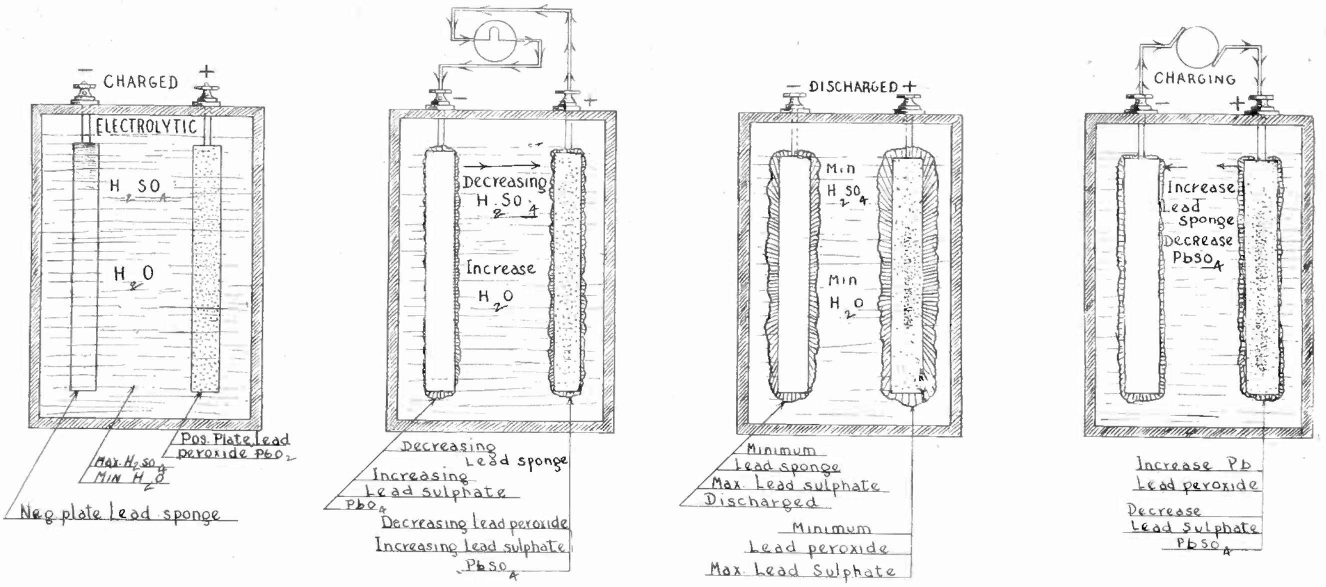
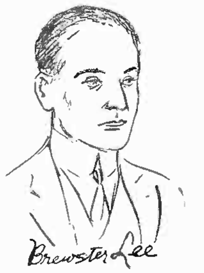


Fig. 1—The picture tells the saory. In the last diagram "Pb" should read "Pb02." In the extreme left-hand diagram the solution called electrolytic should be electrolyte.

By Brewster Lee



MANY sets use a storage battery, either for supplying filament current or for supplying plate potential, regardless of voltage employed. What really goes on inside the battery? The plates composing the positive side of the lead cell battery consist of a chemical known as peroxide of lead. This is the so-called active material. The negative plate is made up of metallic lead in spongy form. The electrolyte or the active liquid chemical consists of 13 to 18 per cent. of H_2SO_4, otherwise called sulphuric acid, which has a specific gravity of 1.212. Specific gravity is defined as the weight of one cubic centimeter (C.C.) of the chemical solution as compared with one C.C. of absolutely chemical pure H_2O (water). This is measured with a hydrometer which has a small glass tube, usually filled up at one end with lead shot, upon which there is etched a calibrated scale, whereby the specific gravity of the solution is taken.

When this bulb is inserted in the acid solution the gravity is noted by reading the scale at the level of the solution. When the battery is fully charged, the scale will read 1.300 and when discharged it will read 1.100. When the scale reads about 1.210 the battery should be immediately put on charge. This is the only accurate way of showing how the battery stands. If, however, you have no hydrometer, a voltmeter may be put into use. The voltage of each cell when fully charged is 2.08 but in a brand new cell, it may read as high as 2.7 volts per cell. When each cell has reached a voltage of 1.8 volts the battery should be put on charge.

What Happens Inside

Fig. 1 shows what goes on inside of the battery during charge and discharge processes. During the charging process a current is produced by the acid in the electrolyte combining with the lead of the active material.

As soon as the sulphuric acid in the electrolyte combines with the lead in the active material, $PbSO_4$ or lead sulphate, is formed. As the electrolyte becomes weaker, on account of the amount of acid being used in the plate, the acid combines with the lead and forms lead sulphate or $PbSO_4$. This is the beginning of the discharging of the battery. As the battery discharges this combination of sulphate gets larger in amount and bulk and fills up all the pores of the plate. We cannot breathe when our bronchial tubes are filled up with foreign matter, and neither can the acid in the plate circulate freely, when the pores of the plate are filled up with the sulphate. The acid is now stopped, that is, it cannot get into the plates any more on account of the clogging of the pores. This causes the battery to become less active and can easily be noticed by the sudden drop in the line voltage of the battery.

Current Flow Changes

Now, when we charge the battery the current (which is direct) passes in the opposite direction to that when it was discharged. When the current is reversed the active material is brought back to its original condition, which takes the acid off the plates and brings it back to the electrolyte. The electrolyte becomes stronger and stronger (the acid going off the plates, until all the pores are clear, so that they can pass through them without any retarding whatsoever). This continues until the electrolyte becomes of the same strength as it was when the battery started to discharge. There is no loss of acid in the above process and you can readily see why storage batteries have a sign reading "DO NOT ADD ACID TO BATTERY." The only way that the acid becomes weaker is by the careless handling of the battery, e.g., spilling of acid or shaking of battery and allowing of acid to seep through walls of the battery case. We can, therefore, see that the main purpose of charging is not to put electricity into the cells, but to clear the pores of the plates and take acid off them.

The Gas Sign

When, after a charge, you find that your voltmeter or hydrometer does not work the next best thing to do is to see if the cells are gassing freely. This is a sign of the battery being fully charged.

Never add water after the battery is charged and by the way, do not add anything but pure distilled water. Always add water before charging battery, repeating the water addition about every two or three months. Do not put in too much water. About ¼" above level of plates will do, as the water combines with the acid slowly and becomes strong enough to eat through almost anything when spilt over, which will happen during charging if too much water is added.

For an ordinary 3-tube set employing UV201As throughout, an 80-ampere-hour battery will do. By 80-ampere-hour one means that 80 amperes can be taken out during 80 hours of use. In other words for every hour of use, one ampere may be taken out of the battery.

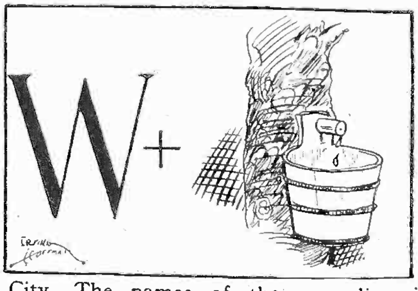
Any charger employing a bulb for rectifying purposes is all right for charging the battery.

Avoid the Auto Battery

The radio storage A battery should have very large plates, so that a slow steady drain may be obtained thereby. The automobile battery plates are made for a sudden discharge and when on a radio set, where the tubes take a slow discharge, the battery current starts to fluctuate, causing the tube to flicker, due to the battery giving a source of current for a certain known time, stopping, and continuing, as this is exactly the way which it functions on the automobile.

The Weekly Rebus

WHAT does this Rebus represent? Send answer to Rebus Editor, RADIO WORLD, 1493 Broadway, New York



City. The names of those sending in the solution will be published.

A Portable Super-Heterodyne

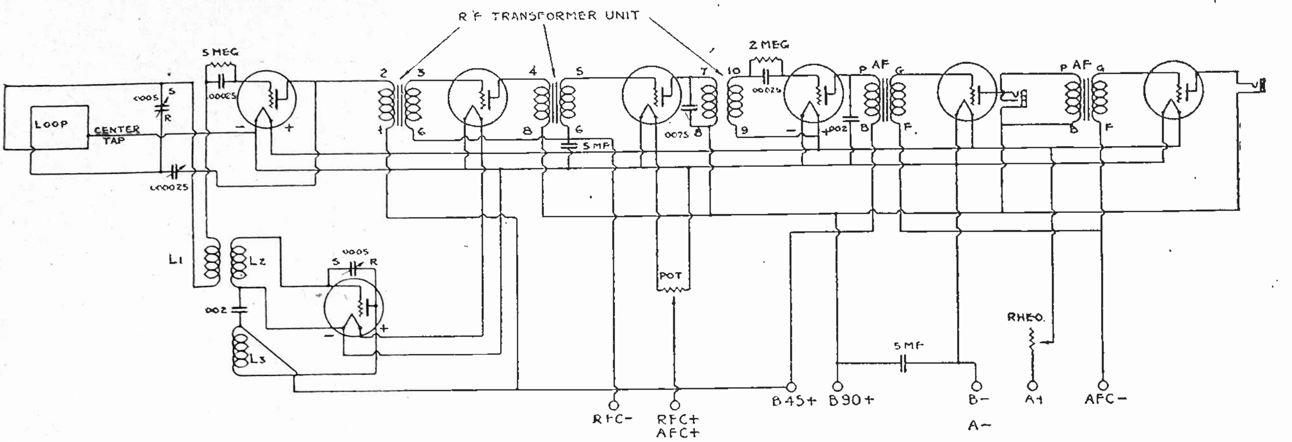


FIG. 1—The diagram of the Silver Portable Super-Heterodyne. The RFT unit is in a solid enclosed block, there being 5 terminals on each side of the block numbered in the following manner from left to right bottom to top: 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Between RFC— and RFC+, AFC+, place a 4½-volt C battery. The same applies to AFC, at the extreme where another 4½-volt C battery is placed. L1L2L3 is the special oscillator coupler. The capacity of the condenser between points 7 and 8 is .0025 not .0075 mfd.

By Wainwright Astor

THE time to make portable receivers is here. We shall all be on our vacation sooner or later, where music and topics of the day will be most welcome. This all sounds all right but the main difficulty is to get a receiver that will bring in the stations with a large volume, almost regardless of distance of the station. Such a receiver has been designed by McMurdo Silver, A. M. I. R. E., and of Silver-Marshall Inc. This set is portable, selective and a volume getter.

May Use 199 Tubes

The use of UV199 tubes in a super-heterodyne has heretofore been considered poor policy, but this was principally because the transformers and the balance of the circuits were designed for the larger tubes and would not function satisfactorily with UV199s. This is not the case with the set herein described since the equipment and circuit have been designed for maximum results with UV199 tubes.

The amplification of a weak signal is practically as great with UV199 tubes as with 201As—it is only where great volume is to be handled that the merits of the 201A are so outstanding as to render its use imperative. If we design our equipment for use with UV199 tubes, it is evident that we can obtain substantially the same results as with 201As where only loud speaker volume sufficient to fill an ordinary home or small auditorium is needed.

With a 150 K. C. amplifier the two heterodyne points on a given station are roughly thirty degrees apart on the oscillator dial for a given condition. This is decidedly an advantage. With a 50 K.C. amplifier they will be roughly ten degrees apart, with a thirty K.C. amplifier they will run four to five. The advantage here is all with the high frequencies, unless regeneration is introduced into the first detector or some other method of reducing its circuit resistance. Then the loop dial is about as sharp as the oscillator dial and this separation is of no importance at 50 K.C., although the effect is still detrimental at 30 K.C. Here another thing creeps in, in that, due to the greater stability of the 50 K.C. amplifier, it is easier to incorporate a very slight amount of regeneration in the first detector circuit than in the case of a 100 K.C. amplifier. This regeneration is not detrimental to quality to the extent to which it is used in the portable super.

Had the second harmonic or some similar principle been employed in this super, it would have been possible to eliminate one tube and make the first tube do the work of both the detector and oscillator, but such a practice was considered inadvisable, since it would have complicated the construction and testing of the set very much.

Reflexing on the intermediate stages of a super-heterodyne is almost impossible, in view of the frequencies used, except where one or more of the intermediate stages are used for direct radio-frequency amplification on the signal wavelength. This also was considered inadvisable since playing with two or more high frequencies in common circuits is a laboratory job and not well adapted for treatment on the kitchen table.

Tips on Wiring

The Chelton-Midget or balancing condenser is fastened to the upper frame support of the loop condenser by means of two lugs soldered together which will provide a firm mounting. All mica condensers are soldered directly to the wiring itself and may be put in place as the wiring progresses.

The wiring may be done either with bus wire or with magnet wire, say No. 20 or 22, with the insulation scraped off, run in spaghetti.

The accessories required will be a single 4½ volt C battery, 3 dry cells, 90 volts of B battery, seven 199 tubes, a pair of phones with plug and a loop. All these parts are standard with the exception of the loop which may be either a Silver tapped loop or any standard loop on the market from which a center tap has been taken. This center tap need not be in the exact center of the loop but may be one turn either side of the center. The three leads from the loop should be brought out through wires having a comparatively heavy insulation such as lamp cord and should be twisted together so that their positions relative to each other will remain constant even though the loop position is varied. These leads should not be over 3 feet long.

A loop may be built if desired by winding 16 turns of No. 18 solid or stranded wire on a form, roughly, 24" on a side. The winding can be in either spiral or solenoid form and should be spaced ¼" between turns. A standard loop wire may be used for this purpose very nicely, but Litz is to be avoided. If a spiral loop is used the outside end of the loop should always go to the binding post connecting to the grid of the first detector tube.

If an antenna is to be used with the set a coupling coil can be made by winding 50 turns of No. 24 DSC wire on a 3" tube, tapped at the center. The three leads from this coil go directly to the set in place of the loop. A 10-turn primary coil of the same wire wound on the same tube is connected between the antenna and ground. This coil may be located either at the center of the tube or toward the grid end of the 50-turn coil, and if desired, may be placed directly on top of it. A suitable antenna would consist of a single wire 30 to 70 feet long or a small indoor antenna anywhere from 30 to 50 feet long.

Ignore Tap at First

In the preliminary test of the set the center tap feature of the loop or turning coil should be ignored. This may be done by short circuiting the two bottom binding posts on the set and leading them directly to the inside end of the loop. The center tap is left unconnected and the outside end of the loop goes to the top binding post on the set. This will render the loop tuning

(Concluded on page 27)

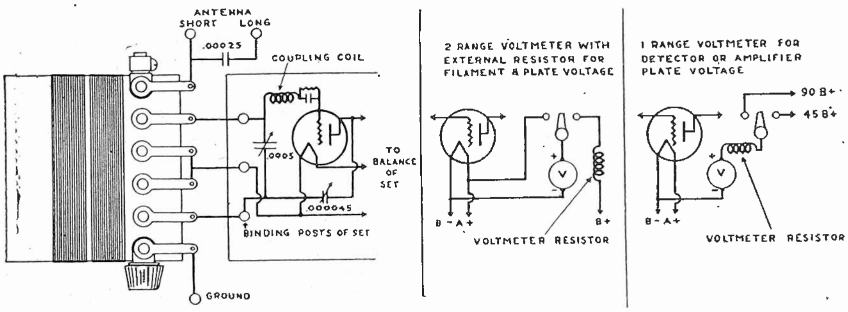


FIG. 2—The diagram at extreme left shows how to wire up the first detector in the Silver Super-Heterodyne, so as to use an antenna and ground. See text for description of coil. The sketch second from left shows how to connect up a filament and plate voltmeter and the next one how to connect up a plate voltmeter only. The voltmeter resistor is wound on a 3" tubing with 500 turns of No. 36 enameled wire.

Wavemeter Test of Condensers

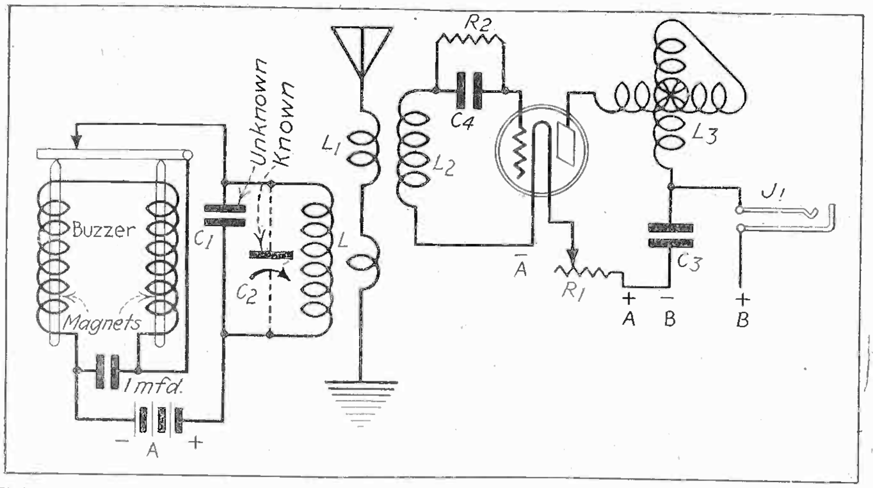


FIG. 1, showing how the unknown capacity of a condenser (fixed or variable) is determined by the wavemeter test. L1 is the regular aperiodic primary of a receiver and L a small extra winding (6 or 8 turns) in inductive relationship to the wavemeter coil next to it. No variable condenser is needed on the receiver.

By Lewis Winner

Radio Engineer

PART II

AFTER you have completed your wavemeter, the one for the calculating of the wavelength of receivers, there is something that might have stumped you when you started to calibrate your receiver. Perhaps you found that the figures did not coincide with the dial numbers on your set. That and the calibrating of a condenser from a known condenser are the main purposes for the writing of this instalment.

In Fig. 1 the wire is seen running through the coil, which is attached to the condenser on the wavemeter, and the wire is considerably long. The length of this wire is exactly two feet long, no more, no less. If you have made this wire longer, you will note that you will receive the high pitched note in your phones at a lower point on the dial than was stated in the data last week, or if you have made it shorter, the opposite will hold true, that is the readings will be higher. Also make all the leads in the wavemeter as short as you can. One has to be very careful to get all this straight, as this is the dividing line between failure and success.

You probably will note that it is kind of difficult to get the buzzer to buzz, that is, you will not get it to vibrate at once at a very high pitch. This is easily accomplished by turning the little knob on the left of the buzzer to a very tight position and then loosening very slowly, until you hit the position. Do not turn the knob fast, as the critical point is very easily missed. There is no absolute necessity of having two dry batteries connected in series to actuate the buzzer. The only reason I put two in was to obtain a little higher pitched note than obtainable on a single dry cell, and also a bit louder signal, so as not to mistake the note of the buzzer outside the box for the note in my phones. I also warned the constructor not to put any holding material on the coil. First the coil will hold itself if made in a secure fashion, that is if you put the ends of the coils through holding posts. If you put on collodion, which is the best binder substance, even then the natural frequency of the winding will be lowered, i.e., the wavelength will be increased on account of the capacity effects, and also on account of the fact that this substance or any other, such as shellac, varnish or paraffine, will get damp very quickly and tighten the windings, thereby either increasing or decreasing the fundamental wavelength of the coil. This, therefore, spoils the calibrating of your receiver.

Test For Condensers

Beside the calibrating of your receiver the wavemeter may be put to other uses, these being more difficult to accomplish but a bit more beneficial. Calibrating your variable air condenser or fixed condenser and also finding out if the condenser is punctured is possible. It is quite difficult to make the puncture test by putting a pair of phones across the condenser and listening for a click. Usually the tested condenser will click anyway, which will show that it can store up energy in electrostatic form, and yet sometimes it will not give a click on the phones at all.

