June 20 1925

RADIO WORLD

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Vol. 7. No. 13. ILLUSTRATED Every Week

155-169

STATIONS HIDE THEIR SHORT-WAVE WORK

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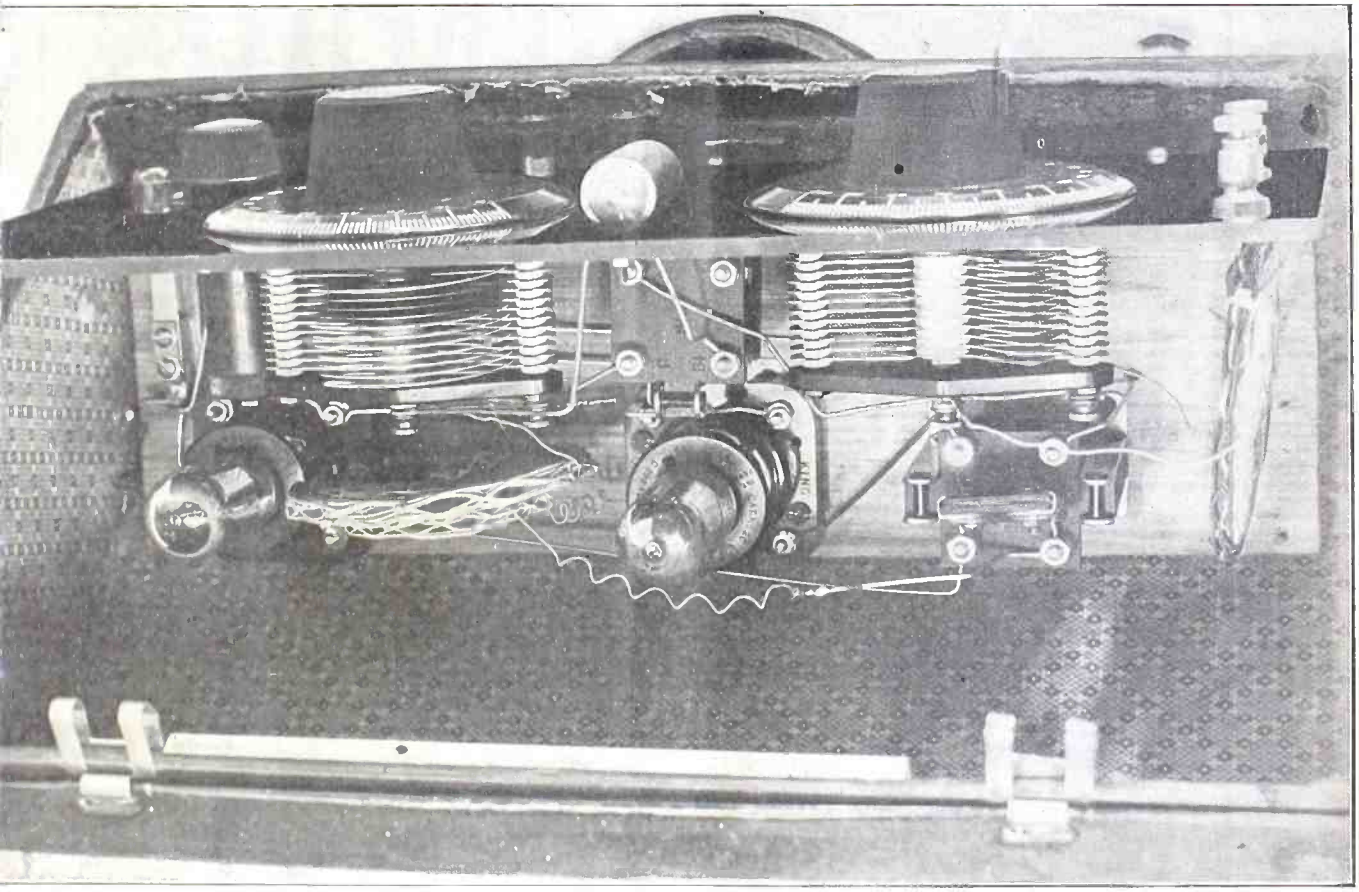
A 2-TUBE PORTABLE REFLEX

By HERBERT E. HAYDEN



THE 2-TUBE SPEAKER PORTABLE. SEE ARTICLE ON PAGE 5

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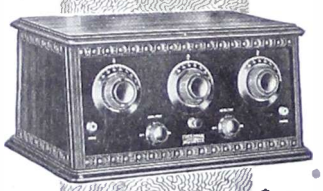

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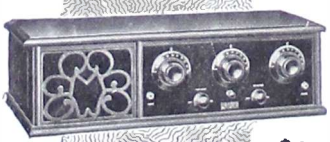

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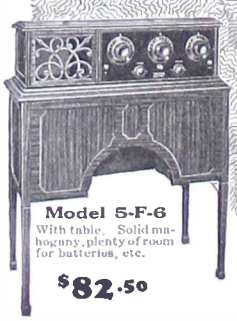

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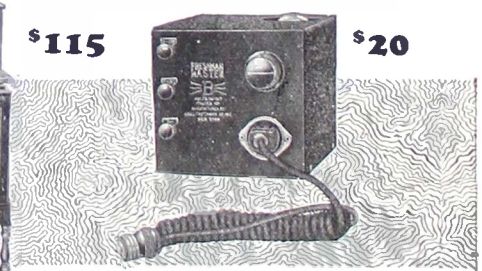

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VOLUME SEVEN OF

RADIO WORLD

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The Diamond as a Reflex

By Herman Bernard

Associate, Institute of Radio Engineers

FOR those who desire to construct the Diamond of the Air, using only three tubes instead of four, the reflex principle will be attractive, since this circuit may be built that way with little sacrifice of the original simplicity. As a reflex the set can not be better than the 4-tube model, but approximately the same results will be obtained. The reflex will make a good portable set, especially as the panel is only 7x18", and several firms sell portable cases which will accommodate this size.