It is very difficult to find out if there is an open circuit this way, because if the current does not pass through the condenser and you do not hear the click it shows nothing conclusive. The only other way beside the wavemeter method is to put a milliameter in series with a battery and see how much current is passing through the condenser. Even this method requires a great deal of patience and also a knowledge of mathematics, as you have to calculate how many milliamperes can pass through the condenser, which has to be done by formula, the formula requiring a knowledge of algebra and calculus. We therefore use the simplest and most effective method of both finding the value of a condenser and if a condenser has an open or short circuit. The chief objection in the case of calibrating the condenser is that you need a standard calibrated variable condenser, which is a bit expensive for the average pocket, but it certainly does serve a lot of purposes in the radio laboratory. The General Radio Company manufactures such an instrument, the price being about $15.

Fig. 1 shows how to hook up the instrument. The following procedure is followed in the calibrating of a fixed condenser or a variable condenser:

Insert the fixed condenser in series with the inductance in the wavemeter. Set the buzzer going and listen in on your set until you hear exact same note in your receiver phones. Now remove the unknown condenser and put the variable condenser in its place, and turn condenser dial (calibrated) until you hear the same note in the phones of your receiver. At this point the capacity (which is marked in microfarads) is equal to that of the unknown. To obtain the highest possible efficiency, the capacity of the rest of the circuit as compared with the capacity of the condenser must be very small.

To get rid of possible eddy currents that may exist around the condenser it is a very good idea to build a small copper box, one terminal going to ground and one to condenser. The size of the box is about 3" square for the fixed condenser and about 6" square for the variable condenser. The rotary plates of the variable condenser are then brought to the other terminal of the copper box. However, in the case of the fixed condenser bring either lead to the copper box. If you desire to calculate a large number of variables, insert a switch which may be of the DPDT type. This is inserted in series with the fixed or variable condenser and may be switched from one terminal to another without disconnecting any of them. In the above case it is necessary that the inductance and the capacity of the two pairs of leads running from the switch to the condenser and the mutual capacities to the rest of the circuit should be very nearly the same in the two positions. If the above directions are not carried out the results will not be as accurate as you would want them to be.

If you wish to calibrate the condenser as to the frequencies it is capable of covering listen in to the stations which have been standardized as to wavelength, WEAF, WBZ, KDKA, WSB, etc. From this data all your other condensers may be calibrated as to frequency or wavelength.

Is Condenser All Right?

As to finding out if your condenser is O. K. or not, put the condenser in series with the coil and set your buzzer going, now take the coil off and if you still hear the note you are sure that the condenser is shorted.

As to the testing of your condenser to see if there is an "open," put the condenser in series with the buzzer, using a 10-volt battery across the terminals of the buzzer. If after five minutes there is a slight little buzz the condenser is all right, but if there is no response the condenser is no good. This is due to the fact that during that period the condenser builds up a charge of current and discharges across the phones, hence, if the condenser is no good there will be no charge built up and there will be no response in the phones.

The above method is no doubt tedious, but it is a great help to find out whether the condenser is all right without going to the expense of purchasing an extra condenser just because you think it is no good. In the method requiring simply a pair of phones connected across the condenser, the possibility of hearing the click is much greater on account of the direct way of connection, but in the buzzer scheme there is lots of resistance and there is not such an easy chance of hearing the buzz, the current taking a long period to pass through the windings of the magnets. If the condenser is strong enough to build up such a charge through the windings then it is good enough to use in any set.

If a friend is desirous of making a wavemeter to test the wavelength of his transmitting set and he hasn't the material

(Concluded on page 31)

THE RADIO UNIVERSITY

A QUESTION and Answer Department conducted by RADIO WORLD for its Readers by its Staff of Experts. Address Letters to The Radio University, RADIO WORLD, 1493 Broadway, New York City.

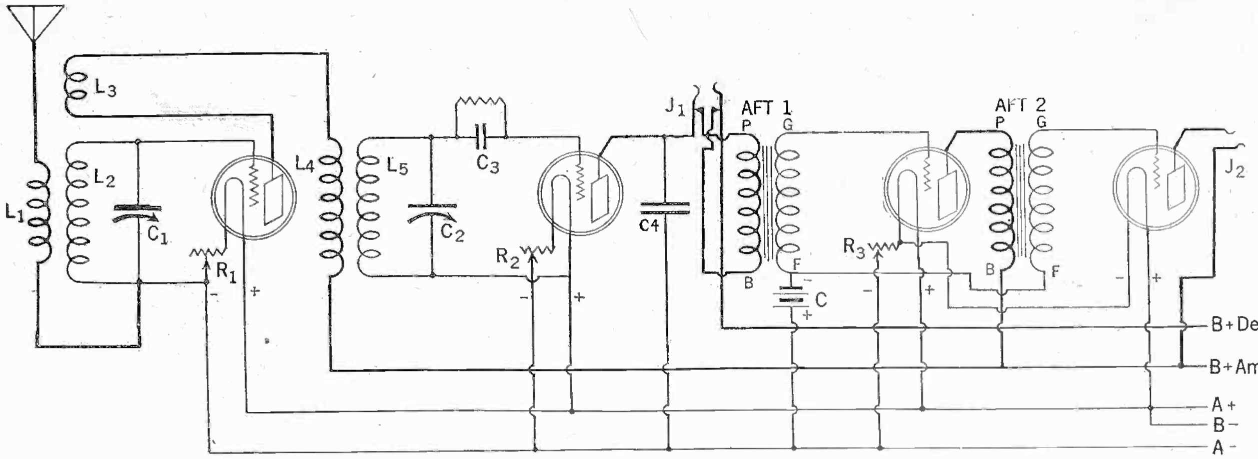


FIG. 157—Shows the schematic wiring diagram of the 4-tube DX set. Note that the ground connection is omitted as the set works without ground. But a ground connection may be made at A minus, if desired. L1L2 is wound on a 3½" diameter tubing. L1 consists of 10 turns of No. 20 DSC. Leave ½" and wind 40 turns of same wire. For the tickler L3, use a 2¾" diameter tubing, 2" high, and wind 35 turns of No. 24 SCC all in same direction. L4 has 10 turns (on a 3½" form) leave ¼" and L5 has 42 turns, using No. 20 DSC wire. C1C2 are both .0005 mfd. variable condensers. C3 is a .00025 mfd. fixed mica condenser, and C4 is a .001 mfd. fixed condenser.

PLEASE GIVE a diagram of the 3-control DX set as described by Capt. Peter V. O'Rourke, in the March 21 issue of RADIO WORLD.—B. Z. Brien, Long Island City, N. Y.

See Fig. 157.

* * *

THE FOLLOWING information is requested for enlightenment of a novice. (1) I built a 3-tube set published in the May 30 issue of RADIO WORLD. I notice the detector tube is in second position. Is that the proper place for best reception or should the RF follow the detector tube? (2) I want to do away with the troublesome method of plugging in on first step and second step audio. (3) In wiring a set is it necessary to use spaghetti or bell wire? If so, where is it needed the most and why? I do not care much about looks, but quality. (4) In using B batteries with Edison elements how long do they last before recharging is necessary, and how is the ampere-hour figured and drainage per hour on a 3-tube set? Are these better than dry batteries? (5) In regard to tubes, please advise which one is best as detector. (6) Your suggestion for best direction for aerial. (7) Would a C battery help in reception?—H. C. Heidrich, 4714 Lambert St., Glendale, L. I., N. Y.

(1) When radio-frequency amplification is employed it is always placed before detector tube. (2) See June 6 of RADIO WORLD in the Radio University for a diagram that will help you. (3) No. Bell wire is better than bus bar. (4) This depends on types of tubes used, number of cells in B battery, number of milliamperes battery will give as stated by manufacturer, etc. The storage cells are better than dry batteries and should be charged usually every two months. (5) UV200 or C300 are the best detectors. (6) Place antenna pointing in same direction as the favorite broadcasting station which you desire to receive and take leadin from that end. (7) Not necessarily. It is an economy adjunct primarily.

* * *

PLEASE ANSWER the following questions in regard to H. E. Wright's "Powerful Three-Tube Reflex," in the May 23 issue of the RADIO WORLD: (1) Can commercial tuned radio-frequency be used instead of the coils described? (2) Could neutralizing condensers be employed? (3) If these are used shouldn't the potentiometer, which is used to stabilize the set, be discarded?—A. Rowen, Farmington, Ia.

(1) Yes. (2) Yes. (3) Yes.

* * *

DO I HAVE to be licensed to do repairing and wiring of all types of sets?—E. S. Brothers, Williamstown, W. Va.

Not for repair work, but making sets for sale is a violation of the patent rights of the set.

* * *

IN THE May 23 issue of RADIO WORLD you have a transmitting diagram of a transmitting set described by C. H. West. I have nearly completed this set, but do not know what to do with the tap points on the Helix.—Walter Ezell, 1818 West Quake St., Chicago, Ill.

Connect the antenna post to a switch arm and the plate post of the tube socket to the other switch arm. The taps of both sides of the Helix are brought to the front of the panel.

* * *

I AM quite puzzled as how to wind the coils for the 1-Tube Set for the Novice, described in your May 23 issue by Percy Warren. I don't understand if the grid and the antenna coils are wound together or separate.—E. F. Watters, 394 Lafayette Ave., Brooklyn, N. Y.

The grid coil, the plate coil and the antenna coil are all wound on the same tubing, but are all spaced ¼" away from each other, i.e., are separate.

* * *

COULD I use the Birco 3-circuit tuner for the Diamond of the Air as described by Herman Bernard in the April 4 issue of RADIO WORLD. How many turns should I use on my radio-frequency coils if I use this coil?—Thomas C. Joyner, 2537 Vimy Ridge Ave., Norfolk, Va.

(1) Yes. (2) See Herman Bernard's article on coil matching in this issue.

* * *

IN THE DX Transmitter as described by C. H. West, in the May 23 issue of RADIO WORLD, where should the key go?—Ralph E. Witt, Guitman, Ark.

Place it in the grid circuit after the grid condenser, that is, where the switch is and where it says C.W.

* * *

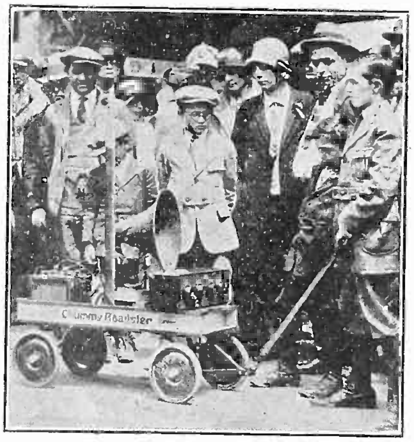
COULD I use an Ambassador coil in the set described in the May 30 issue of the RADIO WORLD by Percy Warren, instead of the fixed coil and still use the variable condenser across the tickler leads? (2) How can I connect two stages of transformer-coupled audio-frequency to this set? (3) I wish to use the UV199s in this

(Concluded on page 24)

Panel Portraiture Arrives

THE LATEST HOME TOUCH deals not with the bankroll, but the radio. Family photos are framed on the very panel itself. Clara Horton shows how this does not complicate tuning in the least. (Kadel & Herbert.)

NELLIE REVELL, back in health, broadcasts. (Foto Topics.)



CROWDS wondered where the aerial was in this Saling Street scene, Syracuse, N. Y. (Underwood & Underwood.)

FATHER and son, radio fans in the village of Volsana, Russia. The father, by right of seniority, enjoys the concert while the son awaits his turn. A crystal set is used. Super-power has no terrors for this type of listener, although a speaker with proper AF would not be a bit irritating. Hurrah for U. S.! (Wide World)

Hazeltine Inve

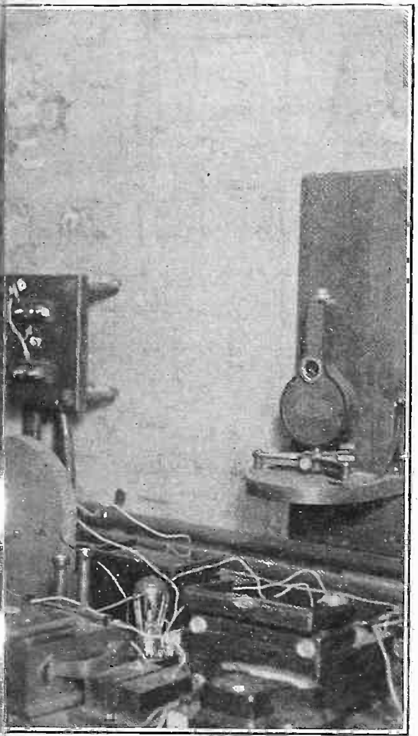
PROF. LOUIS A. HAZELTINE, the man w
department of Electrical Engineering at Steven
on a new inventi

Vote for Your F

WHOM do you prefer on t
ence in a material way
contest. Use the coupon publ

SAX OF GOLD, this lucky band of thirteen calls its instrumen
as the first all-saxophone aggregation they are winning radio pop
prosperous engagements outside the studio. Note the expressi
philosophical faces of these moan magicians. The guy at low
the microphone looks enraptured, but the one at middle right o
to be taking a vengeful bite out of the nozzle. (Foto Topi

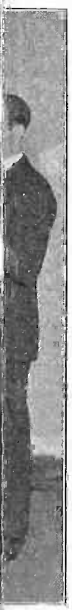
ting Something



ave us the Neutrodyne principle, head of the titute of Technology, Hoboken, N. J., is working (Kadel & Herbert)

orite Entertainer!

ir? You can show your prefer- balloting in RADIO WORLD'S d in this issue.



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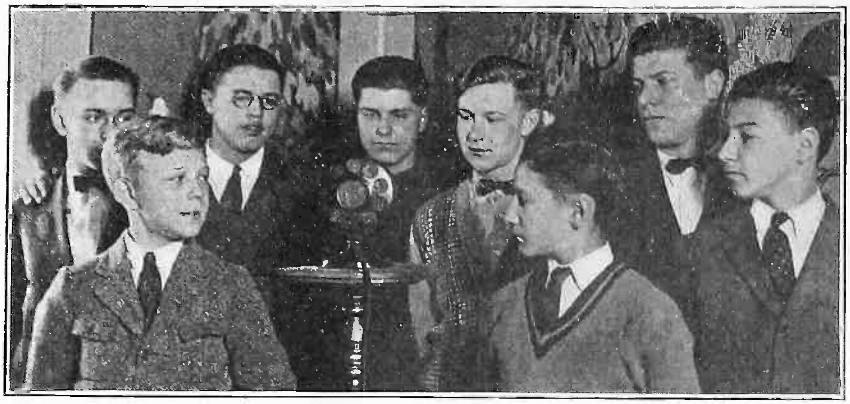
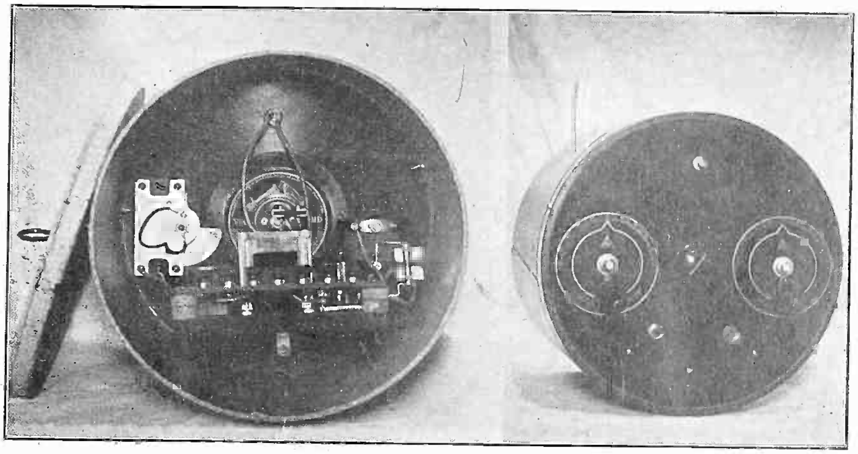
Merry Clash for Big Job



A FIERCE CONTEST, almost as hot as the one for captain of the track team, is waged at Lane Technical High School, Chicago, for the job of announcer at the school's new broadcasting station. All the boys are students at the school and the students will run the station. Left to right, front row, C. Gruner, A. Blyberg, W. Lara and A. Zuckerman; rear row, R. Kroft, C. Petrie, E. Knaack and G. Kalb. (Underwood & Underwood.)



USING a phonograph record as a panel for a portable radio set the result is shown above. The material in the record is a very good insulator. Note the space inside for batteries. (Kadel & Herbert)

PUT a nickel in the slot of this radio set and hear music for five minutes. That's how Miss Florence Ginder of Fort Worth, Tex., is spending her money. (Intnat.)

WHY warm one's hands over the hot roof on a Summer afternoon? No reason for it, so this pair avoids such foolishness and instead sensibly drops new, good (not no good) radio tubes. Kerplunk! The tubes—a new type—are unbreakable. Herbert H. Metcalfe and Elsie Glassen demonstrating. (K.&H.)

THE KEY TO THE AIR

KEY

Abbreviations: E. S. T., Eastern Standard Time; C. S. T., Central Standard Time; M. S. T., Mountain Standard Time; P. S. T., Pacific Standard Time; D. S., Daylight Saving Time.

How to tune in a desired distant station at just the right time—Choose your station from the list published herewith. See what time division the station is under (E. S. T., C. S. T., etc.); then consult the table below. Add to or subtract, as directed from the time as given on the PROGRAM. The result will be the same BY YOUR CLOCK that you should tune in, unless daylight saving time intervenes, as explained below.—The table:

If you are in	*And want a station in*	*Subtract*	*Add*
E. S. T.	C. S. T.	..	1 hr.
E. S. T.	M. S. T.	..	2 hrs.
E. S. T.	P. S. T.	..	3 hrs.
C. S. T.	E. S. T.	1 hr.	..
C. S. T.	M. S. T.	..	1 hr.
C. S. T.	P. S. T.	..	2 hrs.
M. S. T.	E. S. T.	2 hrs.	..
M. S. T.	C. S. T.	1 hr.	..
M. S. T.	P. S. T.	..	1 hr.
P. S. T.	E. S. T.	3 hrs.	..
P. S. T.	C. S. T.	2 hrs.	..
P. S. T.	D. S. T.	1 hr.	..

FRIDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.) —11 A. M. to 12.

WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 to 1:05 P. M.; 8 to 12 P. M.

WAMD, Minneapolis, Minn., 243.8 (C. S. T.)—12 to 1 P. M.; 10 to 12.

WBBM, Chicago, Ill., 226 (C. S. T.)—8 to 10 P. M.

WBBR, New York City, 272.6 (E. S. T., D. S.) —8 P. M. to 10.

WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.) —6 P. M. to 11.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 to 4; 5:30 to 10.

WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.) —12:30 to 1:30 P. M.; 4:30 to 5:30; 6:30 to 11.

WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—3:30 to 7 P. M.; 8 to 10; 11:45 to 1 A. M.

WEAF, New York City, 492 (E. S. T., D. S.) —6:45 A. M. to 7:45; 11 to 12; 4 P. M. to 5; 6 to 12.

WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 3:30 to 4:10; 8 to 11.

WEAO, Ohio State University, 293.9 (E. S. T.) —8 P. M. to 10.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2 P. M. to 3:15; 5:30 to 10.

WEMC, Berrien Springs, Mich., 286 (C. S. T.)—9 P. M. to 11.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30.

WGBS, New York City, 316 (E. S. T., D. S.) —10 A. M. to 11; 1:30 P. M. to 4; 6 to 11

WGCP, New York City, 252 (E. S. T., D. S.)—8 P. M. to 11.

WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 7; 10:30 to 1 A. M.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 11:30.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:45 P. M.; 7:30 to 11.

WGST, Atlanta, Ga., 270 (C. S. T.)—7 P. M. to 8.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—1 P. M. to 2; 5:30 to 10:30.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 8.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.) —12:30 P. M. to 1; 2:15 to 5; 7 to 11; 12 to 12:30 A. M.

WHO, Des Moines, Iowa, 526 (C. S. T.)—7:30 P. M. to 9; 11 to 12; 12:30 to 1:30; 4:30 to 5:30; 6:30 to 9:30.

WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.) —7 A. M. to 8; 1 P. M. to 2; 3 to 4:50; 6 to 8.

WJY, New York City, 405 (E. S. T., D. S.)—7:30 P. M. to 11:30.

WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11; 1 P. M. to 2; 4 to 6; 7 to 10:30.

WLIT, Philadelphia, Pa., 395 (E. S. T.)—12:02 P. M. to 12:30; 2 to 3; 4:30 to 6; 7:30 to 1 A. M.

WLW, Cincinnati, O., 422.3 (E. S. T.)—10:45 A. M. to 12:15; 1:30 P. M. to 2:30.

WMCA, New York City, 341 (E. S. T., D. S.)—3 P. M. to 3:45; 4 to 5; 6:30 to 10:30; 11 to 12.

WNYC, New York City, 526 (E. S. T., D. S.) —3:45 P. M. to 4:45; 6:20 to 11.

WOAW, Omaha, Neb., 526 (C. S. T.)—12:30 P. M. to 1; 5:45 to 7:10; 9 to 11.

WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 3 to 3:30; 5:45 to 12.

WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 7.

WPAK, Fargo, N. D., 283 (C. S. T.)—7:30 P. M. to 9.

WPG, Atlantic City, N. J., 299.8 (E. S. T., D. S.) —7 P. M. to 8:30; 10 to 12.

WOJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12M; 3 P M to 4; 7 to 8; 10 to 2 A. M.

WRC, Washington, D. C., 469 (E. S. T.)—4:30 P. M. to 5; 6:45 to 12.

WWJ, Detroit, Mich., 352.7 (E. S. T.)—8 A. M. to 8:30; 9:30 to 10:30; 11:55 to 1:30; 3 to 4; 6 to 7; 8 to 10.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—6 A. M. to 7; 9:45 to 12:20 P. M.; 1:30 to 3:20; 5:30 to 11.

KFAE, State College of Wash., 348.6 (P. S. T.) —7:30 P. M. to 9.

KFDY, Brookings, S. D., 273 (M. S. T.)—8 P. M. to 9.

KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 10.

KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 9:30 to 12.

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 P. M. to 1:15; 3 to 4; 6:30 to 10.

KFOA, Seattle, Wash., 455 (P. S. T.)—12:30 P. M. to 1:30; 4 to 5:15; 6 to 11.

KGO, Oakland, Cal., 361.2 (P. S. T.)—11:10 A. M. to 1 P. M.; 1:30 to 3; 4 to 7.

KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 5 to 11.

KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 3:30 P. M.; 5:30 to 11:30.

KNX, Hollywood, Cal., 337 (P. S. T.)—11:30 A. M. to 12:30 P. M.; 1 to 2; 4 to 5; 6:30 to 12.

KOB, State College of New Mexico, 348.6 (M. S. T.)—11:55 A. M. to 12:30 P. M.; 7:30 to 8:30; 9:55 to 10:10.

KPO, San Francisco, Cal., 429 (P. S. T.)—7:30 A. M. to 8; 10:30 to 12 M.; 1 P. M. to 2; 4:30 to 11.

KSD, St. Louis, Mo., 545.1 (C. S. T.)—4 P. M. to 5.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—12:30 P. M. to 1; 8:20 to 10.

KYW, Chicago, Ill., 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:55 to 1 P. M.; 2:25 to 3:30; 6:02 to 7:20; 9 to 1:30 A. M.

CNRA, Moncton, Canada, 313 (E. S. T.)—8:30 P. M. to 10:30.

CNRE, Edmonton, Canada, 516.9 (M. S. T.)—8:30 P. M. to 10:30.

CNRS, Saskatoon, Canada, 400 (M. S. T.)—2:30 P. M. to 3.

CNRT, Toronto, Canada, 357 (E. S. T.)—6:30 P. M. to 11.

SATURDAY

WAAM, Newark, N. J., 263 (E. S. T.)—7 P. M. to 11.

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WAMD, Minneapolis, Minn., 243.8 (C. S. T.)—12 M. to 1 P. M.; 10 to 12.

WBBM, Chicago, Ill., 226 (C. S. T.)—8 P. M. to 1 A. M.

WBBR, New York City, 272.6 (E. S. T., D. S.) —8 P. M. to 9.

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WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 4 P. M. to 5; 6 to 12.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 7 A. M.

WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 3:30 to 4:10; 7 to 8.

WEMC, Berrien Springs, Mich., 286 (C. S. T.) —11 A. M. to 12:30 P. M.; 8:15 to 11.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—12:30 P. M. to 1; 6 to 7; 8:30 to 9:30; 11 to 12:30 A. M.

WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11; 1:30 P. M. to 3; 6 to 12.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 2:30 P. M.; 3 to 5:57; 6 to 11:30.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:45 P. M.; 2:30 to 4:30; 7:30 to 8.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—7:30 P. M. to 10.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 8.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.)—2:15 P. M. to 5; 7:30 to 10.

WHO, Des Moines, Iowa, 526 (C. S. T.)—11 A. M. to 12:30 P. M.; 4 to 5:30; 7:30 to 8:30.

WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—7 A. M. to 8; 10:20 to 11; 1 P. M. to 2; 3 to 4; 6 to 11:30.

WJY, New York City, 405 (E. S. T., D. S.)—2:30 P. M. to 5; 8 to 10:30.

WJZ, New York City, 455 (E. S. T., D. S.)—9 A. M. to 12:30 P. M.; 2:30 to 4; 7 to 10.

WKRC, Cincinnati, O., 326 (E. S. T.)—10 to 12 M.

WLW, Cincinnati, O., 422.3 (E. S. T.)—9:30 A. M. to 12:30 P. M.; 7:30 to 10.

WMAK, Lockport, N. Y., 265.5 (E. S. T.)—10:25 A. M. to 12:30 P. M.

WMC, Memphis, Tenn., 499.7 (E. S. T.)—7:30 P. M. to 10.

WMCA, New York City, 341 (E. S. T., D. S.) —3 P. M. to 3:15; 3:30 to 5; 8 to 8:15; 8:30 to 8:45; 11 P. M. to 1 A. M.

WNYC, New York City, 526 (E. S. T., D. S.)—1 P. M. to 3; 7 to 11.

WOAW, Omaha, Neb., 526 (C. S. T.)—9 A. M. to 11; 2:15 P. M. to 4; 9 to 11.

WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 5:45 to 7:10; 9 to 12.

WOO, Philadelphia, Pa., 508.2 (E. S. T., D. S.) —11 A. M. to 1 P. M.; 4:40 to 5; 10:55 to 11:02.

WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 7:30; 8 to 11.

WPG, Atlantic City, N. J., 299.8 (C. S. T.)—7 P. M. to 12.

WOJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4; 7 to 8; 10 to 3 A. M.

WRC, Washington, D. C., 469 (E. S. T.)—4:30 to 5:30 P. M.; 6:45 to 12.

WWJ, Detroit Mich. 352.7 (E. S. T.)—8 A. M. to 8:30; 9:30 to 10:30; 11:55 to 1:30 P. M.; 3 to 4.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—10 A. M. to 12:30 P. M.; 1:30 to 6:30; 8:45 to 10.

KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.

KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 9:30 to 12:30.

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 P. M. to 1:15; 3 to 4; 6:30 to 10:30.

KFOA, Seattle, Wash., 455 (P. S. T.)—Silent.

KGO, Oakland, Cal., 361.2 (P. S. T.)—11 A. M. to 12:30 P. M.; 3:30 to 5:45; 7:30 to 9.

KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 6 to 7; 10 to 11.

KHJ, Los Angeles, Cal., 405.2 (E. S. T., D. S.)—7 A. M. to 7:30; 10 to 1:30 P. M.; 2:30 to 3:30; 5:30 to 2 A. M.

KNX, Hollywood, Cal., 337 (P. S. T.)—1 P. M. to 2; 6:30 to 2 A. M.

KOA, Denver, Colo., 322.4 (M. S. T.)—11:30 A. M. to 1 P. M.; 7 to 10.

KPO, San Francisco, Cal., 429 (P. S. T.)—8 A. M. to 12 M.; 2 P. M. to 3; 6 to 10.

KSD, St. Louis, Mo., 545.1 (C. S. T.)—7 P. M. to 8:30.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—12:30 P. M. to 1; 8:30 to 10:30.

KYW, Chicago, Ill., 536 (C. S. T., D. S.)—1 A. M. to 12:30 P. M.; 4 to 5; 7 to 8.

CKAC, Montreal, Canada, 411 (E. S. T.)—4 P. M. to 5:30.

CNRO, Ottawa, Ontario, Canada, 435 (E. S. T.) —7:30 P. M. to 10.

PWX, Havana, Cuba, 400 (E. S. T.)—8:30 P. M. to 11:30.

SUNDAY

WBBM, Chicago, Ill., 226 (C. S. T.)—4 P. M. to 6; 8 to 10.

WBBR, New York City, 272.6 (E. S. T., D. S.)—10 A. M. to 12 M., 9 P. M. to 11.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—11 A. M. to 12:30 P. M.; 4:10 to 5:10; 7:20 to 10.

WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—4 P. M. to 5:30.

WEAF, New York City, 492 (E. S. T., D. S.)—3 P. M. to 5; 7:20 to 10:15.

WEAR, Cleveland, O., 390 (E. S. T.)—3:30 P. M. to 5; 7 to 8; 9 to 10.

WGBS, New York City, 316 (E. S. T., D. S.)—3:30 P. M. to 4:30; 9:30 to 10:30.

WGN, Chicago, Ill., 370 (C. S. T.)—11 A. M. to 12:45 P. M.; 2:30 to 5; 9 to 10.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—3 P. M. to 4; 7:15 to 8.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—9:30 A. M. to 12:30 P. M.; 2:35 to 3:45; 6:30 to 10:30.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—2 P. M. to 3.

WHN, New York City, 360 (E. S. T., D. S.)—1 P. M. to 1:30; 3 to 6; 10 to 12.

WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.) —10:45 A. M. to 12:30 P. M.; 3:30 to 4:30.

WKRC, Cincinnati, O., 326 (E. S. T.)—6:45 P. M. to 11.

WNYC, New York City, 526 (E. S. T., D. S.)—9 P. M. to 11.

WMCA, New York City, 341 (E. S. T., D. S.)—11 A. M. to 12:15 P. M.; 4 to 5; 7 to 8.

WPG, Atlantic City, N. J., 299.8 (C. S. T., D. S.) —3:15 P. M. to 5; 9 to 11.

WQJ, Chicago, Ill., 448 (C. S. T.)—10:30 A. M. to 12:30 P. M.; 3 P. M. to 4; 8 to 10.

WWJ, Detroit, Mich., 352.7 (E. S. T.)—11 A. M. to 12:30 P. M.; 2 to 4; 6:20 to 9.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—9:45 A. M. to 10:30; 11:55 to 12 M.; 2:30 P. M. to 5:30; 7 to 11.

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—10:45 A. M. to 12:30 P. M.; 2:30 to 4:30; 6:30 to 10.

KOA, Denver, Col., 322.4 (M. S. T.)—10:55 A. M. to 12 M.; 4 P. M. to 5:30 P. M.; 7:45 P. M. to 10 P. M.

KGW, Portland, Oregon, 491.5 (P. S. T.)—10:30 A. M. to 12:30 P. M.; 6 to 9.

KHJ, Los Angeles, Cal., 405.2 (E. S. T., D. S.) —10 A. M. to 12:30 P. M.; 6 to 9.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—11 A. M. to 12:30 P. M.; 2:30 to 3:40; 8:40 to 11.

MONDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.) —11 A. M. to 12 M.; 7 P. M. to 11.

WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 M. to 1:05 P. M.; 8 to 2 A. M.

WAMB, Minneapolis, Minn., 243.8 (C. S. T)—10 P. M. to 12.

WBBM, Chicago, Ill., 226 (C. S. T.)—6 P. M. to 7.

WBBR, New York City, 272.6 (E. S. T., D. S.) —8 P. M. to 9.

WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.) —6 P. M. to 11:30.

WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.)—12:30 P. M. to 1:30; 4:30 to 5:30; 6:30 to 12.

WCBD, Zion, Ill., 344.6 (C. S. T.)—8 P. M. to 10.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 P. M. to 6:15; 8 to 10.

WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—3:30 P. M. to 7; 8 to 10; 11:45 to 1 A. M.

WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 4 P. M. to 5; 6 to 11:30.

WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 3:30 to 4:10; 7 to 8.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 8; 3 P. M. to 4; 5:30 to 10.

WEMC, Berrien Springs, Mich., 286 (C. S. T.)—8:15 P. M. to 11.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30.

WGBS, New York City, 316 (E. S. T., D. S.) —10 A. M. to 11; 1:30 P. M. to 3:10; 6 to 7:30.

WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 8.

WGCP, New York City, 252 (E. S. T., D. S.)—8 P. M. to 1 A. M.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 5:57.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:30 P. M.; 2:30 to 4:30; 7:30 to 11.

WGST, Atlanta, Ga., 270 (C. S. T.)—9 P. M. to 10.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—1 P. M. to 2; 5:30 to 8:30.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 10:30.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.)—2:15 P. M. to 5; 6:30 to 12.

WHO, Des Moines, Iowa, 526 (C. S. T.)—12:15 P. M. to 1:30; 7:30 to 9; 11:15 to 12.

WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—7 A. M. to 8; 1 P. M. to 2; 3 to 8.

WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11; 1 P. M. to 2; 4 to 5:30; 6 to 6:30; 7 to 11.

WKRC, Cincinnati, O., 326 (E. S. T.)—8 P. M. to 10.

WLIT, Philadelphia, Pa., 395 (E. S. T.)—12:02 P. M. to 1; 2 to 3; 4:30 to 6; 7:30 to 11:30.

WPAK, Fargo, N. D., 283 (C. S. T.)—7:30 P. M. to 9.

WLW, Cincinnati, O., 422.3 (E. S. T.)—10:45 A. M. to 12:15 P. M.; 1:30 to 3:20; 3 to 5; 6 to 10.

WMAK, Lockport, N. Y., 265.5 (E. S. T.)—8 P. M. to 12.

WNYC, New York City, 526 (E. S. T., D. S.)—3:15 P. M. to 4:15; 6:20 to 11.

WOAW, Omaha, Neb., 526 (C. S. T.)—12:30 P. M. to 1:30; 5:45 to 10:30.

WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 3 to 3:30; 5:45 to 6.

WOO, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—11 A. M. to 1 P. M.; 4:40 to 6; 7:30 to 11.

WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 11:30.

WPG, Atlantic City, N. J., 299.8 (E. S. T., D. S.)—7 P. M. to 11.

WQJ, Chicago, Ill., 488 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4.

WRC, Washington, D. C., 469 (E. S. T.)—1 P. M. to 2; 4 to 6.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—6 A. M. to 7; 9:45 to 12:15 P. M.; 2:30 to 3:20; 5:30 to 10.

KFAE, State College of Wash., 348.6 (P. S. T.)—7:30 P. M. to 9.

KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.

KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 5:15 to 6:15; 9:30 to 12:30.

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 P. M. to 1:15; 3 to 4; 6:30 to 10.

KFOA, Seattle, Wash., 455 (P. S. T.)—12:45 P. M. to 1:30; 4 to 5:15; 6 to 10.

KGO, Oakland, Cal., 361.2 (P. S. T.)—9 A. M. to 10:30; 11:30 A. M. to 1 P. M.; 1:30 to 6; 6:45 to 7; 8 to 1 A. M.

KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30; 5 to 8.

KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 1:30 P. M.; 5:30 to 10.

KNX, Hollywood, Cal., 337 (P. S. T.)—12 M. to 1 P. M.; 4 to 5; 6:30 to 12.

KOB, State College of New Mexico, 348.6 (M. S. T.)—11:55 A. M. to 12:30 P. M.; 7:30 to 8:30; 9:55 to 10:10.

KPO, San Francisco, Cal., 429 (P. S. T.)—10:30 A. M. to 12 M.; 1 P. M. to 2; 2:30 to 3:30; 4:30 to 10.

KSD, St. Louis, Mo., 545.1 (C. S. T.)—7:30 P. M. to 10.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—12:30 P. M. to 1; 8:30 to 10.

KYW, Chicago, Ill., 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:55 to 1 P. M.; 2:15 to 3:30; 6:02 to 7.

TUESDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.)—11 A. M. to 12 M.; 7 P. M. to 11.

WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 P. M. to 1:05 A. M.

WAMD, Minneapolis, Minn., 243.8 (C. S. T.)—12 M. to 1 P. M.; 10 to 12.

WBBM, Chicago, Ill., 226 (C. S. T.)—8 P. M. to 12.

WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—6 P. M. to 11.

WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.)—12:30 P. M. to 1:30; 4:30 to 5:30; 6:30 to 11.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 P. M. to 4; 5:30 to 10.

WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—3:30 P. M. to 7; 11:45 to 1 A. M.

WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 11 to 12 M.; 4 P. M. to 5; 6 to 12.

WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 7 to 10; 10 to 11.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 8; 1 P. M. to 2; 6:30 to 10.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30; 11 to 12.

WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11; 1:30 P. M. to 3; 6 to 11:30.

WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 8; 10:30 to 1 A. M.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 11:30.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—11 A. M. to 12:45 P. M.; 7:30 to 11.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—11 P. M. to 2:30; 5:20 to 7:30; 9 to 11:30.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 8.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.)—12:30 P. M. to 1; 2:15 to 3:15; 4 to 5:30; 7:30 to 10:45; 11:30 to 12:30 A. M.

WHO, Des Moines, Iowa, 526 (C. S. T.)—12:15 P. M. to 1:30; 7:30 to 9; 11 to 12.

WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—7 A. M. to 8; 1 P. M. to 2; 3 to 4:50; 6 to 11.

WJY, New York City, 405 (E. S. T., D. S.)—7:30 P. M. to 1:30.

WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11; 1 P. M. to 2; 4 to 6; 7 to 11.

WKRC, Cincinnati, O., 326 (E. S. T.)—8 P. M. to 12.

WLIT, Philadelphia, Pa., 395 (E. S. T.)—11 A. M. to 12:30 P. M.; 2 to 3; 4:30 to 7.

WLW, Cincinnati, O., 422.3 (E. S. T.)—10:45 A. M. to 1 P. M.; 1:30 to 2:30; 3 to 5; 6 to 11.

WNYC, New York City, 526 (E. S. T., D. S.)—3:45 P. M. to 5; 6:50 to 11.

WOAW, Omaha, Neb., 526 (C. S. T.)—12:30 P. M. to 1:30; 5:45 to 11.

WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 3 to 3:30; 5:45 to 10.

WOO, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—11 A. M. to 1 P. M.; 4:40 to 5; 10:55 to 11:02.

WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 7:30.

WPG, Atlantic City, N. J., 299.8 (E. S. T., D. S.)—7 P. M. to 11.

WQJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4; 7 to 8; 10 to 2 A. M.

WRC, Washington, D. C., 469 (E. S. T.)—4:30 P. M. to 5:30; 6:45 to 11.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—9:45 P. M. to 12 M.; 1:30 P. M. to 3:20; 5:30 to 10:45.

KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.

KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 5:15 to 6:15; 9:30 to 12:30.