The circuit (Fig. 1) uses the multiple tuning system, so that only two controls are needed, one for wavelength, the other for regeneration. The double condenser, C1, having a common rotor but two separate stators, each of the two sections .0005 mfd., tunes both the RF and the detector coil secondaries. This makes for space economy, too, so that for portable use an additional advantage is derived.

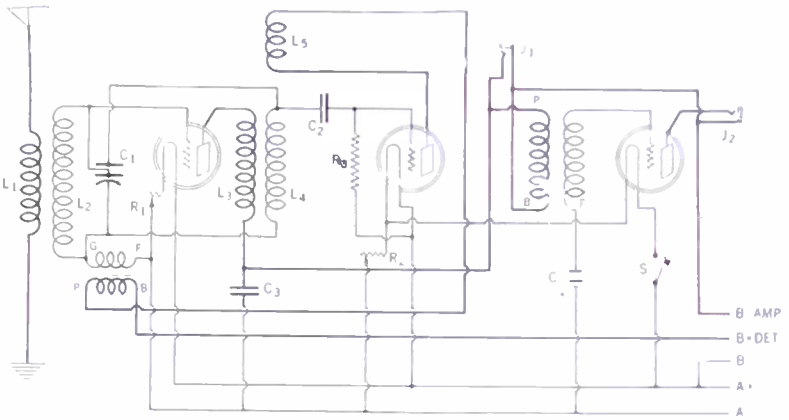


FIG. 1, the Diamond of the Air as a reflex. There are one stage of tuned radio-frequency amplification, tuned regenerative detector stage and two stages of transformer-coupled audio-frequency amplification, the first stage being reflexed in the RF tube. Thus one tube does double duty. While not better than the original straight 4-tube model, this set is better adaptable to portable use, on account of space conservation and slightly lighter weight. The two secondary coils are tuned by a compound condenser, eliminating one control, leaving only two. This set also will work well on a loop. It is a DX receiver of considerable volume and clarity.

Loop May Be Used

As a reflex the set will operate on a loop as the 4-tube model does, but the wiring would have to be altered slightly in respect to Fig. 1. A double-circuit jack would be included. This could go to the left of the RF rheostat, the lower-left-hand knob shown in the panel layout, Fig. 2. The secondary L2 would be connected to the inside springs of the jack, while the outside right-angle would go to the G post of the first audio transformer, lower left. Fig. 1, and the hooked outside leaf to the post on C1 that connects to the grid of the RF tube. Thus when the loop, connected to a plug, is inserted it makes contact with that section of the condenser C1 that tunes the RF stage. The aerial secondary L2 is cut out, likewise L1, the aperiodic primary, whence the secondary derives its energy. Thus with the loop provision the set may be operated on a water craft, in an automobile, and in camp or at one's bosky Summer home. If preferable, provision may be made for using the set for loop operaton exclusively, the coil L1L2 then being omitted. In case both options are desired, of course the two secondaries and the loop must be matched. Data on these points was given in detail in the May 23 and 30 issues of RADIO WORLD, where the fundamental circuit was discussed as a 2-control receiver for exclusive operation on outdoor aerial or exclusive operation on a loop. In the June 13 issue information was presented on the combination of uses, together with particulars for matching coils and loop. Those desiring to depart from the diagram as shown in Fig. 1 this week should consult the issues cited, but so much of the information necessary to construct the circuit just as it is now shown will be repeated.

Coil Matching

Probably the simplest way of matching the two secondaries, L2 and L4, would be to wind a given inductance for L2, then wind the secondary L4 with four more turns than the other had. Using only half of the double condensor (one stator to grid of the RF tube, rotor to minus A, the other stator unconnected for the moment) place any other variable condenser temporarily across L4. The test condenser may be .00025, .00035, .005 or even .001. Tune in a few stations, spread as much as possible over the dial range of C1, that is, giving readings on low, high and intermediate wave stations. If that is not convenient, select, if possible, a station or two over 450 meters, otherwise, even if only one station can be received at the time, use that as your guide. Now note the dial readings for C1, the half-section of the compound condenser. Then transfer the connections, so that the leads that went to the test condenser now go to the half-section of the double condenser. This is done simply by switching the two grid leads (RF and detector tubes). The object is to get exactly the same reading or readings on C1 in its new position as were obtained formerly, for then the detector stage will be tuning in step with the RF stage, and this is necessary, otherwise two slightly different wavelengths will be represented by the same setting of C1. You will find that C1 is now running behind in dial readings, compared with the previous record. This is due to the four extra turns. The inductance increases approximately as the square of the number of turns, when the length of the winding is equal to the diameter, which gives you an idea of how quickly the inductance rises. However, in this case the increase will be swifter, as we shall not use a diameter equal only to the length of the winding (distance between terminals).

Remove one turn at a time until the readings of C1 are made to coincide with the previous readings. It may be necessary to remove the entire four turns, and on a rare occasion perhaps even an extra turn, but about two turns in excess of the number on L2 usually will be found correct. Fractions of a turn may be regarded, but experience has not vindicated any such assumption.

With a 3¼" diameter tubing, about 4" high, the primaries L1 and L3, may consist of twelve turns of No. 24 silk over cotton wire, the secondaries, 45 turns and 49 turns (for test), respectively. If commercially made coils are used, two coils, each with 45 turns on the secondary, may be used experimentally just as they are, and if two settings close together both bring in the same station, the trouble will be on the RF side. A safe method would be to scrape a tiny bit of the insulation off the 44th turn of the RFT (L2) and short-circuit that turn. If that doesn't do the trick, short-circuit the 43d turn. When the correct position is found, the excess wire may be unwound, cut off, and the new terminal restored to the binding post on the coil. In doing this take care to hold the winding firmly in place, otherwise the wire will spring away from the form and you would have to rewind the entire secondary.