KFOA, Seattle, Wash., 455 (P. S. T.)—12:30 P. M. to 1:30; 4 to 5:15; 6 to 11.

KGO, Oakland, Cal., 361.2 (P. S. T.)—11:30 A. M. to 1 P. M.; 1:30 to 3; 4 to 6:45; 8 to 1 A. M.

KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 5 to 11.

KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 3:30 P. M.; 5:30 to 11.

KNX, Hollywood, Cal., 337 (P. S. T.)—9 A. M. to 10; 1 P. M. to 2; 4 to 5; 6:30 to 12.

KPO, San Francisco, Cal., 429 (P. S. T.)—7 A. M. to 7:45; 10 to 12 M.; 1 P. M. to 2; 3:30 to 11.

KSD, St. Louis, Mo., 541.1 (C. S. T.)—6 P. M. to 7.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—12:30 P. M. to 1; 8:30 to 10:30.

KYW, Chicago, Ill., 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:30 to 1 P. M.; 2:15 to 4; 6:02 to 11:30.

CNRA, Moncton, New Brunswick, Canada, 313 (E. S. T.)—9:30 P. M. to 11.

CNRR, Regina, Saskatchewan, Canada, 8 P. M. to 11.

WEDNESDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.)—11 A. M. to 12 M.; 7 P. M. to 11.

WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 M. to 1:05 P. M.; 8 to 12.

WAMD, Minneapolis, Minn., 243.8 (C. S. T.)—12 M. to 1 P. M.; 10 to 12.

WBBM, Chicago, Ill., 226 (C. S. T.)—8 P. M. to 10.

WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—6 P. M. to 11.

WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.)—12:30 P. M. to 1:30; 4:30 to 5:30; 6:30 to 11.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 to 4; 5:30 to 11.

WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—3:30 P. M. to 7; 8 to 9:15; 11:45 to 1 A. M.

WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 11 to 12 M.; 4 P. M. to 5; 6 to 12.

WEAO, Ohio State University, 293.9 (E. S. T.)—8 P. M. to 10.

WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 3:30 to 4:10; 6:45 to 7:45.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 8; 3 P. M. to 4; 5:30 to 10.

WEMC, Berrien Springs, Mich., 286 (C. S. T.)—8:15 P. M. to 11.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1.

WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 7; 10:30 to 1 A. M.

WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11 P. M.; 1:30 to 4; 6 to 7.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 11:30.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:45 P. M.; 2:30 to 4:30; 6:30 to 11.

WGY, Schenectady, N. Y., 379.5 (C. S. T.)—5:30 P. M. to 7:30.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 4 P. M. to 5; 6 to 10; 11:30 to 12:30 A. M.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.)—2:15 P. M. to 5:30; 7:30 to 11; 11:30 to 12:30 A. M.

WHO, Des Moines, Iowa, 526 (C. S. T.)—12:15 P. M. to 1:30; 6:30 to 12 M.

WIP, Philadelphia, Pa., 508 (E. S. T., D. S.)—7 A. M. to 8; 10:20 to 11; 1 P. M. to 2; 3 to 4; 6 to 8.

WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11; 1 P. M. to 2; 4 to 6; 7 to 11:30.

WKRC, Cincinnati, Ohio, 326 (E. S. T.)—8 P. M. to 10.

WLIT, Philadelphia, Pa., 395 (E. S. T.)—12:02 P. M. to 12:30; 2 to 3; 4:30 to 6; 7:30 to 9.

WLW, Cincinnati, O., 422.3 (E. S. T.)—10:45 A. M. to 12:15 P. M.; 1:30 to 2:30; 3 to 5; 6 to 11.

WNYC, New York City, 526 (E. S. T., D. S.)—6:30 P. M. to 11.

WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 3 to 3:30; 4 to 7:05; 9 to 11.

WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 12 M.

WPAK, Fargo, N. D., 283 (C. S. T.)—7:30 P. M. to 9.

WQJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4; 7 to 8; 10 to 2 A. M.

WRC, Washington, D. C., 469 (E. S. T.)—1 P. M. to 2; 4 to 6:30.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—6 A. M. to 7; 9:45 to 12:15 P. M.; 2:30 to 3:20; 5:30 to 11.

KFAE, State College of Wash., 348.6 (P. S. T.)—7:30 P. M. to 9.

KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.

KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 5:15 to 6:15; 9:30 to 12:30.

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 P. M. to 1:15; 3 to 4; 6:30 to 10.

KFOA, Seattle, Wash., 455 (P. S. T.)—12:30 P. M. to 1:30; 4 to 5:15; 6 to 10.

KGO, Oakland, Cal., 361.2 (P. S. T.)—11:30 A. M. to 1 P. M.; 1:30 to 2:30; 3 to 6:45.

KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 5 to 10.

KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 1:30 P. M.; 5:30 to 12.

KNX, Hollywood, Cal., 337 (P. S. T.)—1 P. M. to 2; 7 to 12.

KOB, State College of New Mexico, 348.6 (M. S. T.)—11:55 A. M. to 12:30 P. M.; 7:30 to 8:30; 9:55 to 10:10.

KPO, San Francisco, Cal., 429 (P. S. T.)—7 A. M. to 8; 10:30 to 12 M.; 1 P. M. to 2; 4:30 to 11.

KSD, St. Louis, Mo., 545.1 (C. S. T.)—7 P. M. to 10.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—8:30 P. M. to 10.

KYW, Chicago, Ill., 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:55 to 1 P. M.; 2:15 to 4; 6:02 to 11:30.

PWX, Havana, Cuba, 400 (E. S. T.)—8:30 P. M. to 11:30.

CNRO, Ottawa, Ontario, Canada, 435 (E. S. T.)—7 P. M. to 11.

THURSDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.)—11 A. M. to 12 M.; 7 P. M. to 11.

WAHG, Richmond Hill, N. Y., 316 (E. S. T.)—12 P. M. to 1:05.

WAMB, Minneapolis, Minn., 243.8 (C. S. T.)—12 M. to 1 P. M.; 10 to 12 M.

WBBM, Chicago, Ill., 226 (C. S. T.)—8 P. M. to 10.

WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—6 P. M. to 11:45.

WCAE, Pittsburgh, Pa., 461.3 (C. S. T., D. S.)—12:30 P. M. to 1:30; 4:30 to 5:30; 6:30 to 11.

WCBD, Zion, Ill., 344.6 (C. S. T.)—8 P. M. to 10.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 P. M. to 4; 5:30 to 10.

WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 11 to 12 M.; 4 P. M. to 5; 6 to 12.

WEAR, Cleveland, O., 390 (E. S. T.)—10:30 A. M. to 12:10 P. M.; 3:30 to 4:15; 7 to 11.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 7:45; 1 P. M. to 2; 2:30 to 10.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30; 11 to 1 A. M.

WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11; 1:30 P. M. to 4; 6 to 7:30.

WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 8; 10:30 to 1 A. M.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 11:30.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:45 P. M.; 2 to 4; 7:30 to 11.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 7:15; 8:30 to 11.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.)—2:15 P. M. to 5; 7:30 to 11; 11:30 to 12:30 A. M.

WHO, Des Moines, Iowa, 526 (C. S. T.)—7:30 P. M. to 9; 11 to 12 M.

WJY, New York City, 405 (E. S. T., D. S.)—7:30 P. M. to 11:30.

WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11 P. M.; 1 to 2; 4 to 6; 7 to 12 M.

WLIT, Philadelphia, Pa., 395 (E. S. T.)—12:02 P. M. to 12:30; 2 to 3; 4:30 to 6; 8:30 to 9.

WLW, Cincinnati, O., 422.3 (E. S. T.)—10:40 A. M. to 12:15 P. M.; 1:30 to 5; 6 to 8; 10 to 11.

WMAK, Lockport, N. Y., 265.5 (E. S. T.)—11 P. M. to 1 A. M.

WNYC, New York City, 526 (E. S. T., D. S.)—3:15 P. M. to 4:15; 6:50 to 11.

WOAW, Omaha, Neb., 526 (C. S. T.)—12:30 P. M. to 1:30; 5:45 to 11.

WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 A. M. to 2 P. M.; 3 to 3:30; 4 to 7:10; 8 to 9.

WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 7.

WPG, Atlantic City, N. J., 299.8 (E. S. T., D. S.)—7 P. M. to 11.

WQJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4; 7 to 8; 10 to 2 A. M.

WRC, Washington, D. C., 469 (E. S. T.)—1 P. M. to 2; 4 to 6:30.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—9:45 A. M. to 12:15 P. M.; 2:30 to 3:20; 5:30 to 10:15.

KFAE, State College of Washington, 348.6 (P. S. T.)—7:30 P. M. to 9.

KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.

KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 5:15 to 6:15; 9:30 to 12:30.

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 to 1:15 P. M.; 3 to 4; 6:30 to 10.

KFOA, Seattle, Wash., 455 (P. S. T.)—12:30 P. M. to 1:30; 4 to 5:15; 6 to 7.

KGO, Oakland, Cal., 361.2 (P. S. T.)—11:30 A. M. to 1 P. M.; 1:30 to 3; 4 to 6:45; 7:15 to 10.

KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 5 to 11.

KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 3:20; 5:30 to 11:30.

KNX, Hollywood, Cal., 337 (P. S. T.)—11 A. M. to 12:05 P. M.; 4 to 5; 6 to 12.

KPO, San Francisco, Cal., 429 (P. S. T.)—7 A. M. to 8; 10:30 to 12 M.; 1 P. M. to 2; 3:30 to 11.

KSD, St. Louis, Mo., 595.1 (C. S. T.)—7:30 P. M. to 9.

KYW, Chicago, 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:55 to 1 P. M.; 2:25 to 2:30; 6:02 to 11.

CNRC, Calgary, Canada, 430 (M. S. T.)—7 P. M. to 10.

CNRM, Montreal, Canada, 411 (E. S. T.)—8:30 P. M. to 10:30.

CNRW, Winnipeg, Canada, 384.4 (C. S. T.)—8 P. M. to 10.

THE KEY TO THE AIR

KEY

Abbreviations: E. S. T., Eastern Standard Time; C. S. T., Central Standard Time; M. S. T., Mountain Standard Time; P. S. T., Pacific Standard Time; D. S., Daylight Saving Time.

How to tune in a desired distant station at just the right time—Choose your station from the list published herewith. See what time division the station is under (E. S. T., C. S. T., etc.); then consult the table below. Add to or subtract, as directed from the time as given on the PROGRAM. The result will be the same BY YOUR CLOCK that you should tune in, unless daylight saving time intervenes, as explained below.—The table:

If you are in	*And want a station in*	*Subtract*	*Add*
E. S. T.	C. S. T.	..	1 hr.
E. S. T.	M. S. T.	..	2 hrs.
E. S. T.	P. S. T.	..	3 hrs.
C. S. T.	E. S. T.	1 hr.	..
C. S. T.	M. S. T.	..	1 hr.
C. S. T.	P. S. T.	..	2 hrs.
M. S. T.	E. S. T.	2 hrs.	..
M. S. T.	C. S. T.	1 hr.	..
M. S. T.	P. S. T.	..	1 hr.
P. S. T.	E. S. T.	3 hrs.	..
P. S. T.	C. S. T.	2 hrs.	..
P. S. T.	D. S. T.	1 hr.	..

FRIDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.)—11 A. M. to 12.

WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 to 1:05 P. M.; 8 to 12 P. M.

WAMD, Minneapolis, Minn., 243.8 (C. S. T.)—12 to 1 P. M.; 10 to 12.

WBBM, Chicago, Ill., 226 (C. S. T.)—8 to 10 P. M.

WBBR, New York City, 272.6 (E. S. T., D. S.)—8 P. M. to 10.

WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—6 P. M. to 11.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 to 4; 5:30 to 10.

WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.)—12:30 to 1:30 P. M.; 4:30 to 5:30; 6:30 to 11.

WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—3:30 to 7 P. M.; 8 to 10; 11:45 to 1 A. M.

WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 11 to 12; 4 P. M. to 5; 6 to 12.

WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 3:30 to 4:10; 8 to 11.

WEAO, Ohio State University, 293.9 (E. S. T.)—8 P. M. to 10.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2 P. M. to 3:15; 5:30 to 10.

WEMC, Berrien Springs, Mich., 286 (C. S. T.)—9 P. M. to 11.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30.

WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11; 1:30 P. M. to 4; 6 to 11

WGCP, New York City, 252 (E. S. T., D. S.)—8 P. M. to 11.

WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 7; 10:30 to 1 A. M.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 11:30.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:45 P. M.; 7:30 to 11.

WGST, Atlanta, Ga., 270 (C. S. T.)—7 P. M. to 8.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—1 P. M. to 2; 5:30 to 10:30.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 8.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.)—12:30 P. M. to 1; 2:15 to 5; 7 to 11; 12 to 12:30 A. M.

WHO, Des Moines, Iowa, 526 (C. S. T.)—7:30 P. M. to 9; 11 to 12; 12:30 to 1:30; 4:30 to 5:30; 6:30 to 9:30.

WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—7 A. M. to 8; 1 P. M. to 2; 3 to 4:50; 6 to 8.

WJY, New York City, 405 (E. S. T., D. S.)—7:30 P. M. to 11:30.

WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11; 1 P. M. to 2; 4 to 6; 7 to 10:30.

WLIT, Philadelphia, Pa., 395 (E. S. T.)—12:02 P. M. to 12:30; 2 to 3; 4:30 to 6; 7:30 to 1 A. M.

WLW, Cincinnati, O., 422.3 (E. S. T.)—10:45 A. M. to 12:15; 1:30 P. M. to 2:30.

WMCA, New York City, 341 (E. S. T., D. S.)—3 P. M. to 3:45; 4 to 5; 6:30 to 10:30; 11 to 12.

WNYC, New York City, 526 (E. S. T., D. S.)—3:45 P. M. to 4:45; 6:20 to 11.

WOAW, Omaha, Neb., 526 (C. S. T.)—12:30 P. M. to 1; 5:45 to 7:10; 9 to 11.

WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 3 to 3:30; 5:45 to 12.

WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 7.

WPAK, Fargo, N. D., 283 (C. S. T.)—7:30 P. M. to 9.

WPG, Atlantic City, N. J., 299.8 (E. S. T., D. S.)—7 P. M. to 8:30; 10 to 12.

WOJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12M; 3 P M to 4; 7 to 8; 10 to 2 A. M.

WRC, Washington, D. C., 469 (E. S. T.)—4:30 P. M. to 5; 6:45 to 12.

WWJ, Detroit, Mich., 352.7 (E. S. T.)—8 A. M. to 8:30; 9:30 to 10:30; 11:55 to 1:30; 3 to 4; 6 to 7; 8 to 10.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—6 A. M. to 7; 9:45 to 12:20 P. M.; 1:30 to 3:20; 5:30 to 11.

KFAE, State College of Wash., 348.6 (P. S. T.)—7:30 P. M. to 9.

KFDY, Brookings, S. D., 273 (M. S. T.)—8 P. M. to 9.

KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 10.

KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 9:30 to 12.

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 P. M. to 1:15; 3 to 4; 6:30 to 10.

KFOA, Seattle, Wash., 455 (P. S. T.)—12:30 P. M. to 1:30; 4 to 5:15; 6 to 11.

KGO, Oakland, Cal., 361.2 (P. S. T.)—11:10 A. M. to 1 P. M.; 1:30 to 3; 4 to 7.

KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 5 to 11.

KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 3:30 P. M.; 5:30 to 11:30.

KNX, Hollywood, Cal., 337 (P. S. T.)—11:30 A. M. to 12:30 P. M.; 1 to 2; 4 to 5; 6:30 to 12.

KOB, State College of New Mexico, 348.6 (M. S. T.)—11:55 A. M. to 12:30 P. M.; 7:30 to 8:30; 9:55 to 10:10.

KPO, San Francisco, Cal., 429 (P. S. T.)—7:30 A. M. to 8; 10:30 to 12 M.; 1 P. M. to 2; 4:30 to 11.

KSD, St. Louis, Mo., 545.1 (C. S. T.)—4 P. M. to 5.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—12:30 P. M. to 1; 8:20 to 10.

KYW, Chicago, Ill., 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:55 to 1 P. M.; 2:25 to 3:30; 6:02 to 7:20; 9 to 1:30 A. M.

CNRA, Moncton, Canada, 313 (E. S. T.)—8:30 P. M. to 10:30.

CNRE, Edmonton, Canada, 516.9 (M. S. T.)—8:30 P. M. to 10:30.

CNRS, Saskatoon, Canada, 400 (M. S. T.)—2:30 P. M. to 3.

CNRT, Toronto, Canada, 357 (E. S. T.)—6:30 P. M. to 11.

SATURDAY

WAAM, Newark, N. J., 263 (E. S. T.)—7 P. M. to 11.

WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 M. to 2 A. M.

WAMD, Minneapolis, Minn., 243.8 (C. S. T.)—12 M. to 1 P. M.; 10 to 12.

WBBM, Chicago, Ill., 226 (C. S. T.)—8 P. M. to 1 A. M.

WBBR, New York City, 272.6 (E. S. T., D. S.)—8 P. M. to 9.

WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—11 A. M. to 12:30 P. M.; 7 to 9.

WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.)—10:45 A. M. to 12 M.; 3 P. M. to 4; 6:30 to 7:30.

WCBD, Zion, Ill., 344.6 (C. S. T.)—8 P. M. to 10.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12:30 P. M.; 2:30 to 5; 6 to 10.

WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 4 P. M. to 5; 6 to 12.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 7 A. M.

WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 3:30 to 4:10; 7 to 8.

WEMC, Berrien Springs, Mich., 286 (C. S. T.)—11 A. M. to 12:30 P. M.; 8:15 to 11.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—12:30 P. M. to 1; 6 to 7; 8:30 to 9:30; 11 to 12:30 A. M.

WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11; 1:30 P. M. to 3; 6 to 12.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 2:30 P. M.; 3 to 5:57; 6 to 11:30.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:45 P. M.; 2:30 to 4:30; 7:30 to 8.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—7:30 P. M. to 10.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 8.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.)—2:15 P. M. to 5; 7:30 to 10.

WHO, Des Moines, Iowa, 526 (C. S. T.)—11 A. M. to 12:30 P. M.; 4 to 5:30; 7:30 to 8:30.

WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—7 A. M. to 8; 10:20 to 11; 1 P. M. to 2; 3 to 4; 6 to 11:30.

WJY, New York City, 405 (E. S. T., D. S.)—2:30 P. M. to 5; 8 to 10:30.

WJZ, New York City, 455 (E. S. T., D. S.)—9 A. M. to 12:30 P. M.; 2:30 to 4; 7 to 10.

WKRC, Cincinnati, O., 326 (E. S. T.)—10 to 12 M.

WLW, Cincinnati, O., 422.3 (E. S. T.)—9:30 A. M. to 12:30 P. M.; 7:30 to 10.

WMAK, Lockport, N. Y., 265.5 (E. S. T.)—10:25 A. M. to 12:30 P. M.

WMC, Memphis, Tenn., 499.7 (E. S. T.)—7:30 P. M. to 10.

WMCA, New York City, 341 (E. S. T., D. S.)—3 P. M. to 3:15; 3:30 to 5; 8 to 8:15; 8:30 to 8:45; 11 P. M. to 1 A. M.

WNYC, New York City, 526 (E. S. T., D. S.)—1 P. M. to 3; 7 to 11.

WOAW, Omaha, Neb., 526 (C. S. T.)—9 A. M. to 11; 2:15 P. M. to 4; 9 to 11.

WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 5:45 to 7:10; 9 to 12.

WOO, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—11 A. M. to 1 P. M.; 4:40 to 5; 10:55 to 11:02.

WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 7:30; 8 to 11.

WPG, Atlantic City, N. J., 299.8 (C. S. T.)—7 P. M. to 12.

WOJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4; 7 to 8; 10 to 3 A. M.

WRC, Washington, D. C., 469 (E. S. T.)—4:30 to 5:30 P. M.; 6:45 to 12.

WWJ, Detroit Mich. 352.7 (E. S. T.)—8 A. M. to 8:30; 9:30 to 10:30; 11:55 to 1:30 P. M.; 3 to 4.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—10 A. M. to 12:30 P. M.; 1:30 to 6:30; 8:45 to 10.

KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11

KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 9:30 to 12:30

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 P. M. to 1:15; 3 to 4; 6:30 to 10:30

KFOA, Seattle, Wash., 455 (P. S. T.)—Silent

KGO, Oakland, Cal., 361.2 (P. S. T.)—11 A. M. to 12:30 P. M.; 3:30 to 5:45; 7:30 to 9.

KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 6 to 7; 10 to 11.

KHJ, Los Angeles, Cal., 405.2 (E. S. T., D. S.)—7 A. M. to 7:30; 10 to 1:30 P. M.; 2:30 to 3:30; 5:30 to 2 A. M.

KNX, Hollywood, Cal., 337 (P. S. T.)—1 P. M. to 2; 6:30 to 2 A. M.

KOA, Denver, Colo., 322.4 (M. S. T.)—11:30 A. M. to 1 P. M.; 7 to 10.

KPO, San Francisco, Cal., 429 (P. S. T.)—8 A. M. to 12 M.; 2 P. M. to 3; 6 to 10.

KSD, St. Louis, Mo., 545.1 (C. S. T.)—7 P. M. to 8:30.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—12:30 P. M. to 1; 8:30 to 10:30.

KYW, Chicago, Ill., 536 (C. S. T., D. S.)—1 A. M. to 12:30 P. M.; 4 to 5; 7 to 8.

CKAC, Montreal, Canada, 411 (E. S. T.)—4 P. M. to 5:30.

CNRO, Ottawa, Ontario, Canada, 435 (E. S. T.)—7:30 P. M. to 10.

PWX, Havana, Cuba, 400 (E. S. T.)—8:30 P. M. to 11:30.

SUNDAY

WBBM, Chicago, Ill., 226 (C. S. T.)—4 P. M. to 6; 8 to 10.

WBBR, New York City, 272.6 (E. S. T., D. S.)—10 A. M. to 12 M., 9 P. M. to 11.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—11 A. M. to 12:30 P. M.; 4:10 to 5:10; 7:20 to 10.

WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—4 P. M. to 5:30.

WEAF, New York City, 492 (E. S. T., D. S.)—3 P. M. to 5; 7:20 to 10:15.

WEAR, Cleveland, O., 390 (E. S. T.)—3:30 P. M. to 5; 7 to 8; 9 to 10.

WGBS, New York City, 316 (E. S. T., D. S.)—3:30 P. M. to 4:30; 9:30 to 10:30.

WGN, Chicago, Ill., 370 (C. S. T.)—11 A. M. to 12:45 P. M.; 2:30 to 5; 9 to 10.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—3 P. M. to 4; 7:15 to 8.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—9:30 A. M. to 12:30 P. M.; 2:35 to 3:45; 6:30 to 10:30.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—2 P. M. to 3.

WHN, New York City, 360 (E. S. T., D. S.)—1 P. M. to 1:30; 3 to 6; 10 to 12.

WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—10:45 A. M. to 12:30 P. M.; 3:30 to 4:30.

WKRC, Cincinnati, O., 326 (E. S. T.)—6:45 P. M. to 11.

WNYC, New York City, 526 (E. S. T., D. S.)—9 P. M. to 11.

WMCA, New York City, 341 (E. S. T., D. S.)—11 A. M. to 12:15 P. M.; 4 to 5; 7 to 8.

WPG, Atlantic City, N. J., 299.8 (C. S. T., D. S.)—3:15 P. M. to 5; 9 to 11.

WQJ, Chicago, Ill., 448 (C. S. T.)—10:30 A. M. to 12:30 P. M.; 3 P. M. to 4; 8 to 10.

WWJ, Detroit, Mich., 352.7 (E. S. T.)—11 A. M. to 12:30 P. M.; 2 to 4; 6:20 to 9.

KDKA, Pittsburgh, Pa., 309 (E. S. T.)—9:45 A. M. to 10:30; 11:55 to 12 M.; 2:30 P. M. to 5:30; 7 to 11.

KFNF, Shenandoah, Iowa, 266 (C. S. T.)—10:45 A. M. to 12:30 P. M.; 2:30 to 4:30; 6:30 to 10.

KOA, Denver, Col., 322.4 (M. S. T.)—10:55 A. M. to 12 M.; 4 P. M. to 5:30 P. M.; 7:45 P. M. to 10 P. M.

KGW, Portland, Oregon, 491.5 (P. S. T.)—10:30 A. M. to 12:30 P. M.; 6 to 9.

KHJ, Los Angeles, Cal., 405.2 (E. S. T., D. S.)—10 A. M. to 12:30 P. M.; 6 to 9.

KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—11 A. M. to 12:30 P. M.; 2:30 to 3:40; 8:40 to 11.

MONDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.)—11 A. M. to 12 M.; 7 P. M. to 11.

WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 M. to 1:05 P. M.; 8 to 2 A. M.

WAMB, Minneapolis, Minn., 243.8 (C. S. T)—10 P. M. to 12.

WBBM, Chicago, Ill., 226 (C. S. T.)—6 P. M. to 7.

WBBR, New York City, 272.6 (E. S. T., D. S.)—8 P. M. to 9.

WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—6 P. M. to 11:30.

WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.)—12:30 P. M. to 1:30; 4:30 to 5:30; 6:30 to 12.

WCBD, Zion, Ill., 344.6 (C. S. T.)—8 P. M. to 10.

WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 P. M. to 6:15; 8 to 10.

WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—3:30 P. M. to 7; 8 to 10; 11:45 to 1 A. M.

WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 4 P. M. to 5; 6 to 11:30.

WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 3:30 to 4:10; 7 to 8.

WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 8; 3 P. M. to 4; 5:30 to 10.

WEMC, Berrien Springs, Mich., 286 (C. S. T.)—8:15 P. M. to 11.

WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30.

WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11; 1:30 P. M. to 3:10; 6 to 7:30.

WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 8.

WGCP, New York City, 252 (E. S. T., D. S.)—8 P. M. to 1 A. M.

WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 5:57.

WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:30 P. M.; 2:30 to 4:30; 7:30 to 11.

WGST, Atlanta, Ga., 270 (C. S. T.)—9 P. M. to 10.

WGY, Schenectady, N. Y., 379.5 (E. S. T.)—1 P. M. to 2; 5:30 to 8:30.

WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 10:30.

WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.

WHN, New York City, 360 (E. S. T., D. S.)—2:15 P. M. to 5; 6:30 to 12.
WHO, Des Moines, Iowa, 526 (C. S. T.)—12:15 P. M. to 1:30; 7:30 to 9; 11:15 to 12.
WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—7 A. M. to 8; 1 P. M. to 2; 3 to 8.
WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11; 1 P. M. to 2; 4 to 5:30; 6 to 6:30; 7 to 11.
WKRC, Cincinnati, O., 326 (E. S. T.)—8 P. M. to 10.
WLIT, Philadelphia, Pa., 395 (E. S. T.)—12:02 P. M. to 1; 2 to 3; 4:30 to 6; 7:30 to 11:30.
WPAK, Fargo, N. D., 283 (C. S. T.)—7:30 P. M. to 9.
WLW, Cincinnati, O., 422.3 (E. S. T.)—10:45 A. M. to 12:15 P. M.; 1:30 to 2:30; 3 to 5; 6 to 10.
WMAK, Lockport, N. Y., 265.5 (E. S. T.)—8 P. M. to 12.
WNYC, New York City, 526 (E. S. T., D. S.)—3:15 P. M. to 4:15; 6:20 to 11.
WOAW, Omaha, Neb., 526 (C. S. T.)—12:30 P. M. to 1:30; 5:45 to 10:30.
WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 3 to 3:30; 5:45 to 6.
WOO, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—11 A. M. to 1 P. M.; 4:40 to 6; 7:30 to 11.
WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 to 4; 6:15 to 11:30.
WPG, Atlantic City, N. J., 299.8 (E. S. T., D. S.)—7 P. M. to 11.
WQJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4.
WRC, Washington, D. C., 469 (E. S. T.)—1 P. M. to 2; 4 to 6.
KDKA, Pittsburgh, Pa., 309 (E. S. T.)—6 A. M. to 7; 9:45 to 12:15 P. M.; 2:30 to 3:20; 5:30 to 10.
KFAE, State College of Wash., 348.6 (P. S. T.)—7:30 P. M. to 9.
KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.
KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 P. M. to 1:15; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (P. S. T.)—12:45 P. M. to 1:30; 4 to 5:15; 6 to 10.
KGO, Oakland, Cal., 361.2 (P. S. T.)—9 A. M. to 10:30; 11:30 A. M. to 1 P. M.; 1:30 to 6; 6:45 to 7; 8 to 1 A. M.
KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30; 5 to 8.
KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 1:30 P. M.; 5:30 to 10.
KNX, Hollywood, Cal., 337 (P. S. T.)—12 M. to 1 P. M.; 4 to 5; 6:30 to 12.
KOB, State College of New Mexico, 348.6 (M. S. T.)—11:55 A. M. to 12:30 P. M.; 7:30 to 8:30; 9:55 to 10:10.
KPO, San Francisco, Cal., 429 (P. S. T.)—10:30 A. M. to 12 M.; 1 P. M. to 2; 2:30 to 3:30; 4:30 to 10.
KSD, St. Louis, Mo., 545.1 (C. S. T.)—7:30 P. M. to 10.
KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—12:30 P. M. to 1; 8:30 to 10.
KYW, Chicago, Ill., 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:55 to 1 P. M.; 2:15 to 3:30; 6:02 to 7.

TUESDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.)—11 A. M. to 12 M.; 7 P. M. to 11.
WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 P. M. to 1:05 A. M.
WAMD, Minneapolis, Minn., 243.8 (C. S. T.)—12 M. to 1 P. M.; 10 to 12.
WBBM, Chicago, Ill., 226 (C. S. T.)—8 P. M. to 12.
WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—6 P. M. to 11.
WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.)—12:30 P. M. to 1:30; 4:30 to 5:30; 6:30 to 11.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 P. M. to 4; 5:30 to 10.
WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—3:30 P. M. to 7; 11:45 to 1 A. M.
WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 11 to 12 M.; 4 P. M. to 5; 6 to 12.
WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 7 to 10; 10 to 11.
WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 8; 1 P. M. to 2; 6:30 to 10.
WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30; 11 to 12.
WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11; 1:30 P. M. to 3; 6 to 11:30.
WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 8; 10:30 to 1 A. M.
WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 11:30.
WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—11 A. M. to 12:45 P. M.; 7:30 to 11.
WGY, Schenectady, N. Y., 379.5 (E. S. T.)—11 P. M. to 2:30; 5:20 to 7:30; 9 to 11:30.
WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 8.
WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.
WHN, New York City, 360 (E. S. T., D. S.)—12:30 P. M. to 1; 2:15 to 3:15; 4 to 5:30; 7:30 to 10:45; 11:30 to 12:30 A. M.
WHO, Des Moines, Iowa, 526 (C. S. T.)—12:15 P. M. to 1:30; 7:30 to 9; 11 to 12.
WIP, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—7 A. M. to 8; 1 P. M. to 2; 3 to 4:50; 6 to 11.
WJY, New York City, 405 (E. S. T., D. S.)—7:30 P. M. to 1:30.
WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11; 1 P. M. to 2; 4 to 6; 7 to 11.
WKRC, Cincinnati, O., 326 (E. S. T.)—8 P. M. to 12.
WLIT, Philadelphia, Pa., 395 (E. S. T.)—11 A. M. to 12:30 P. M.; 2 to 3; 4:30 to 7.
WLW, Cincinnati, O., 422.3 (E. S. T.)—10:45 A. M. to 1 P. M.; 1:30 to 2:30; 3 to 5; 6 to 11.
WNYC, New York City, 526 (E. S. T., D. S.)—3:45 P. M. to 5; 6:50 to 11.
WOAW, Omaha, Neb., 526 (C. S. T.)—12:30 P. M. to 1:30; 5:45 to 11.
WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 3 to 3:30; 5:45 to 10.
WOO, Philadelphia, Pa., 508.2 (E. S. T., D. S.)—11 A. M. to 1 P. M.; 4:40 to 5; 10:55 to 11:02.
WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 7:30.
WPG, Atlantic City, N. J., 299.8 (E. S. T., D. S.)—7 P. M. to 11.
WQJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4; 7 to 8; 10 to 2 A. M.
WRC, Washington, D. C., 469 (E. S. T.)—4:30 P. M. to 5:30; 6:45 to 11.
KDKA, Pittsburgh, Pa., 309 (E. S. T.)—9:45 P. M. to 12 M.; 1:30 P. M. to 3:20; 5:30 to 10:45.
KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.
KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFOA, Seattle, Wash., 455 (P. S. T.)—12:30 P. M. to 1:30; 4 to 5:15; 6 to 11.
KGO, Oakland, Cal., 361.2 (P. S. T.)—11:30 A. M. to 1 P. M.; 1:30 to 3; 4 to 6:45; 8 to 1 A. M.
KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 5 to 11.
KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 3:30 P. M.; 5:30 to 11.
KNX, Hollywood, Cal., 337 (P. S. T.)—9 A. M. to 10; 1 P. M. to 2; 4 to 5; 6:30 to 12.
KPO, San Francisco, Cal., 429 (P. S. T.)—7 A. M. to 7:45; 10 to 12 M.; 1 P. M. to 2; 3:30 to 11.
KSD, St. Louis, Mo., 541.1 (C. S. T.)—6 P. M. to 7.
KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—12:30 P. M. to 1; 8:30 to 10:30.
KYW, Chicago, Ill., 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:30 to 1 P. M.; 2:15 to 4; 6:02 to 11:30.
CNRA, Moncton, New Brunswick, Canada, 313 (E. S. T.)—9:30 P. M. to 11.
CNRR, Regina, Saskatchewan, Canada, 8 P. M. to 11.

WEDNESDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.)—11 A. M. to 12 M.; 7 P. M. to 11.
WAHG, Richmond Hill, N. Y., 316 (E. S. T., D. S.)—12 M. to 1:05 P. M.; 8 to 12.
WAMD, Minneapolis, Minn., 243.8 (C. S. T.)—12 M. to 1 P. M.; 10 to 12.
WBBM, Chicago, Ill., 226 (C. S. T.)—8 P. M. to 10.
WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—6 P. M. to 11.
WCAE, Pittsburgh, Pa., 461.3 (E. S. T., D. S.)—12:30 P. M. to 1:30; 4:30 to 5:30; 6:30 to 11.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 to 4; 5:30 to 11.
WDAF, Kansas City, Kansas, 365.6 (C. S. T.)—3:30 P. M. to 7; 8 to 9:15; 11:45 to 1 A. M.
WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 11 to 12 M.; 4 P. M. to 5; 6 to 12.
WEAO, Ohio State University, 293.9 (E. S. T.)—8 P. M. to 10.
WEAR, Cleveland, O., 390 (E. S. T.)—11:30 A. M. to 12:10 P. M.; 3:30 to 4:10; 6:45 to 7:45.
WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 8; 3 P. M. to 4; 5:30 to 10.
WEMC, Berrien Springs, Mich., 286 (C. S. T.)—8:15 P. M. to 11.
WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1.
WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 7; 10:30 to 1 A. M.
WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11 P. M.; 1:30 to 4; 6 to 7.
WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 11:30.
WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:45 P. M.; 2:30 to 4:30; 6:30 to 11.
WGY, Schenectady, N. Y., 379.5 (C. S. T.)—5:30 P. M. to 7:30.
WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 4 P. M. to 5; 6 to 10; 11:30 to 12:30 A. M.
WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.
WHN, New York City, 360 (E. S. T., D. S.)—2:15 P. M. to 5:30; 7:30 to 11; 11:30 to 12:30 A. M.
WHO, Des Moines, Iowa, 526 (C. S. T.)—12:15 P. M. to 1:30; 6:30 to 12 M.
WIP, Philadelphia, Pa., 508 (E. S. T., D. S.)—7 A. M. to 8; 10:20 to 11; 1 P. M. to 2; 3 to 4; 6 to 8.
WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11; 1 P. M. to 2; 4 to 6; 7 to 11:30.
WKRC, Cincinnati, Ohio, 326 (E. S. T.)—8 P. M. to 10.
WLIT, Philadelphia, Pa., 395 (E. S. T.)—12:02 P. M. to 12:30; 2 to 3; 4:30 to 6; 7:30 to 9.
WLW, Cincinnati, O., 422.3 (E. S. T.)—10:45 A. M. to 12:15 P. M.; 1:30 to 2:30; 3 to 5; 6 to 11.
WNYC, New York City, 526 (E. S. T., D. S.)—6:30 P. M. to 11.
WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 P. M. to 2; 3 to 3:30; 4 to 7:05; 9 to 11.
WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 12 M.
WPAK, Fargo, N. D., 283 (C. S. T.)—7:30 P. M. to 9.
WQJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4; 7 to 8; 10 to 2 A. M.
WRC, Washington, D. C., 469 (E. S. T.)—1 P. M. to 2; 4 to 6:30.
KDKA, Pittsburgh, Pa., 309 (E. S. T.)—6 A. M. to 7; 9:45 to 12:15 P. M.; 2:30 to 3:20; 5:30 to 11.
KFAE, State College of Wash., 348.6 (P. S. T.)—7:30 P. M. to 9.
KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.
KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 P. M. to 1:15; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (P. S. T.)—12:30 P. M. to 1:30; 4 to 5:15; 6 to 10.
KGO, Oakland, Cal., 361.2 (P. S. T.)—11:30 A. M. to 1 P. M.; 1:30 to 2:30; 3 to 6:45.
KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 5 to 10.
KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 1:30 P. M.; 5:30 to 12.
KNX, Hollywood, Cal., 337 (P. S. T.)—1 P. M. to 2; 7 to 12.
KOB, State College of New Mexico, 348.6 (M. S. T.)—11:55 A. M. to 12:30 P. M.; 7:30 to 8:30; 9:55 to 10:10.
KPO, San Francisco, Cal., 429 (P. S. T.)—7 A. M. to 8; 10:30 to 12 M.; 1 P. M. to 2; 4:30 to 11.
KSD, St. Louis, Mo., 545.1 (C. S. T.)—7 P. M. to 10.
KTHS, Hot Springs, Ark., 374.8 (C. S. T.)—8:30 P. M. to 10.
KYW, Chicago, Ill., 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:55 to 1 P. M.; 2:15 to 4; 6:02 to 11:30.
PWX, Havana, Cuba, 400 (E. S. T.)—8:30 P. M. to 11:30.
CNRO, Ottawa, Ontario, Canada, 435 (E. S. T.)—7 P. M. to 11.