If the kind of wire specified is not available, use No. 22 single cotton covered. The form may be quartzite rods, bakelite, fibre, etc. The specifications as given are those of the Bruno coils.

The coils are wound so that there is little space between respective windings, no more than ¼". The nearer the primary is to the secondary, usually the

The Diamond Made Portable

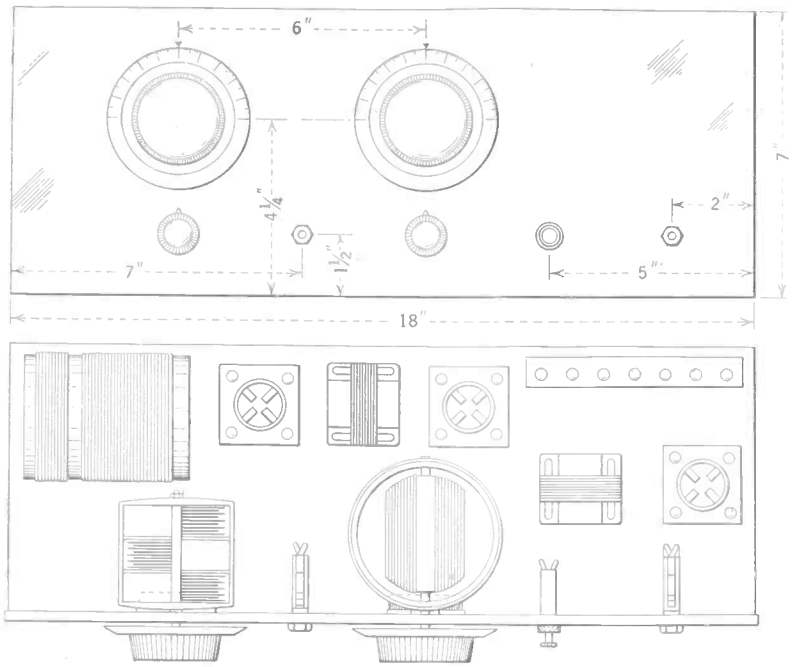


FIG. 2 (top) the panel layout of the 5-tube reflexed Diamond of the Air. The two coils should be mounted at right angles to each other to avoid stray coupling, for this robs any circuit of efficiency.

greater the stability, due to the added apparent resistance in the circuit. This resistance comes in handy in regenerative sets, which have a tendency to reduce resistance even below the safety point. When one consders that super-regeneration (not used in this set) may even create a minus resistance, and that nobody has proven that he can make a serviceable and stable super-regenerator, it is obvious that the goal of best results is not represented solely by the minimization of resistance. There must remain enough resistance to bolster up the tube shortcoming, which is the tendency of the plate energy to flood the grid, on the lower waves particularly, an instance of regeneration to be distinguished from the purposeful kind introduced by the tickler L5.

Do not alter commercial coils, however, to close up the space between primary and secondary.

In each coil the primary is not physically connected to the secondary. The energy transfer is by induction. The number of turns on the primary need not be the same in both cases. A few more or less will not be noticed. It is well to keep the total number under 15. If divergence exists, put the coil with the larger primary in the detector coupler stage (L3).

Making the Tickler

The tickler may be of any sort, pancake (curkoid), spider-web, solenoid, etc. As the stator is about 3¼" inside diameter, the tickler form must not have an outside diameter in excess of 2¼". The same kind of wire may be used as previously, the form having all the wire that it can accommodate without putting turns on top of one another. For a 2¼" diameter form about 2¼" high, 30 turns may be used. Finer wire is all right on the tickler, such as No. 26 single silk covered, in which case 26 turns would be enough.

If other diameters are to be used than those described, the number of turns will have to be increased for smaller diameters and decreased for larger ones. Approximately equivalent values for the 45-turn, 3½" diameter coils would be: 3" diameter, 55 turns; 4" diameter, 35 turns. The primaries would be, in that order, 15 turns and 10 turns.

Two Single-Circuit Jacks

A novelty in the hookup (Fig. 1) is the use of a single-circuit jack in the first audio stage. This will afford voluminous earphone service, even on distant stations. Some locals may be heard on the speaker, if it is plugged in at J1. The normal speaker connection, of course, would be J2. The single-circuit jack in the intermediate audio stage simplifies the wiring somewhat and is an asset in a portable set, where rough usage might easily loosen the soldered connection often made in a fragile manner to the inside springs of the jack. Under the system shown in Fig. 1 simultaneous reception is possible from both jacks.

A C battery is shown, connected in the last audio stage only. For a portable set this should be omitted, the connection from the F post of the second audio transformer (at right in Fig. 1), being made direct to A minus. Otherwise connect C minus to the F post and C plus to A minus. The C battery should be about 4½ volts for 90 on the plate.

Tubes and Rheostats

The rheostats must match the type of tubes used. For a portable set the WD11 or WD12 tubes will serve very well, requiring two No. 6 dry cells, parallel-connected. One dry cell will not be enough for economical use, the drain being too great. Two midget 22½-volt B batteries, series-connected, may be used, giving an audio plate voltage of 45, detector about 22½, for portables. Otherwise use two 45-volt batteries, series connected, with about 90 volts on the two amplifier plates.

C3 is a bypass condenser, .001 or .002 mfd. C2 is the grid condenser, .00025 mfd. The grid leak is 2 megohms, fixed type, for portable use. Otherwise a good variable leak may be used, a little better stability possibly resulting, along with a smoother leakage path, aiding finer regeneration control.

The two rheostats R1 and R2 are in the negative leg of the A battery. For the 11 or 12 type of tubes these should be 6 ohms each. For the 199 or equal, R1 would be 30 ohms and R2 15 or 20. For the 201A type, R1, 20 ohms, R2, 15 ohms. Notice that the detector rheostat actuates the last audio stage as well. To turn the last stage on or off the switch S is used.