THURSDAY

WAAM, Newark, N. J., 263 (E. S. T., D. S.)—11 A. M. to 12 M.; 7 P. M. to 11.
WAHG, Richmond Hill, N. Y., 316 (E. S. T.)—12 P. M. to 1:05.
WAMB, Minneapolis, Minn., 243.8 (C. S. T.)—12 M. to 1 P. M.; 10 to 12 M.
WBBM, Chicago, Ill., 226 (C. S. T.)—8 P. M. to 10.
WBZ, Springfield, Mass., 333.1 (E. S. T., D. S.)—6 P. M. to 11:45.
WCAE, Pittsburgh, Pa., 461.3 (C. S. T., D. S.)—12:30 P. M. to 1:30; 4:30 to 5:30; 6:30 to 11.
WCBD, Zion, Ill., 344.6 (C. S. T.)—8 P. M. to 10.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (C. S. T.)—9:30 A. M. to 12 M.; 1:30 P. M. to 4; 5:30 to 10.
WEAF, New York City, 492 (E. S. T., D. S.)—6:45 A. M. to 7:45; 11 to 12 M.; 4 P. M. to 5; 6 to 12.
WEAR, Cleveland, O., 390 (E. S. T.)—10:30 A. M. to 12:10 P. M.; 3:30 to 4:15; 7 to 11.
WEEI, Boston, Mass., 476 (E. S. T., D. S.)—6:45 A. M. to 7:45; 1 P. M. to 2; 2:30 to 10.
WFAA, Dallas, Texas, 475.9 (C. S. T.)—10:30 A. M. to 11:30; 12:30 P. M. to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30; 11 to 1 A. M.
WGBS, New York City, 316 (E. S. T., D. S.)—10 A. M. to 11; 1:30 P. M. to 4; 6 to 7:30.
WGES, Chicago, Ill., 250 (C. S. T., D. S.)—5 P. M. to 8; 10:30 to 1 A. M.
WGN, Chicago, Ill., 370 (C. S. T.)—9:31 A. M. to 3:30 P. M.; 5:30 to 11:30.
WGR, Buffalo, N. Y., 319 (E. S. T., D. S.)—12 M. to 12:45 P. M.; 2 to 4; 7:30 to 11.
WHAD, Milwaukee, Wis., 275 (C. S. T.)—11 A. M. to 11:30; 6 P. M. to 7:15; 8:30 to 11.
WHAS, Louisville, Ky., 399.8 (C. S. T.)—4 P. M. to 5; 7:30 to 9.
WHN, New York City, 360 (E. S. T., D. S.)—2:15 P. M. to 5; 7:30 to 11; 11:30 to 12:30 A. M.
WHO, Des Moines, Iowa, 526 (C. S. T.)—7:30 P. M. to 9; 11 to 12 M.
WJY, New York City, 405 (E. S. T., D. S.)—7:30 P. M. to 11:30.
WJZ, New York City, 455 (E. S. T., D. S.)—10 A. M. to 11 P. M.; 1 to 2; 4 to 6; 7 to 12 M.
WLIT, Philadelphia, Pa., 395 (E. S. T.)—12:02 P. M. to 12:30; 2 to 3; 4:30 to 6; 8:30 to 9.
WLW, Cincinnati, O., 422.3 (E. S. T.)—10:40 A. M. to 12:15 P. M.; 1:30 to 5; 6 to 8; 10 to 11.
WMAK, Lockport, N. Y., 265.5 (E. S. T.)—11 P. M. to 1 A. M.
WNYC, New York City, 526 (E. S. T., D. S.)—3:15 P. M. to 4:15; 6:50 to 11.
WOAW, Omaha, Neb., 526 (C. S. T.)—12:30 P. M. to 1:30; 5:45 to 11.
WOC, Davenport, Iowa, 484 (C. S. T.)—12:57 A. M. to 2 P. M.; 3 to 3:30; 4 to 7:10; 8 to 9.
WOR, Newark, N. J., 405 (E. S. T., D. S.)—6:45 A. M. to 7:45; 2:30 P. M. to 4; 6:15 to 7.
WPG, Atlantic City, N. J., 299.8 (E. S. T., D. S.)—7 P. M. to 11.
WQJ, Chicago, Ill., 448 (C. S. T.)—11 A. M. to 12 M.; 3 P. M. to 4; 7 to 8; 10 to 2 A. M.
WRC, Washington, D. C., 469 (E. S. T.)—1 P. M. to 2; 4 to 6:30.
KDKA, Pittsburgh, Pa., 309 (E. S. T.)—9:45 A. M. to 12:15 P. M.; 2:30 to 3:20; 5:30 to 10:15.
KFAE, State College of Washington, 348.6 (P. S. T.)—7:30 P. M. to 9.
KFI, Los Angeles, Cal., 467 (P. S. T.)—5 P. M. to 11.
KFKX, Hastings, Neb., 288.3 (C. S. T.)—12:30 P. M. to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFNF, Shenandoah, Iowa, 266 (C. S. T.)—12:15 to 1:15 P. M.; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (P. S. T.)—12:30 P. M. to 1:30; 4 to 5:15; 6 to 7.
KGO, Oakland, Cal., 361.2 (P. S. T.)—11:30 A. M. to 1 P. M.; 1:30 to 3; 4 to 6:45; 7:15 to 10.
KGW, Portland, Oregon, 491.5 (P. S. T.)—11:30 A. M. to 1:30 P. M.; 5 to 11.
KHJ, Los Angeles, Cal., 405.2 (P. S. T.)—7 A. M. to 7:15; 12 M. to 3:20; 5:30 to 11:30.
KNX, Hollywood, Cal., 337 (P. S. T.)—11 A. M. to 12:05 P. M.; 4 to 5; 6 to 12.
KPO, San Francisco, Cal., 429 (P. S. T.)—7 A. M. to 8; 10:30 to 12 M.; 1 P. M. to 2; 3:30 to 11.
KSD, St. Louis, Mo., 595.1 (C. S. T.)—7:30 P. M. to 9.
KYW, Chicago, 536 (C. S. T., D. S.)—6:30 A. M. to 7:30; 10:55 to 1 P. M.; 2:25 to 2:30; 6:02 to 11.
CNRC, Calgary, Canada, 430 (M. S. T.)—7 P. M. to 10.
CNRM, Montreal, Canada, 411 (E. S. T.)—8:30 P. M. to 10:30.
CNRW, Winnipeg, Canada, 384.4 (C. S. T.)—8 P. M. to 10.

A THOUGHT FOR THE WEEK

If you can get on your set a station 100 miles away, you should be able to get a station 2,000 miles away. The ether always functions. Get your set right—if you can.

RADIO WORLD

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

Radio World's Slogan: "A radio set for every home."

TELEPHONES: LACKAWANNA 6976 and 2063
PUBLISHED EVERY WEDNESDAY
(Dated Saturday of same week)
FROM PUBLICATION OFFICE
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Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order, is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address also. State whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5½"	221 lines	150.00
¼ Page, 4½" D. C.	115 lines	75.00
1 Column, 2¼"x11"	154 lines	100.00
1 Inch		10.00
Per agate line		.75

Times Discounts

52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
4 consecutive issues	10%

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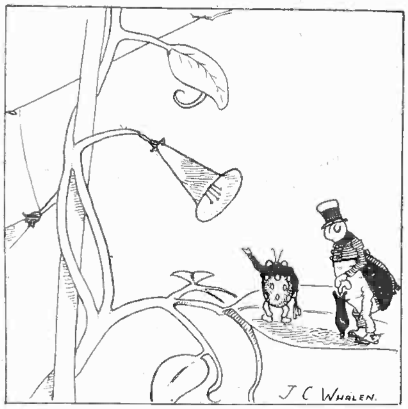
Entered as second-class matter, March 28, 1922, at the Post Office at New York, New York, under the act of March 3, 1879.

JUNE 13, 1925



'PLANE REPEATS SUCCESSFUL SHORT-WAVE TRANSMISSION

REPORTS from radio amateurs indicate success in low wavelength radio transmission from an airplane in flight. Following public notice to amateurs to "stand by" during this second special test, one of the new low wavelength Zenith-Reinartz transmitting sets to be used on the MacMillan Expedition to the Arctic, which sails from Boston, June 17th, Bunker Hill Day, was again installed in an airplane, at Great Lakes Naval Training Station, Great Lakes, Ill.

Short-Wave Summer Impends

THE object of special summer interest in radio will be the reception of short waves. Four broadcasting stations are frequently on the air below 100 meters. Sets that will tune them in are indeed sources of fascinating experiment and study.

Short waves travel better in daylight than long waves, indeed even during the period when the shawl of night covers the earth, the long waves often do not traverse distance as well as their short and stout brethren of the ether.

One of the phenomena of short-wave transmission and reception is the skipping tendency on shorter distances. Thus the short wave may hop over a few hundred miles, being received poorly or not at all, and then, a thousand miles away or more, render excellent service.

Today short-wave work is in about the same stage of investigation as long-wave broadcasting was four years ago, except that the older gives a useful comparative background.

There is every incentive to the scientifically adventurous to explore the territory of the short-wave. Using a 35-foot indoor antenna a short-wave set in RADIO WORLD'S laboratories outperformed a long-wave set that used a 100-foot outdoor aerial, especially as to distance reception, both day and night.

A Makeshift; Not a Solution

SO great a problem is the allocation of wavelengths to the clamoring horde of applicants for a place in the ether that Department of Commerce officials are discussing the advisability of apportioning wavelengths equally by States. The present problem concerns the Class B stations. They are the great and powerful stations and those most worth while to hear. There are 96 Class B channels. That would afford two for each State. The arithmetic isn't difficult, but the proposal is an easy makeshift, not a solution. The objective should be not the easing of the difficult task of Government officials but rather service to the public.

It would be attractive to have as many channels as present or prospective demands would require. Although there are international complications to be settled, the solution seems to lie in putting the broadcasting stations on lower waves, say, under 100 meters, multiplying the channels by the thousands.

Make room for all comers. The room is there.

Send in Photos of Sets

IF you have built a set, send in one or more photographs of it to Set Editor, RADIO WORLD, 1493 Broadway, New York City. Fans who make the neatest sets will be awarded a place on the Set-Builders' Roll of Honor. Any set that you yourself built will meet requirements. If possible, send hookup, too. Watch RADIO WORLD for the publication of these interesting photographs.

Bernie Still Holds Lead

HE standing of the twelve leading contestants in the contest to determine RADIO WORLD readers' choice of the most popular radio entertainer for 1925 follows: Ben Bernie and Orchestra, WEAF, first; Roxy, WEAF, second; Karl Bonawitz, WIP, third; Happiness Boys, WEAF, fourth; Nils T. Granlund, WHN, fifth; Alvin E. Hauser, WFBH, sixth; Ford and Glenn, WLS, seventh; Leo Reisman and Orchestra, WBZ, eighth; Harmony Girls, WLS, ninth; Gold Dust Twins, WEAF, tenth; Olcott Vail, WHN, eleventh; Walter Peterson, WLS, twelfth.

RADIO WORLD'S POPULARITY CONTEST

To Determine the Gold Medal Radio Entertainer for 1925

Popularity Editor, RADIO WORLD, 1493 Broadway, N. Y. C.

I hereby cast one ballot for:

(Name of Entertainer)..

(Entertainer's Station)..

(Voter Sign Full Name Here)..

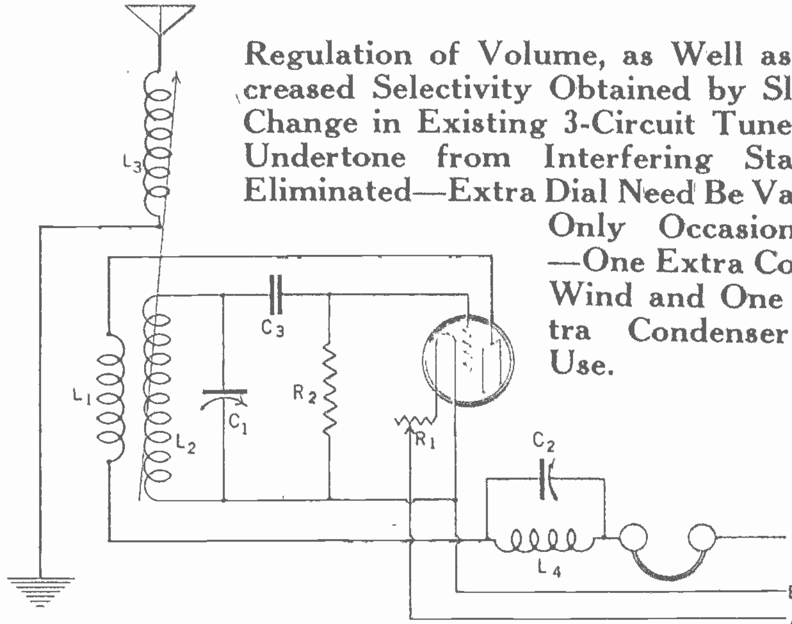
(Street and Number)..

(City)....................................... **(State)**..........................

No. 8-6-6 **FILL OUT THIS COUPON AND MAIL NOW!**

More DX With a Tuned Aerial

By Capt. P. V. O'Rourke



Regulation of Volume, as Well as Increased Selectivity Obtained by Slight Change in Existing 3-Circuit Tuners—Undertone from Interfering Station Eliminated—Extra Dial Need Be Varied Only Occasionally—One Extra Coil to Wind and One Extra Condenser to Use.

EVEN the 3-circuit tuner, with aperiodic primary, is not sufficiently selective for some localities. Take New York City, for instance. There are two broadcasting stations, about 34 meters apart, that use, in one case, 1,000 watts output, and in the other from, 1,000 to 2,500 watts. These are WNYC and WEAF. How many sets, do you suppose, in tuning from one of these stations to the other, registers a silent space on the dial in between them? Not many, you may be sure. When WEAF is momentarily silent, there is an undertone of what's going on at WNYC. When actual listening to one station nothing can be heard from the other, yet the fact remains that the selectivity factor needs some improvement. Moreover, if the set is only as selective as this test proves, why not make it more selective, and thus increase the possibility of getting distant stations never heard before under equal conditions of reception? Then, when you come down to the low waves, some of the stations are so close together that some extraordinary help is necessary if one is to separate them or in some cases avoid the beatnote of heterodyning waves.


CAPT. PETER V. O'ROURKE

Tuning the aerial is a solution.

Of course you might add more radio-frequency amplification, and resort to some other methods, but suppose you simply want to use the same number of tubes (one, for instance)?

Easy to Change Over

Fig. 1 shows how the 3-circuit tuner may be made more selective. The regulation tuning coil is used in conjunction with the prescribed condenser for such a coil. Nearly all commercial 3-circuit coils are made for secondary tuning with a .0005 mfd. variable condenser, 23 plates. To convert your present 3-circuit tuner into the more selective type, some of the wiring has to be changed, but that entails merely transfer of leads from present location on coil posts or terminals to other locations. If you will study the diagram you will see that an extra control is added. Thus there are three controls, but one of them, the aerial control, is not varied unless circumstance of insufficient selectivity require it. A fair estimate would be to rate the controls as 2½, if that isn't delving too deeply into the fantastic.

The windings of the coil are designated L1, L2 and L3, in conventional fashion, to facilitate understanding of the connections. Thus L3 was formerly the tickler, connected from the plate of the tube and thence to B plus. Now it is in the aerial circuit. It will be found to have enough windings on it to constitute about 100 microhenries of inductance, more than one would ordinarily include, yet do not tamper with the tickler until you have proven to your satisfaction that in the aerial circuit it does not increase the selectivity all that you desire. If you find still greater selectivity needed, take off half the number of turns on L3. L2 is the secondary, and the connections thereto are the same in the tuned primary set as in the aperiodic primary hookup, except possibly for conformity to polarity requirements.

Connecting the aerial to the former tickler and leaving the secondary intact leaves regeneration unsupplied, also the former aperiodic primary that went to aerial and ground is an "orphan." While this primary may be ignored altogether, and a tuned plate system inserted between plate and one of the phone connections, it is just as well to derive some benefit from this little stator winding.

THE ELECTRICAL WIRING of Capt. O'Rourke's plan for making a 3-circuit tuner more selective. The former tickler is converted into a primary tuning coil; the secondary remains as formerly (unless leads are switched for polarity advantages, as he explains). A knob may be used for the aerial tuning. The aerial control affects both selectivity and volume. It is easy to log stations, since both C1 and C2 have constant settings for any given wavelength. The aerial knob may then be turned until the station comes in strongest or clearest. The knob then need not be moved except for reception of distant or weak signals.

Improving Regeneration

In some instances the possessor of a tuned plate circuit (with a variometer in the plate lead, or a fixed coil tuned by a variable condenser) does not get enough regeneration. This is entirely the fault of the tube or the inductance-capacity combination, usually the tube. As the regeneration is obtained by a resonant plate sending its impulses back to the grid, inside the tube itself, the inter-element capacity in the tube may be so small as almost to defeat this transfer for the entire broadcast belt. It may be necessary to load more inductance on L4, the plate coil. Better yet, get a tube that oscillates readily. It is well to use this type of circuit, by the way, to be sure that your detector is oscillatory to the necessary degree. Every good oscillating tube will work in this circuit.

At all hazards, some inductive coupling right on the coil may be helpful to those who suffer the ailment of possessing a poor oscillator as detector tube. Thus with inductive coupling between plate and grid (L1 coupled to L2) and with capacity coupling by means of the tube elements, you are pretty safe.

Loggable Regeneration

The plate of the tube is connected to the end of the former aperiodic primary, the beginning of this winding going to one side of the new coil, L4, the other end of L4 connecting to one of the phone terminals. The other phone terminal goes to B plus. The voltage on the plate should be varied until the best one is determined for easy regeneration control.

As many may desire to use apparatus they have about the house, to experiment with this interesting hookup, I shall give alternate values for the LC ratio in the plate lead.

If you have a .0005 mfd. variable condenser, for use as C2, then wind 45 turns of No. 24 double silk covered wire on a 3½" diameter tubing for L4; or 32 turns on a 4" diameter tubing. If you have No. 22 single cotton covered wire around the house, use that. If the condenser is .00035 normally 17 plates, wind 62 and 55 turns for the respective tubing diameters. A .00025 mfd. variable condenser requires about 8 turns more. A honeycomb coil may be used for L4, being 75 turns for .00035 and 60 for .0005 mfd. As there are no 60-turn HC coils, you will have to remove 10 turns from the 75-turn variety. The regeneration control now can be logged.

In connecting C2, join the stator plates to the tube plate side of L4 and the rotor to the phone side of that coil. Also, the stator of C1 goes to the grid condenser, the rotor to A plus. The grid leak, R2, connects from the grid post of the socket to A plus, instead of across the leak itself, although if you have clips on your grid condenser you may follow the other method.

Correct Polarities

The wiring may be made clearer when the following is digested:

One side of the former tickler goes to aerial, the other to ground. When the coupling is full (both rotary coil and stator form windings parallel), the ground lead should be the lower one. Therefore the top of the secondary goes to A plus and the bottom of the secondary to the grid condenser. Also, the bottom of the former aperiodic primary, L1, goes to plate of the tube and the top of L1 to the beginning of L4. Try reversing L4 later for possibly better regenerative control, also try a fixed condenser, .0001 or .002, across the phones (end of LR to L4 to B plus).

Reference to the diagram of the electrical wiring would seem to contradict the

(*Concluded on page 30*)

Super-Power Called a Menace

By Prof. W. J. Williams

of Rensslaer Polytechnic Institute

TROY, N. Y.

WHEN we know that WHAZ, Troy, N. Y., a 500-watt station, has been heard consistently in cool weather—about forty weeks a year for three years—across the continent in one direction and in Europe in the other, we can hardly be criticized for taking the stand that a power level of approximately this value is sufficiently high to meet the demands of the radio audience.

When it is necessary to lift the power level all over the country for a broadcast of national importance it can be done satisfactorily by linking by wires several stations chosen on account of their location.

The Fight Against Noise

Most people wonder why radio should be so noisy. They forget that most of the applications that engineers have recently made of the findings of science to the solution of our everyday problems have produced considerable noise. For instance, most of us can remember in the early days of the automobile how noisy it was. However the engineers soon found a method of reducing the noise below the point at which the public felt it objectionable. Typewriter designers have at last been able to produce machines which, for all practical purposes, can be considered noiseless.