Get Good Audio Transformers

The audio transformers preferably should be of the same ratio, but if not, then the higher ratio should go in the first stage (lower left, Fig. 1). What kind of transformer the constructor uses will govern the quality of the signal emitted through the speaker. As a rule cheap transformers are cheap in other respects than price. The best transformers are expensive, when judged by price list comparisons, but inexpensive when judged by results. General Radio 285, Federal 65 and 65A, Jefferson, Rauland Lyric, Kellogg, Acme, Stromberg-Carlson are among the better quality audio transformers. Some of these produce more volume than is comfortable to a tender ear and it is advisable in such a case to place a 100,000-ohm resistance (.1 megohm) across the secondary of the first audio transformer. When this is done, with the General Radio transformer in the first stage and the Rauland Lyric in the second, an excellent combination results.

Solving Some Difficulties

The only source of difficulty to be expected is failure of sufficient regeneration on the higher waves. To cure this, first reverse the connections of the tickler L5.

The conventional by-pass condensers are omitted from the first audio transformer. Usually the windings of the transformers are sufficient for the desired effect. If volume is low, however, connect a small fixed condenser, of no larger capacity than .00025 mfd., preferably .0001, across the secondary (one side of the fixed condenser to the G post, the other to the F post). Another place where a condenser may be put for by-pass purposes is across the primary of that AFT. This should be a large capacity, say .002 or .001 md., and is to be resorted to only if regeneration still is not great enough on the higher waves, after the tickler connections have been reversed. The object of this reversal, by the way, is to avoid negative feedback.

The oscillations are sufficiently controlled by the tickler, the setting of which at resonance corrects the wayward tendency of the RF tube as well.

Tuning the Set

Tuning is exceedingly simple. The settings of C1 may be charted. They are always the same with the same aerial and differ only microscopically even when a different kind of aerial is used than the one by which the previous dial readings were determined. The station, even of only medium strength, normally will be heard even if the tickler setting is incorrect. The setting of the tickler coil controls volume, by regulating regeneration, matching it with the requirements of the wavelength of the incoming carrier. Thus even the tickler has some bearing on wavelength, and may be rated as a wavelength control. However, change of tubes from socket to socket, inclusion of by-pass condensers and other considerations will change the tickler readings from what they were in tests made previous to the change. Even the filament heating has some effect, as well as plate voltage. Therefore the tickler can not be logged, although under the same conditions it will require the same setting. Even so the readjustment is slight and easy. On re-

(*Continued on page* 23)

A SPARE-PARTS REFLEX
That Works to Beat the Band

STUFF AROUND HOUSE IS PUT TO GOOD USE

Herbert Hayden Reclaims Some Old Condensers, Winds Simple Pair of Coils and Produces Fine Little Portable Set.

By Herbert E. Hayden

HERBERT E. HAYDEN

ONE night I looked over the spare parts I had around my shack and I saw the prospects of making a few sets out of them. Almost everybody has some spare parts. What's the use of letting them eat up space? Why not put them to work?

I caught sight of a couple of audio-transformers, spider-web coil forms, a crystal detector and the like. I lacked a rheostat, so bought that.

All told, including baseboard and dials purchased, I spent less than $5 and got about as good a result as a man could desire. I built myself a reflex something on the order of the Harkness, using a crystal detector, because I wanted speaker operation on two tubes.

The set was put in a little old carrying case which used to contain my spiked shoes and "trunks" in the days when I was clipping off a mile on the cinder path in 4:22.

Those days are gone forever, so now I do most of my exercising with a saw, drill and screwdriver in my radio shack.

Got Some DX Too

I got some distant stations on the set I built and was really surprised that it was as selective as was necessary. It had been a year or more since I monkeyed with this kind of set and meanwhile broadcasting stations had become more numerous and I had some fears as to selectivity. Everything turned out hunky-dory. Also, the set had lots of pep and kick in it, although no regeneration was used. You can see from the diagram (Fig. 1) that the set uses a stage of tuned radio-frequency amplification hooked up to a tuned crystal detector stage, the first audio being reflexed in the radio stage and the second audio step being all by its lonesome.

The case provided enough room for the A and B batteries. As for aerial, I usually string a 40-ft. wire on insulators between trees when I go out in my car, using the frame of the car as a ground.

I got the idea for using spare parts after seeing a similar set built by H. V. Sparks, of 225 East Seventy-first Street, New York City, who took it with him on trips in an auto. It worked fine for him and just as well for me, so I recommend the set to all comers as one that is impartially loyal to all careful constructors.

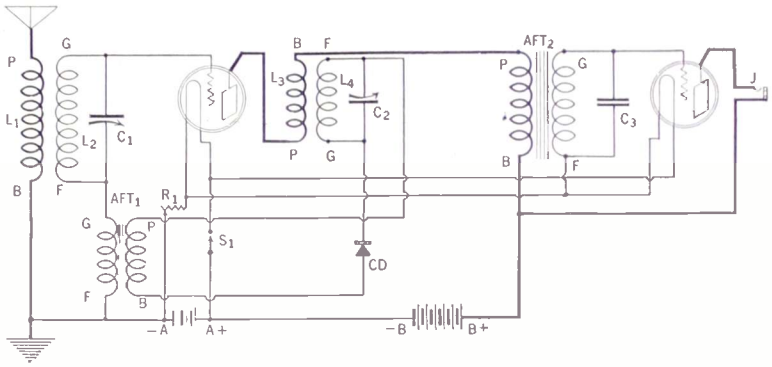


FIG. 1, the wiring diagram of a 2-tube reflex that operates a speaker and which was made into a portable set by Herbert E. Hayden and his friend, H. V. Sparks

Space Saved by Coils

Spider-web coils may be used because they afford great economy of space, an important factor in a portable set. Compactness is the keynote of any portable. And this one is so small and neat, so easy to carry and so light, that it is just the thing for vacation service. And it takes special delight in being on the job on week-end parties. It wouldn't annoy a hiker to lug this baby along with him on the dusty roads.