A Sign of Health

Radio broadcasting is the latest child of the physical sciences, and like every other child we should expect it to be noisy. However, if the baby is making a noise because the nurse is not properly caring for it, common sense tells us that the thing to do is to change nurses and put the child in the hands of those who are capable of properly caring for it.

Similarly with radio, a number of noises we encounter in this field are perfectly natural and show a healthy development condition. There are, however, other noises which we experience which can be traced directly to those who are responsible for the new development. This should give us no cause for worry, for as soon as the radio public realizes the cause of these unnecessary noises it will unquestionably take steps to change nurses.

Function of Set

Noise is sound energy, and since it is possible to transform one form of energy into another it is possible to transform electrical energy into sound energy. In fact, this is the function of the radio receiving set, so that if we wish to limit the amount of noise produced we must limit the amount of electro-magnetic disturbance in the broadcasting medium which will affect receiving sets. This disturbing energy cannot be maintained at zero—that is a practical impossibility.

Therefore, the best we can hope to do is to limit its amount, so that when it is transformed into sound energy the so-called noise level will be so low compared with the power level of the program, that it will not materially interfere with the quality of the program received.

Solution of Interference

A complete solution of the interference problem requires consideration of the social aspect, and also the psychological reaction of the individual radio listener. The principal social groups affected are the radio broadcasters, the radio manufacturers and retailers, the radio audience and those Government departments which have, or are supposed to have, strict supervision over radio broadcasting. The radio broadcasters, manufacturers and retailers have in the past had their attention concentrated on the "golden egg" and have paid little attention to the "goose" that laid it, which in this case in none other than the radio audience. The radio audience is rapidly becoming more dissatisfied with present conditions, and the "quacking" of the goose is being heard by those responsible for this condition, who will probably take steps in the near future to remedy it.

If we allow a large variation in power level we make it extremely difficult to design and construct radio sets that can be operated by the average radio listener, with equally good results over the whole intensity range.

Intensity Too High

We in Troy have experienced more trouble from this source than from any other. Radio listeners have so-called super-sensitive sets with which they hope to hear the Pacific Coast and European stations, also the Troy and Schenectady stations. The nearby stations have an intensity which is too high to be received without distortion by such sets.

The distant stations have a power level which is so low that they cannot be received without sufficient noise to make the reception unpleasant. This is undoubtedly the fault of the user of the set regarding the reception from near-by stations, but it is not true regarding distant stations. There is no place, at least I have been unable to find the place, where there is a zero noise level. It is, therefore, evident that at each location there is a minimum signal strength which can be satisfactorily received on the most sensitive receiving set.

Electro-Magnetic Noises

When the public is educated to the point where it sees interference in its true light all of the unnecessary friction between those who experience interference and those who are unintentionally the cause will disappear. Under this condition the trouble, if it is a real one, can usually be located and corrected in a reasonably short time. The public utilities corporations using electrical energy are making a close study of the situation as far as they are concerned and we have every reason to expect that unnecessary noises from that source will rapidly disappear.

No sane person would be willing to sacrifice the advantages of public utilities which function through the use of electrical energy, and yet there is strong possibility that any electro-magnetic disturbance in the medium used for broadcasting will produce noise in a receiving set.

Room For Others

Though it were possible to design receiving equipment which would respond to all wavelengths throughout the radio-frequency band it would still be necessary to place limitations on broadcasting in order to leave channels for other communication facilities, power and transportation systems, Government agencies and radio amateurs.

It is both theoretically and practically impossible to reduce the noise level to the vanishing point, as the cost to the public of such refinements would make the price of these utilities prohibitive. It is necessary to establish a reasonably low power level limit, as the extreme sensitivity of the receiving set cannot be used without disagreeable interference. Regarding the upper power limit there is difference of opinion, but every radio listener knows that interference has multiplied since the introduction of so-called Super Power.

At Station

WFBH

HOTEL MAJESTIC
NEW YORK CITY

with
Irving Hoffman

JACK NILES, "THE VOICE OF CENTRAL PARK," IS CHIEF ANNOUNCER AT WFBH.

ALVIN E. HAUSER, PROGRAM DIRECTOR, IS A PIANIST AND COMPOSER.

KENNETH MOTT, ANNOUNCER AND REMOTE CONTROL OPERATOR.

FRANCES KIRSCH, SOPRANO, S AN ACTIVE SOCIAL WELFARE WORKER

THE RADIO RAMBLERS, JIMMY FLYNN, AND JACK VAL, BROADCAST LATEST SONGS.

ADELE FRANCES, SOPRANO, STARS WITH PEPPY SONGS.

IRMA SACHS IS ONE OF THE BEST SONGSTERS WE HAVE HEARD.

MR. DX HOUND

A Character Created by RADIO WORLD *Artist*

By HAL SINCLAIR

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THE See-Jay Battery Co., 915 Brook Avenue, New York City, is putting out a remarkably good rechargeable storage B battery, with a strong guarantee behind it as to service, durability and quality which is attested to by many thousands of satisfied users. Their materials have passed the severest tests prescribed by Government standards and they have the indorsement of the Washington Information Service Bureau. Only the best materials are used in these batteries and they are successfully shipped to all parts of the country. The product is reasonably priced for such a high-grade battery.

[Tested and Approved by RADIO WORLD Laboratories.]

SOME RECENT SPECIALS

THE DIAMOND OF THE AIR AS A 2-CONTROL SET, by Herman Bernard. This is the circuit that is sweeping the country. Four tubes; loop or aerial. Send 30c for May 23 and 30 issues of RADIO WORLD. 1493 Broadway. New York City.

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How to make it. See RADIO WORLD, dated May 16, 15c. per copy, or start your subscription with that number. RADIO WORLD, 1493 Broadway, New York City.

A 3-TUBE REFLEXED NEUTRODYNE, by Percy Warren. Send 15c for May 16 issue, RADIO WORLD.

A DX TRANSMITTER, by C. H. West, May 23 issue, RADIO WORLD, 15c.

Coming Events

JUNE 7 to 13—Music Industries, Chamber of Commerce Convention, Drake Hotel, Chicago, Ill.

JUNE 8 to 11—Annual meeting, Associated Manufacturers of Electrical Supplies, Homestead Hotel, Hot Springs, Va. Radio Section meets June 10.

JUNE 15 to 18—Radio Display Show, Hotel Chase, St. Louis, Mo.

AUG. 22 to 28—3d Annual Pacific Radio Exposition, Civic Auditorium, San Francisco. Write P. R. E., 905 Mission St., San Francisco.

SEPT. 5 to 12—Third annual National Radio Exposition, Ambassador Auditorium, Los Angeles, Cal. Address Waldo K. Tupper.

SEPT. 6 to 12—National Radio Expositoin Grand Central Palace, N. Y. C. Write American Radio Exp. Co., 522 Fifth Ave., N. Y. C.

SEPT. 14 to 19—Second Radio World's Fair, 258th Field Artillery Armory, Kingsbridge Road and Jerome Ave., N. Y. C. Write Radio World's Fair, Times Bldg., N. Y. C.

SEPT. 14 to 19—Pittsburgh Radio Show, Motor Square Garden. Write J. A. Simpson, 420 Bessemer Bldg., Pittsburgh, Pa.

SEPT. 21 to 23—International Radio Exposition, Steel Pier, Atlantic City, N. J.

SEPT. 23 to OCT. 4—International Wireless Exp., Geneva, Switzerland.

SEPT. 28 to OCT. 3—National Radio Exposition, American Exp. Palace, Chicago. Write N. R. E., 440 S. Dearborn St., Chicago, Ill.

OCT. 5 to 10—Second Annual Northwest Radio Exposition, Auditorium, St. Paul, Minn.

OCT. 5 to 11—Second Annual Radio Show, Convention Hall, Washington, D. C. Write Radio Merchants' Association, 233 Woodward Bldg.

OCT. 12 to 17—St. Louis Radio Show, Coliseum. Write Thos. P. Convey, manager, 737 Frisco Bldg., St. Louis, Mo.

OCT. 17 to 24—Brooklyn Radio Show, 23d Regt. Armory. Write Jos. O'Malley, 1157 Atlantic Ave., Brooklyn, N. Y.

OCT. 19 to 25—Second Annual Cincinnati Radio Exposition, Music Hall. Write to G. B. Bodenhof, care Cincinnati Enquirer.

NOV. 19 to 25—Milwaukee Radio Exp., Civic Auditorium. Write Sidney Neu, of J. Andrae & Sons, Milwaukee, Wis.

NOV. 17 to 22—4th Annual Chicago Radio Exp., Coliseum. Write Herrmann & Kerr, Cort Theatre Bldg., Chicago, Ill.

DEC. 1 to 6—Boston Radio Show, Mechanics' Hall. Write to B. R. S., 209 Massachusetts Ave., Boston, Mass.

Literature Wanted

THE names if readers of RADIO WORLD who desire literature from radio jobbers and dealers are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

Trade Service Editor,
Radio World,
1493 Broadway, New York City.

I desire to receive radio literature.

Name ....

City or town..................................

State ....

Are you a dealer?..........................

If not who is your dealer?

His Name ....

His Address ....

R. M. Arons, 84 Marvel Rd., New Haven, Conn. (Dealer).

T. Bridgewater, 48 Nina Ave., Toronto, Can.

C. T. Hatch, Hamburg, Ia. (Dealer).

Radio Tube Repair Works, 616 Park Ave., Youngstown, O. (Dealer).

H. Parker, 481 Stimson Place, Detroit, O.

New Corporations

Philbon Radio Corp., N. Y. City, $10,000; I. and L. Molins, R. Martin. (Atty., I. B. Shreiber, 51 Chambers St.)

Robert C. Buchanan, Montclair, N. J., 500 shares, no par; Ray Buchanan, Doris Buchanan, Robert C. Buchanan, Montclair, N. J. (Atty., George S. Harris, Montclair, N. J.)

Mu-Rad Radio Corp., Delaware, radio broadcasting receivers, $10,000,000; Jacob Broches Arnoff, Mollie Turnerollinick, New York City. (Capital Trust Co., of Delaware).

Radio Laboratories, Inc., 30 N. La Salle St., Chicago, Ill.; capital, $3,000. Manufacturing and deal in radio parts, sets, appliances and equipment, Incorporators: William H. Devenish, Charles S. Knudson and Edward H. Luibeck. Correspondent: Devenish & Luebeck, 160 N. La Salle St., Chicago, Ill.

NOW'S THE TIME TO BUY!

PRUDENT fans will purchase radio apparatus and receivers now. Prices are low. Experiments planned for next Fall may well be financed now, for the saving will be considerable. In some instances prices are 1-3 to 1-2 of what they will be when the new season arrives. The articles are worth the price that will be charged for them at that time, but are being sold now because it costs money to carry stock and because of changing sales plans. There is a natural dropping off in sales during the warm weather and both manufacturers and retailers want to keep their forces at work. Hence the price allurement. There is no sense in deferring the purchase of a receiver in the expectation that some great invention suddenly will put all existing receivers in the junk class. Nothing like that will happen. Receivers are so constructed that they are adaptable to changes which will preserve their efficiency under any conditions likely to arise for many years.

Regular radio dealers should be patronized, for they know the radio business.

THE RADIO UNIVERSITY

(*Concluded from page* 15)

set. Will they work successfully?—M. A. Richardson, Conklingville, N. Y.

(1) Yes with very good results, but the tuning will be quite difficult on account of the two instruments tuning the plate, both of which must be in exact resonance, and in the same time obtain the maximum amount of electromagnetic coupling from the grid to the plate of the tube. (2) See the June 6 issue of RADIO WORLD, Radio University department for a complete description of such an amplifier (3) Yes.

* * *

PLEASE TELL me where I can obtain silver wire for wiring up radio sets?—C. E. Gray, Oklahoma.

Stanley and Patterson, West and Hubert Sts., New York, N. Y.

* * *

I HAVE built the Benson Super-Heterodyne and find that I cannot tune below 360 meters. Otherwise the set works like a charm, loud and clear and lots of distance. (2) How many volts will I obtain from the Marle B battery Eliminator when used with the 6 tubes?—Joseph Azinano, Lyndhurst, N. J.

(1) See the May 16 issue of RADIO WORLD, page 11, under the article entitled, "Capacity, Causes and Effects," by Lewis Winner. (2) 110 volts.

* * *

I WOULD like to add a stage of untuned radio-frequency to the Anderson Superdyne. Please give the hookup.—H. A. Keys, Kinder, La.

This is a very poor way of hooking up to get the most out of a set of this type. Use a tuned radio-frequency stage if you like, but the chances are that you will improve the set by adding RF are small.

* * *

I WOULD like to know if I can use the Ambassador coil in the Tube Tone Beauty as described by Brewster Lee in the May 9 issue of RADIO WORLD. (2) Is this set a good distance getter?—Edward Klinusley, 60 Sutton St., Brooklyn, N. Y.

(1) Yes. (2) Yes.

* * *

IN RADIO WORLD of April 11, on page 6 was published a hook-up describing push-pull radio-frequency which I do not understand. Kindly explain.—A. O. Seils, R. D. 6, Box 418, Sacramento, Cal.

This was an experimental hook-up and so stated in the caption. If you are not thoroughly versed on radio do not attempt experimenting with this.

* * *

WHAT SIZE wire is used to wind the coils in the Lindheim set which was described in the May 30 issue of RADIO WORLD, (RF, detector and AF, all on one tube)?—J. L. Diampen, Dophin City, Ia.

Use No. 22 DSC.

* * *

WHAT is the capacity of C2 in the 1-tube set as described in the Dec. 6 issue of RADIO WORLD?—C. J. Kaskin, New York City.

The capacity of this condenser is .001 mfd.

* * *

WILL you please give data as how to attach two stages of radio-frequency to the "Dandy 1-Tube Set." (2) Can you give me a hook-up for a push-pull amplifier that can be plugged in as a separate unit? (3) Would it be practical to build the "Dandy 1-Tube Set" in three units so that they could be easily connected together as one set so that, for experimenting, it would not be necessary to tear up the whole set to change one unit? My reason for this request is that I have had better success with this detector as used in the "Dandy One Tube Set" than any set I have used.—Jesse I. Seward, 2 Clinton St., Palmyra, N. Y.

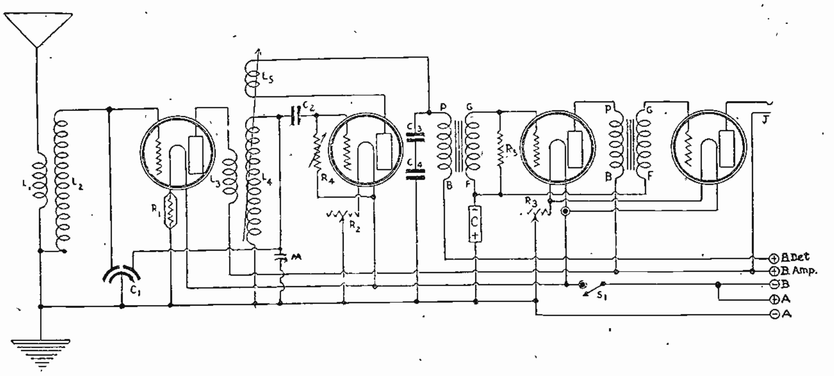
(1) This is not very practical. RF would not improve this set. (2) See the May 9th issue of RADIO WORLD. (3) Yes.

Extra Condenser for Matching

(Continued from page 10)

henries, with the secondaries of the two coils at about the same inductance, plus or minus the other factors, such as plate capacities, capacity of associated parts, etc., which must be determined by test. I recommend this particular task to the Bureau of Standards.

After all is said and done I may have made out a case that shows great difficulty in matching coils. But, granting that the condenser is efficient, the difficulty is not great. Indeed, simply by winding a four more turns on the secondary, L2, so they may be removed as experience distates, the set may be wired up permanently, save for the temporary connecting of the A minus lead from L2, and then the set tuned "as is." The revision is bound to be downward, hence remove one turn at a time until no one station can be tuned in at two settings of the condenser dial that are close together. Settings far apart may tune in the same station on any set, due to reception of harmonics.



See Chester A. Siegel's letter on next page.

The Third Method

Another plan is to put less inductance on the secondary, L2, say four turns less than on L0, shunting a midget variable condenser across the secondary (in parallel with the section of the double condenser attached to that coil).

Existing variation may be compensated for by increasing the capacity setting of the midget condenser, starting from theoretical zero capacity. Once the correct setting is determined, it is left there, hence the midget may be mounted on the baseboard. Personally I would prefer to pay $2.50 for a high-frequency buzzer, wind a coil and pick up a spare condenser, so that I would have a wavemeter for various radio uses, including coil matching. The midget condenser method works, however, its use entailing, nevertheless, the risk of an increased minimum capacity setting for one of the sections of the double condenser, introducing a higher resistance factor, although this is a theoretical objection, and in practice the system works.

After the inductances are matched in respect to their inclusion in the circuit they may be wired up permanently. The readings may be two or three degrees lower than they were when the condenser was not doubled up in the circuit. This may be accounted for by the meeting of the two electrostatic fields, causing an effect like that of electromagnetic interplay (absorption). But the decrease is the same for both sections, hence this possibility may be disregarded as a part of the matching problem.

If under no circumstances can you

(Continued on next page)

Multiple Tuning Infant Art; Much to Learn, Says Bernard

(*Continued from preceding page*)
match up coils satisfactorily, return the double condenser to the seller and get one that has not defeating lead and lag (tendency of separate sections to run ahead of or behind each other capacitatively).

The inclusion of the loop jack is accomplished thus: Connect aerial to one terminal of the primary L, ground to the other end of L. If the ground end of L is nearer the secondary, connect the adjacent secondary terminal to the inside spring of J1 that makes contact with the outside spring that goes to A minus. The other secondary terminal goes to the other inside spring whose outside contact goes to grid. Thus, with the loop terminals connected to a jack plug, the insertion of the plug in the jack cuts out LL0, leaving only the loop as a stage of tuned impedance RF. If the terminal of L0 nearest the secondary is the aerial end, then the adjacent secondary terminal goes to the inside spring connecting to the outside one in contact with grid.

It must not be supposed that the last word on multiple tuning condensers has been learnt. Many interesting questions will provide entertaining experiments for fans. The loop, as an inductance with distributed capacity, the aerial as a capacity with distributed inductance, the tuning condenser as something in the aerial class, all afford a wide field for research, as unlikes are to be matched.

The inclusion of a double condenser simply reduces the controls from three to two, but does not increase the selectivity, sensitivity or otherwise improve the working of The Diamond of the Air. With the double condenser in use any station obtained on the 3-control set should be heard under exactly equal conditions.

* * *

Editor, RADIO WORLD:

IN looking over your issue of RADIO WORLD, dated May 23, relating the "2-Control Diamond," an idea came to me that I would like to pass on.

One variable condenser is used for tuning the two coils, the condenser having a common rotor and separate stators. A perfect balancing of the two circuits is not always realized. Instead of resorting to the process of removing or adding turns of wire, I would suggest the employment of a midget condenser connected across either of the two coils, of about .00005 capacity. By setting this at a certain point a perfect matching of coils can be accomplished. The little condenser would be behind the panel and once corectly set would be left that way.

CHESTER A SIEGEL,
63 Fifth Street,
Newark, N. J.

* * *

This Nameplate FREE

RADIO WORLD'S
DIAMOND
OF THE AIR
"A Gem, A Jewel and A Joy"
1925 SPRING MODEL

A BEAUTIFUL colored nameplate to put on the panel of the Diamond of the Air will be furnished free to all. Send in your request now, if you haven't done so before.