I used standard sockets, with adapters, so that 199 tubes could be employed as an option. However, the constructor can make up his mind what he prefers to do on the tube problem. The 199, 299 and DV3 are all fine for this circuit. Sometimes I use the set at home with a 201A tubes. That's why I used a Fil-Ko-Stat, which gives me the choice of any tubes I desire to put in. The 11 and 12 type tubes all right in the set, too, but of course the others give a little more volume.

Let's wind the coils.

Construction of the Coils

The radio-frequency transformer L1L2 is wound on a spider-web form. An outside diameter of 5½" will be plenty. Actually, less room may be taken up, but the excess form can be out off the outside circumference. Fig. 2 shows a form that may be used as your guide. I happened to have some forms around the house. Others, not so lucky, may twice trace the form, Fig. 2, pasting each tracing on a piece of 6" square heavy cardboard, then cutting each form to shape and removing the tracing paper. This is done twice so that you will have two forms. You may remove the forms, if desirable, by cutting away the spokes, whereupon the inside hub will fall out, too, but that is not necessary. I left the forms on because they afford better support for the coils.

Use No. 24 single cotton covered wire. Wind 20 turns, then pick up a 12-ft. length of the same wire, and wind this on the form the same time you are putting on the continuation of the other (secondary) winding. Then, when you are within 6" of the end of the 12-ft. length, stop that particular winding, and continue on with the other, putting on 30 more turns of that, a total of about 60 turns, this comprising the secondary. The primary will be about 10 turns. You should leave some excess at the beginning of the primary, too, for internal set connection. The resulting coil will be the secondary with the primary wound side by side therewith nearer the hub, for the number of turns the primary comprises. The four terminals, two for primary, two for secondary, may be anchored to pinholes made in the form itself. The primary terminals, however, do not actually require pinholes, as the close coupling with the secondary holds the primary neatly in place. Indeed, the beginning of the secondary is snugly embedded, too, yet the pinholes won't do any harm here, especially in a set that must stand some knocking about.

The other coil, L2L3, is wound in the

List of Parts

½ lb. No. 24 SCC wire.
Two spider-web forms.
Two .0005 mfd. variable condensers (C1,C2).
Two audio-frequency transformers (AFT1, AFT2).
One crystal detector.
One .001 mfd. fixed condenser (C3).
One rheostat (R1).
One single-circuit jack (J).
One jack plug.
One A battery.
Two midget 22½-volt B batteries.
Two sockets.
Two tubes.
One 7x14" panel.
One carrying case.
One speaker.

SPEAKER ON TWO TUBES
On Hayden's Portable Reflex

SET IS "JUST THE THING" FOR VACATION

"It Wouldn't Annoy a Hiker to Lug This Baby Along on Dusty Roads," Observes New York's Philosophical Radioist.

same fashion, except that the primary is larger. Measure off 30 feet of the same kind of wire and wind these 30 turns simultaneously with the 20th to 50th turns, inclusive, of the secondary, which again has about 60 turns. That's all the coil winding you have to do. All windings are in the same direction.

Discussion of Parts

The variable condensers C1 and C2 are .0005 mfd., usually 23 plates. I used a pair of old ones, but they worked the set so well that I have no kick at all. R1 is the rheostat I mentioned previously. A push-pull A battery switch, S1, comes in handy, to avoid much turning of the rheostat. If the new type Fil-Ko-Stat, with switch attached, is used, you have that much solved. The audio transformers, if of different ratios, should have the higher ratio in the first stage (AFT1). C3 is .001, the only bypass condenser used. In some cases bypass condensers may help on AFT1, in which case one across the primary (PB) would be .001 and one across the secondary (GF) would be the smallest capacity, outside of a neutralizing condenser, that you have around the house. The crystal detector may be fixed or adjustable. I happened to have a fixed one and placed it on the panel.

How to Make Connections

In making the coil connections join the terminal of L1 that is nearer the hub (L1P) to the aerial, the outside terminal (L1B) to the F post of AFT1 to ground and minus A. The outside secondary terminal (L2F) goes to the G post of AFT1, while the other, L2G, goes to the grid of the first tube and to the stator plates of C1, whose rotor plates go to L2F. The terminal of L3 nearer the hub (L3P) goes to plate of the first tube, the other L1 terminal (L3B) to the P post of AFT2. The outside end of L4 goes to the P post of AFT1, the B post of AFT1 to one of the crystals, the other side of which goes to L4G. Connect the rotor plates of the condensers respectively to L2F and L4F. Fig. 3 clears these things up. Fig. 1 shows the rest of the wiring. Do not be misled by the wire terminal connections based on reading the wiring diagram, as that is symmetrical and does not necessarily reveal relative position of connections.

Tuning the Set

In tuning the set the voice or music must be your guide, as there should be no regenerative whistle. Note that the primary connections to AFT1 are reversed. If your signals are not loud enough, try reversing these back to standard fashion, simply by exchanging positions on P and B as occupied by the leads from L4. The original reversal was made in the interests of stability.

C3 is mounted right on the secondary of AFT2, going from the G or S1 post to the F or S2 post. The plate voltage may be 45 or higher, but 45 is enough and makes possible the use of two midget 22½-volt B batteries, series-connected. The A battery, if 1½-volt tubes are used, should comprise two parallel-connected No. 6 dry cells (plus to plus and minus to minus). Also two parallel-connected 4½-volt batteries, C-battery type, may be used for 199 or equal tubes.

The set will tune in step, so that not only may stations be logged, but if you know one dial number for a station you automatically know the dial setting for the other, if the same make or exact capacity condensers are used. That seems to be an important advantage in the estimation of many fans. I like this set and I feel sure that all who build it will experience the same joyful emotions.

Very fine quality of reception is to be expected, due to crystal rectification, the virtues of which I am not going to brag about at this belated day.

Ordinarily for DX work I used a tube as detector, but unless a crystal is used here you can not get the two audio stages, while limiting the total number of tubes to a single pair.

Not Expensive

This is probably the most inexpensive speaker set that can be built, and while it has appeared in various forms, I can assure you that the present arrangement is about as good as the best.

I have heard many sets of this type and, after having compared results with this one, I am willing to lay my small bankroll on this baby.

The adjustable crystal often will give more volume but in a portable set I suppose a fixed crystal is the best bet. There are several excellent makes on the market. But have an extra crystal in your pocket so

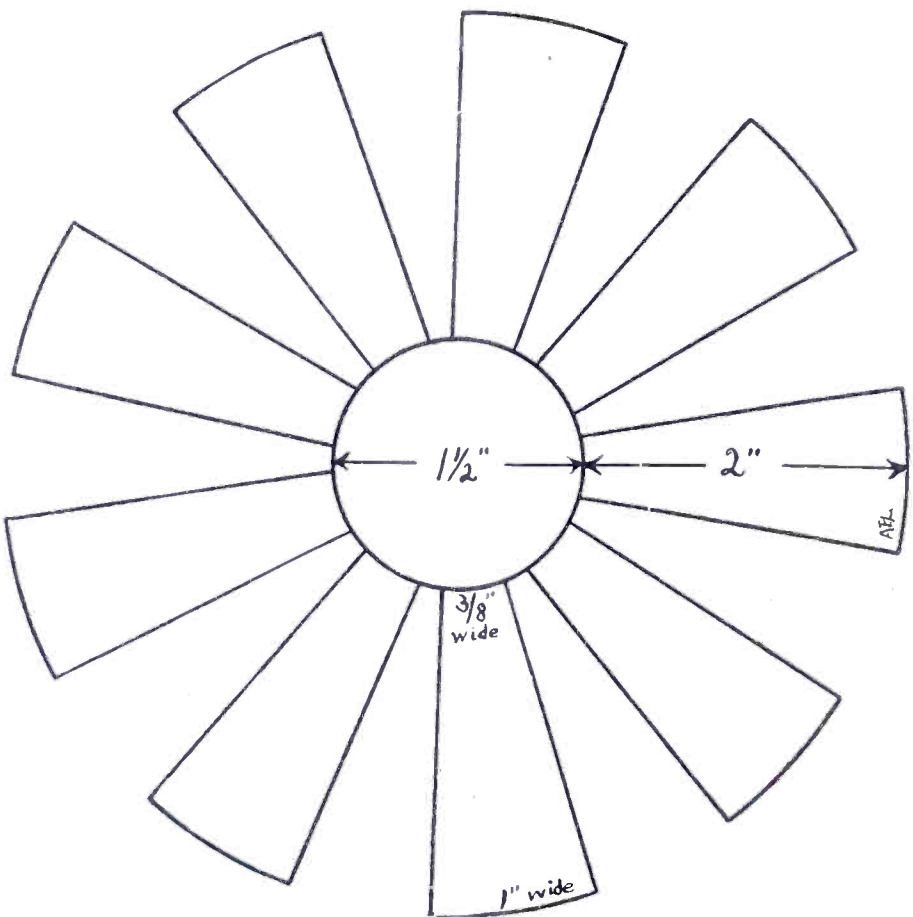
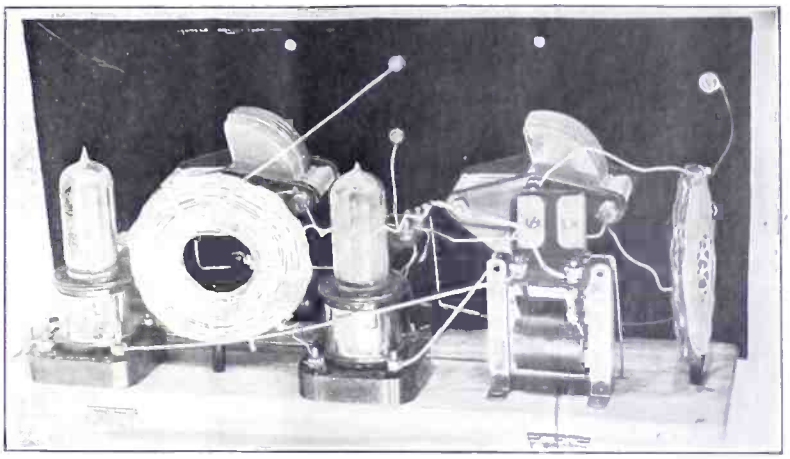


FIG. 2, template for a spider-web form that may be used for winding coils for Hayden's 2-tube portable reflex. Wind "over one, under one."

THE RECLAIMED REFLEX

As Made by Hayden's Friend

THE PORTABLE in the case. The outside dimensions of the case are 15½" long, 10½" wide and 5½" deep. The inside dimensions are 14¾" x 9¾". The constructor suggests it would be better to put the bottom of the panel at the bottom of the case, so that in carrying the set the batteries would not be (as above) at the handle end. The four binding posts in a row identify the lower part of panel. In other words, reverse the above, and make the room for batteries (lower part) at the now "tightly coupled" upper end.



REAR VIEW of the set built by H. V. Sparks. He made each RFT as two separate coils and tied them together. Standard sockets were used. The tubes are 199 type, which require adapters to fit standard sockets.

you'll be sure of good reception all the time. I've been using this set considerably and I have yet to be disappointed in it. I give it a good reference "to whom it may concern."

New Broadcasters

WASHINGTON.

SIX new class A stations were licensed by the Department of Commerce.