Directions For Use

Take the nameplate and immerse it for two minutes in a glass of water, making sure that the entire nameplate is covered with the water. When you insert it in the water, the paper will coil up and only after it starts to uncoil, take out and

(*Continued on next page*)

A Portable Super-Heterodyne On a Panel Measuring 7x18"

(*Concluded from page 13*)

control rather broad and will simplify the preliminary testing of the outfit.

The batteries and loop having been connected, a single tube should be inserted in the audio socket at the right hand end of the set, and the rheostat just turned on. The phone plug being inserted, a slight click should be heard as it goes into the last jack. If the grid post of the socket is touched, a slight click will also be heard. The second detector and first audio tube should now be inserted in their sockets and the rheostat adjustment left unchanged. A click or squeal should be heard when the grid terminals of these tubes, or their sockets are touched. The two RF tubes may now be inserted, and the potentiometer moved from its positive to its negative end, with 1½ volts C battery on the RF tubes. A scraping noise should be heard as the arm is moved over the resistance sector, getting slightly louder as the negative end is reached.

The oscillator tube, at the left end, and the first detector should now be inserted in their sockets, making all seven tubes in place. The oscillator coupler should be set full in, the Chelton-Midget, or balancing condensor all out, and the five megohm leak put in the clips of the first condenser, the two megohm leak being in the second detector grid condenser clips. The loop condenser should be set at about 20 to 30 degrees, and the oscillator condenser adjusted. At some point a sharp click should be heard, indicating that the oscillator is in resonance with the loop circuit. At this point no signal can be heard, but if an outdoor antena is used, the set is radiating slightly. This click adjustment is the only setting of the set where radiation is likely to occur, and it is practically negligible, especially on a loop.

An oscillator adjustment about five to ten degrees either side of this click is proper for a given loop condenser setting, and is where a station can be heard. These two points, one either side of the click, will hold over the entire wavelength range of the set, which is from 200 to 600 meters. This means that each station may be heard at two oscillator adjustments, which is often a convenience, as if interference is noticed on one point, the other may be resorted to.

LIST OF PARTS

Two .0005 low-loss condensers (such as the Silver, Cardwell or General Radio).
Two 3" or 4" dials; preferably moulded (vernier types may be used if so desired).
One Howard or similar 6or- 7-ohm rheostat.
One Howard or similar 150- to 400-ohm potentiometer.
Three binding posts, insulated type.
One Carter three-spring No. 102A jack, or similar.
One Carter one-spring No. 101 jack or similar.
One Carter on-off switch.
One Silver RF transformer unit (50 kc.).
One Silver oscillator coupler.
Two Silver UV199 sockets.
One Silver 5 gang sockets for UV199.
A battery panel 7x18", one cabinet, oak baseboard, 7 tubes, etc.

FREE NAMEPLATE

(*Concluded from preceding page*)

place on a piece of blotting paper. Take a pin and lift off the nameplate gently, to get it transferred to the blotter. Do not injure the nameplate. You won't if you take care. On your panel draw a line representing where the top of nameplate is to go. By coiling back the blotter or other piece of absorbant paper you can see the nameplate top sufficiently to justify it with the line on the panel. Press firmly and nameplate will stick to panel. Allow to dry.

All nameplate requests received up to May 26 have been complied with, so if you didn't get your nameplate, please write to Nameplate Editor, RADIO WORLD 1493 Broadway, New York City.

The nameplate is of the decalcomania or transfer type.

Stanley Merrel, Swanton, O.
Frank Doulek, 1319 Avenue A, N. Y. City.
Edgar D. Smith, L-Shell, Big Horn County, Wyoming.
Russel Ammer, 1110 E. Adler St., Portland, Ore.
L. Payette, P. O. Box 654, Jolliette, Quebec, Canada.
Joseph Bujdoso, 3206 West 90th St., Cleveland, Ohio.
J. H. Banks, 827 5th Ave. Sq., St. Petersburg, Florida.
D. Ross, 117 Belmont, Edmonton, Alberta, Can.
R. A. Scholz, 72 East 3d Ave., Columbus, O.
D. J. Luger, 453 Williams Ave., Brooklyn, N. Y.
Geo. Sassman, 811 E. Russell St., Philadelphia, Pa.
C. W. H. Bray, 4th and Pennsylvania Ave., East Pensanken, N. Y.
James Corey, 424 19th St., Niagara Falls, N. Y.
O. Wycough, 243 Grove St., St. Paul, Minn.
M. A. Luzack, 91 Layfayette St., Newark, N. J.
G. Lutz, 110 9th St., L. I. City, N. Y.
J. E. Nebohm, 779 40th St., Brooklyn, N. Y.
C. Browser, 1216 Hiner Place, N. E., Canton, O.
Curtis Sever, Milford, Ill.
E. L. Diexor, 815 E. 72nd St., Cleveland, O.
H. P. James, 464 W. Baltimore Ave., Detroit, Mich.
G. A. Gieseke, 231 Fillmore St., Gloucester City, N. Y.
J. D. Schmidt, Wheaton, Kan.
F. Cervantes, P. O. Gox 236, St. Joseph, Mo.

How to Tune a Short-Wave Receiver Told By An Expert

(*Continued from page 3*)

a tuned plated, with fixed inductance and variable capacity, is employed. This hookup will simplify set construction for those having no parts with which to make the inductive tickler set shown in Fig. 1. The coil L3 has about the same number of turns as the secondary L2. The stator form coils are exactly the same as those (L1L2) for the Fig. 1 circuit. In practice it is usually better to put two more turns on L3 than were used on L2, to insure best regenerative results. The tuned plate hookup nearly always justifies the inclusion of a by-pass condenser (C4) of .001 or .002 mfd. For the Fig. 2 circuit, of course, two forms will be required of the same diameter and height, whereas in the other case the plate coil form (L3, Fig. 1) has to be smaller than the stator form, to permit rotation of the tickler coil.

Tubes to Use

Any of the oscillating type of tubes may be used. The WD11 and WD12 are very fine, especially as they require only a 1½-volt dry cell. UV199, C299, UV201A, UV200, etc., are all good, especially the 200.

Socket and Rheostat

The socket should be of some insulation material, e.g., bakelite, porcelain, etc., rather than metal. Avoid using tubes that have metal bases. The capacity effect of this combination of metal in socket cups and tube bases is indeed injurious on low-wave work.

The filament heating is especially critical on low-wave reception. It is often well to use the rheostat for vernier regeneration control. For instance, when the whistle of a station is heard in the phones it may seem impossible to get rid of this so as to make the voice or music audible. However, by careful adjustment of the rheostat, providing the regeneration setting of the tickler is correct, the whistle can be made to disappear. It is, therefore, virtually imperative to use some form of vernier rheostat. Trouble in getting rid of the whistle may lead one to decrease the plate voltage, but this may result in low audibility. High plate voltage seems essential, at least a considerably higher voltage than would be used for normal broadcast reception.

If a variable grid leak of good make is used, this of course may be made to function as an additional regeneration control. Usually it is not well to use even the rheostat for this auxiliary purpose, but with short-wave work, where tuning is hard enough, the rheostat is to be commended. However, it will be found that the correct rheostat setting may suffice for a wide sweep of the tuning condenser dial and additional adjustment might be necessary only at the other extreme of the dial reading.

Short Aerial Better

An aerial system used for broadcast reception may be used for short-wave work, but it is better to have a short antenna, say 35 feet. If the broadcast antenna is to be employed, put a small condenser in series with the ground lead, say .0001 mfd. or, if that isn't accessible, .00025 mfd. That reduces the fundamental wavelength of the antenna system.

For a special short-wave antenna, the 35-foot stretch may be indoors. Indeed, as short waves often travel farther and better than long waves, you will undergo the pleasant experience of receiving stations of considerable distance on the short antenna and short-wave set that cannot be heard in a radio-frequency broadcast receiver hooked up to the regulation antenna. Short waves nearly always travel better in daylight than waves in the broadcast belt; also it is often possible to get much better reception on them at night than on the others. Another peculiarity of short-wave work is that the signal may be hard to receive a short distance from the transmitter, or even for a hundred or a few hundred miles, but will be heard splendidly 500, 1,000 or 1,500 miles away.

What You May Hear

Besides tuning in stations that are broadcasting programs on special low waves it is possible to pick up harmonics

What Stations You Can Hear On a Short-Wave Receiver

of other broadcasting stations. For instance, KDKA sends out its regular programs on a wavelength of 301.9 meters. It also broadcasts the same programs on 94 meters. When you hear KDKA on the low waves it will most likely be the 94-meter wave, and that normally will be loud and clear. If a harmonic is picked up it is likely to be muffled and distorted. The fundamental of the KDKA short wave, 94 meters, will come in about 20 on the tuning condenser dial, using .0005 mfd. with the coils described. Other stations that engage in special short-wave work include KOA, Denver, Col.; WGY, Schenectady, and WAHG, Richmond Hill, N. Y. The Richmond Hill station uses various short wavelengths for relay or remote control work and most of them will not be received on the sets described, as the condenser will not tune down low enough. It is impossible to use any given coil and cover the entire short-wave range. Interchangeable coils would have to be employed, but if less inductance is used than described, then the capacity will be too great, compared with inductance, for best efficiency.

WJZ, New York City, when engaged in remote control work only, relays on a short wave, sometimes 40, sometimes 80 meters. The highest it used was 110. Therefore the sets described would pick up some of these. The combinations described will tune approximately from 85 to 120 meters, although this is no guarantee. Tube capacity, set wiring, strays, etc., affect these considerations mightily on short-wave work.

Besides the music and speech to be heard it must be expected that code will come in. But this is not to be rated as interference, for the tuning on short waves is very sharp indeed. For instance, KDKA may be heard at 20 on the tuning condenser dial, and some code picked up at 20½, with KDKA completely tuned out. Also the tickler adjustment would have to be varied for this scant difference in tuning condenser dial setting. Those who can read code, therefore, will have lots of fun calibrating a wavemeter for short waves. The calls will be heard and the callbooks consulted for the wavelengths of these stations.

Using a Smaller Condenser

As has been intimated, the tuning is excessively critical with the inductance-capacity values as prescribed. It would be better to use a .00025 mfd. variable condenser. This will decrease the criticalness of tuning. No change need be made in the coil data, for KDKA will be picked up at a higher reading. Where the tuned plate method is used, the same holds true. If you can't pick up a program with the .00025 mfd. condenser, add four or five turns to the coils.

One of the phenomena of short-wave

How to Employ Dials Correctly On Short-Wave or Other Set

work that sometimes is present in these sets is that there is a short gap in the regeneration control where little feedback is obtainable. This may be due to a neutralizing effect, when the natural period of the control is very close to or equals the tube elements, capacity effect.

The usual regeneration sound like the rushing of distant waters, is to be looked for. No squawking should take place due to failure of regeneration to synchronize with the lower dial readings of the tuning condenser C1. Add a turn or two to the tickler coil if the squawk is present below a reading of 5.

Data on Dials

It is assumed that dials rotate from right to left (counter-clockwise) and that such movement corresponds with capacity increase (plates more and more enmeshed). With condensers that rotate 360 degrees it makes no difference what type of dial is used, clockwise or counter-clockwise. But if the end-stop type of condenser is employed, then full capacity should give a reading of 100. If the reading is 0 for full capacity the dial will read backwards, and if a 100-degree dial is used, as assumed, then KDKA would be heard at 80 instead of at 20. It is very annoying to have the wrong kind of dial. Some condensers with end-stops rotate one way, others the opposite way, but most of them from right to left (counter-clockwise). When buying a dial for a condenser be sure to get one that will register in the correct direction. A dial that, when you pick it up, reads from left to right is a counter-clockwise dial, because the direction in which the dial is turned governs the type, and the direction of improvement is always opposite to the direction in which the numbers read. An inspection of any dial will confirm this to your understanding.

First "Governoress"

BEHOLD THE GOVERNOR! No, not the one with the glasses. 'Tis out West, where men are men—and women are Governors. At KOA, Denver, Nellie Taylor Ross, Governor of Wyoming, broadcasts. Beside her is Clarence J. Morley, also Governor, Colorado being his empire. (KOA Studio.)

TUNED PRIMARY IS SELECTIVE

(*Concluded from page 21*)

manner of connection described above. But the diagram is schematic and is not intended to show polarities, for to do so would mean the reversal of diagrammed leads in such a way as to make the wiring look complicated.

If an existing set is to be converted, put the two dials on C1 and C2. No dial is needed for the aerial tuning coil, a simple knob sufficing. This coil will be found to affect volume, so that stronger signals may be received than formerly, and also has an effect on regeneration, due to apparent resistance produced by tighter coupling between the aerial coil and the secondary.

JOIN THE A. B. C.

A. B. C. stands for the American Broadcast Club. Join it today. It involves no dues or payment of any kind, and no obligations. It was founded by RADIO WORLD simply to unite the broadcast listeners and radio fans in general in a common bond to promote their welfare as occasion requires. Send your name and address to A. B. C. Editor, RADIO WORLD, 1493 Broadway, New York City.

Milton Gordon, 481 Ft. Washington Ave., N. Y. City.
Thos. Berger, 3340 Seymore, Los Angeles, Cal.
C. H. Bingham, Knoxville, Tenn.
S. Franklin Hall, 904 Davis Ave., Mobile, Ala.

WAVEMETER

(*Concluded from page* 14)

to do so, you can easily help by bringing your receiving wavemeter over to his house. Put the coil of the receiving wavemeter in inductive relation to the coil of the transmitting wavemeter (the unilateral wavemeter). Tune the condenser until you hear the note of the buzzer in the phones of your unilateral wavemeter. Mark down on graph or outside of dial and calculate for all the frequencies in the same manner.

Many other uses of the wavemeter are described in the Bureau of Standards pamphlet, "Radio Instruments and Measurements." Of course the data in this book are very difficult to understand unless you have a flowing knowledge of all types of mathematics and electricity. If, however, you possess such, this is the best book. The other uses of the wavemeter are mainly theoretical and are for use by those who can afford to spend money on

Conversion Table for Frequency and Wavelength

EVEN though the wavelengths of the stations are expressed in meters, more accurate results can be obtained by expressing the wavelength in frequency (the number of cycles or kilocycles). If you are given the frequency in cycles and you wish to express it in kilocycles, divide the number of cycles by 1,000, as kilo means 1,000. For example, if you are given a station with a frequency of 600,000 cycles, and you divide it by 1,000, the answer will be 600 kcy.

As the frequency is increased the wavelength as expressed in meters decreases. KDKA has a wavelength of 309.1 meters and a frequency of 970.5 kcy. WEAF has a wavelength of 491.5 meters, a frequency of 610 kcy. Note that the wavelength of the two stations differs by 182.4 meters (WEAF higher). In kilocycles there is a difference of 360.5 (WEAF lower). On most variable condensers, as you come to the low waves, the stations become jammed up on the dial, in fact so jammed, that a station at, say, 273 meters can hardly be separated from a station operating at a wavelength of 250 meters, even though the difference in meters is quite large. To cure that trouble straight line frequency or SL wavelength condensers are used, overcoming the crowding effect due solely to comparative capacity variations.

A station on a wavelength of 200 meters has a frequency of 1,500,000 cycles (1,500 kcy.) and a station having a frequency of 210 meters, has a frequency of 1,480,000 cycles (1,480 kcy.). The difference is 20 kcy. as compared with only 10 meters dffierence.

Below is given a table of four standard wavelength stations:

Station	Wavelength in Meters	Frequency
WEAF	491.5	610
WBZ	333.1	900.09
KDKA	309.1	970.5
WSB	428.3	700.4

The formulas:

$$\text{Frequency in cycles} = \frac{300,000,000}{\text{wavelength in meters.}}$$

$$\text{Wavelength in meters} = \frac{300,000,000}{\text{frequency in cycles.}}$$

$$\text{Frequency in kilocycles} = \frac{300,000}{\text{Wavelength in meters.}}$$

$$\text{Wavelength in meters} = \frac{300,000}{\text{Frequency in kilocycles.}}$$

Frequency in cycles × wavelength in meters = 300,000,000

Frequency in kilocycles × wavelength in meters = 300,000,000.

[Note: 300,000,000 is the velocity of the wave; it travels that many meters in 1 second, i.e., 186,000 miles. Hence:

$$\text{Frequency} = \frac{\text{velocity}}{\text{wavelength}}.$$

$$\text{Wavelength} = \frac{\text{velocity}}{\text{frequency}}.]$$

"HOW TO MAKE—"

The following constructional articles have appeared in recent issues of RADIO WORLD:

Sept. 6, 1924—A simplified Neutrodyne with Grid-Biased Detector, by J. E. Anderson. A Low-Loss Wave Trap, by Brewster Lee.

Nov. 15—A Sturdy Low-Loss Coil, by Lieut. P. V. O'Rourke. An Ultra 1-Tube Receiver, by Byrt C. Caldwell.

Dec. 6—A 6-Tube Super-Heterodyne Using a Variometer, by J. E. Anderson. A $1 Coil Winder by Herbert E. Hayden.,

Dec. 13—The World's Simplest Tube Set, by Lieut. P. V. O'Rourke.

Dec. 20—A 1-Tube DX Wonder, Rich in Tone, by Herman Bernard. An Interchangeable Detector, by Chas. M. White.

Dec. 27—A 2-Tube Variometer Set, by Lieut. P. V. O'Rourke.

Jan. 3, 1925—A 3-Tube Portable That Needs No Outdoor Aerial, by Abner J. Gelula.

Jan. 10—A Low-Loss DX Inductance, by Herbert E. Hayden.

Jan. 17—A $25 1-Tube DX Wonder by Abner J. Gelula.

Jan. 24—A Selective $15 Crystal Set, by Brewster Lee. A Variometer-Tuned Reflex by Abner J. Gelula. An $18 1-Tube DX Circuit for the Beginner, by Feodor Rofpatkin.

Jan. 31—A Transcontinental 3-Tube Set, by H. E. Wright. An Experimental Reflex, by Lieut. P. V. O'Rourke.

Feb. 7—The Bluebird Reflex, by Lieut. P. V. O'Rourke. A $5 Home-Made Loudspeaker, by Herbert E. Hayden.

Feb. 14—A Super-Sensitive Receiver by Chas. H. M. White. A Honeycomb RFT for DX, by Herbert E. Hayden.

Feb. 21—A 1-Tube Reflex for the Novice, by Feodor Rofpatkin. A Set for Professional Folk, by Lieut. P. V. O'Rourke. A Honeycomb Crystal Receiver by Raymond B. Walles.

Feb. 28—A Set That Does the Most Possible With 6 Tubes by Thomas W. Benson. Three Resistance Stages of AF on the 3-Circuit Tuner, by Albert Edwin Sonn.

March 7—Storage B Battery, by Herbert E. Hayden. Benson's Super-Heterodyne.

March 14—The Reflexed 3-Circuit Tuner That You Can Log, by Herman Bernard.

March 21—A Variable Leak, by Herbert E. Hayden. A 4-Tube, 3-Control Set That Gets the Most DX, by Lieut. P. V. O'Rourke.

March 28—The Improved DX Dandy Set, by Herbert E. Hayden. A 3-Tube Reflex for the Novice, by Feodor Rofpatkin.

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May 30—A Set That Uses the Detector Also for an AF Stage, by Burton Lindheim; Your Set Tunes the Entire Wavelength Band, by J. E. Anderson; The 5-Tube Neutrodyne Set With "One Lonely Dial," by Sidney E. Finkelstein.

June 6—The Smokestack Portable, by Neal Fitzalan; A. & B. Battery Eliminator, by P. E. Edelman; A Wavemeter, by Lewis Winner.

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