Station	Location	Met.	Watts
KFVW	Airfan Raido Corp., San Diego. Cal.	246	500
KFGX	First Presbyterian Church, Orange, Ttexas...	250	500
WIBM	Billy Maine, Chicago, Ill.	215.7	10
WGNP	George Harrison Phelps, Inc., Detroit, Mich	270	500
KFVX	Radio Shop, Bentonville, Ark.	236	10
KFVU	The Radio Shop, Eureka, Cal.	209.7	5

13 Dropped from List

Thirteen class A stations were discontinued. They follows:

WGBO—Dr. Roses Artan, San Juan, P. R.
WRAN—Black-Hawk Elec. Co., Waterloo, Ia.
WABM—F. E. Doherty, Saginaw, Mich.
WCBY—Forks Elec. Shop, Buck Hill Falls, Pa.
KFBE—Horn and Wilson, San Luis Obispo, Cal.
WGBN—Hub Radio Shop, LaSalle, Ill.
WSL—J. & M. Elec. Co., Utica, N. Y.
WCBL—Northern Radio Mfg. Co., Houlton, Maine.
WRAL—Northern States Power Co., St. Croix Falls, Wisc.
WDBF—Robert G. Phillips, Youngstown, Ohio.
KFQG—Southern Calif. Radio Assn., Los Angeles, Cal.
KFRP—Trinity Episcopal Church, Redlands, Cal.
WGBW—Palley Theatre, Spring Valley, Ill.

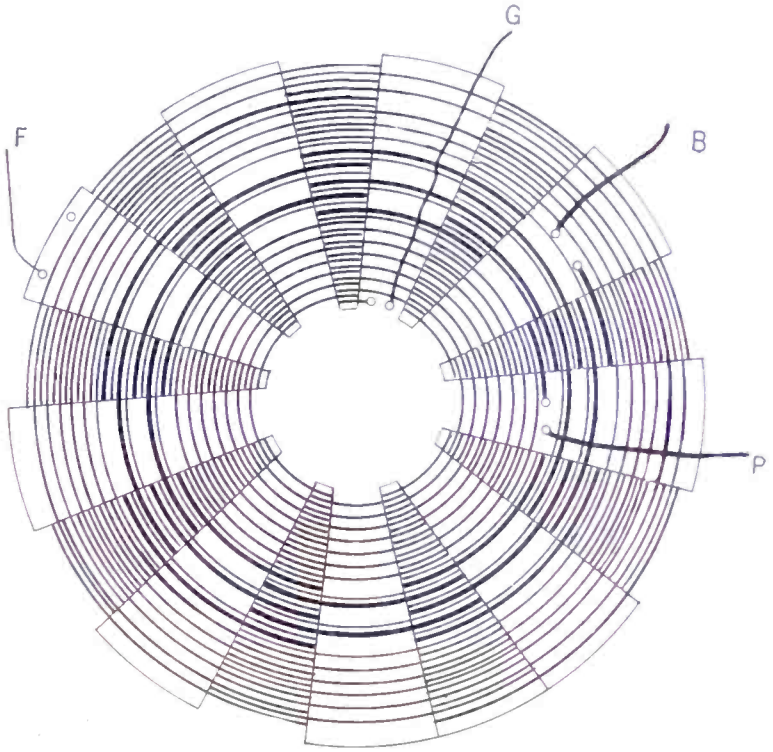


FIG. 3, how the RF coil connections are made (both for L1L2 and L3L4). P represents high potential of primaries, B low potential. G is high potential of the secondaries, F is low voltage. Aerial and plate are "high" and go to P. Ground, A— and B battery are "low" and go to F. G goes to crystal and to grid, in the respective instances.

Rudder Compensates Loop

AN odd device astounded some recent week-end visitors at Lake Popolopen, N. Y. A fan had a set in his canoe. A loop antenna was used. The loop being directional, the fan was in danger of being tuned out as he changed his course, the observers thought. But he wasn't tuned out. He had a reverse gear attached to the rudder and loop base, so that the changed direction of the rudder compensated the loop's direction, keeping it uniform.

Wavemeters Without Buzzers

The Simplest Type Described for Benefit of Novices, Also the Most Difficult and Accurate Device, for Advanced Experimenters — Variometer May Be Used As Wavemcter — Absorption Tests for Calibrating.

By Lewis Winner
Radio Engineer

THE wavemeter that I am going to describe is the simplest and cheapest one that anyone could build. It is to be calibrated from your receiver and after concluding this work you may calibrate all kinds of receivers from the wavemeter.

A single-winding coil, having a certain number of turns, and shunted by a variable condenser, constitutes the wavemeter. Besides the above meter I am going to tell something about two other types of meters, one employing a variometer, something rather novel in the field of wavemeters, and the other the oscillator method of calibration, which by the way is the most difficult but the most efficient.

The Condenser-Coil Wavemeter

If you are contemplating using the simplest wavemeter for calibration of many receivers it is a good policy to enclose it in a cabinet, 7x8", the panel being the same size. The panel will have to be cut down from the standard size of 7x10", your radio dealer will do this on you can do it yourself with a hacksaw. When doing this do not rush as you will split the panel, especially if it is bakelite, which is extremely difficult to saw. Put a little oil on the edge of the panel to smoothe the sawing. The cabinet either will have to be made to order or be built by yourself. I got hold of an old General Electric Crystal Receiver and used the cabinet, which was composed of steel and was just the thing for the fitting of the wavemeter. I think the best place to pick this set is at a radio salvage shop.

For the dial I think that the best is not too good, not that it plays an important part in the calculating of the receiver, but it enables the operator to tune the condenser with greater ease, that is, if it has a vernier control movement, and a space on the front of the dial to mark down the frequency or wavelength of the different stations that you have calibrated from your receiver.

The condenser, which is the biggest item of cost, should be a .0005 mfd. variable, ordinarly 23 plates. There are some 23-plate condensers on the market where the maximum capacity is .00034 to .0007 mfd. This is because the area of the plates, the nature of the end-plate material, and the way that the plates are cut. It is best to purchase a condenser that is being manufactured by a reliable, well-advertised company. The coil which is wound on a piece of hard rubber tubing, 3 ½" in diameter and about 3" high, with 50 turns of No. 18 bell wire, otherwise know as annunciator wire. As a matter of fact the same coil used for a wavemeter with buzzer attached may be employed. Wind the 50 turns of the wire in one direction. After winding coil, which by the way will take up about 2 ¼" of the space on the tubing, leave ⅛" and drill a ¼" hole for the binding post, leave 1 ½" and drill another hole of the the same dimensions. Do not put any holding material on the coil.

Mount the condenser on the panel. I will give no data on how to drill the panel as this is dependent on the type of the condenser that you get, each of which is accompanied with a template. Place the condenser in the middle on the panel. Leads from the condenser are brought to the outside of the panel and secured to a couple of binding posts. Shunt the condenser across the coil, connecting two leads to the coil, each one of which is exactly 1 foot in length. This makes the actual number of turns equal to 54 instead of 50. It is not advisable to mount the coil inside of the panel, on account of the stray electrostatic field between the condenser and the coil. A honeycomb coil may be used, but the results obtained thereby may not be so good.

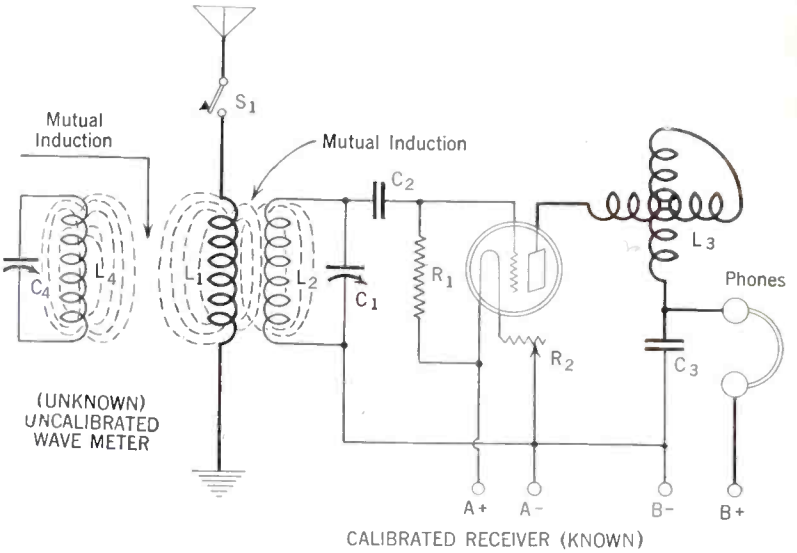


FIG. 1, how the simple wavemeter is put in inductive relation to the antenna coil of the receiver. Note the magnetic lines between the coil of the wavemeter and the primary of the receiving circuit, which is called mutual induction. The switch S1 is used for connecting and disconnecting the antenna from the set. This is for calibrating the set with or without antenna. L1L2 of the receiver are wound on a piece of tubing 3½" in diameter with No. 22 DCC, L1 having 12 turns and L2, 45 turns; no spacing. C1 has a capacity of .0005 mfd. and is variable. L3 is a variometer. C2 is a .00025 mfd. fixed condenser. R1 is a 2-megohm fixed grid leak. R2 is a 6-ohm rheostat and the tube used is a UV200, a 6-volt A battery being used to supply filament voltage. C3 is a .001 mfd. fixed condenser. L4 and C4 are described in the text. The length of antenna should be no more than 75 feet, including lead-in.

How to Calibrate

After the preliminary steps have been taken, a receiver may be used for calibration of the wavemeter in the following manner:

Place the wavemeter in inductive relation to the antenna coil of the set (Fig. 1.) Tune in a signal on your receiver, being sure to employ plenty of regeneration. Do not put the coil of the wavemeter too near the antenna coil, as the result will be poor (broad tuning). We use the meter as we would use a wavetrap, that is, we tune in signal on the set, and then tune the wavemeter condenser until the signal disappears entirely. Mark down this reading on the condenser dial or on a log. The same method is followed for all the stations.

After you complete calibrating your wavemeter from your receiver the wavemeter may be used to calibrate other receivers, by leaving the meter coil in inductive relation to the antenna coil, and then tuning in a signal on the set. Tune out the signal with the wavemeter.

The following data may be used as reference when calibrating your meter, if made as directed:

Station	Meters	Dial
WGCP	252 meters	14
WMCA	341 meters	25
WHN	361 meters	30½
WOR, WJY	405 meters	40
WJZ	455 meters	55½
WEAF	492 meters	69
WNYC	523 meters	90

If you wish some accurate scientfic data on the above you may use a graph (Fig. 2). On the left hand side of the graph paper, not on the paper itself though, print the word wavelength. Extend the ten heavy lines of the large squares to the outside of the paper ½ in. in length and write down, still on the same side, the wavelengths, that is, beginning with 200, in line with the bottom of the first of the ten small boxes, or the first of the ten lines that you just drew, following up with 240 meters, 280, 320, 360, 400, 440, 480, 520, 560 meters and finally 600 meters.

Thus, as there are ten major squares, each with ten subdivisions, there are 100 lines, or, for the range (200 to 600 meters) there are 4 meters to each tiny line and 40 to a major square.

On the horizontal axis, but outside the lines of the paper, mark down the words, "Wavemeter Dial," and extend the heavy lines 2 in., marking on everyone of these ten lines numbers corresponding to numbers on the dial. This will take up the 11 lines, as zero dial reading will be marked down. If you are using a 100-Dursion dial (reading from 0 to 100) then the lines on the horizontal will be, left to right, 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100. If a 180-division dial is used to designations would be 0, 18, 36, 54, etc. From the interpolated tables the graph can be drawn very easily, e.g. between 240 and 280 there is no station that was calibrated. However, at 252, WGCP was caught. This on the graph (for dial) will lie between 10 and 20 (horizontal axis). From the horizontal axis 4 points from 10 make a dot, now on the vertical axis at 252 make another dot. Make these two dots meet with a very light

How to Use Oscillating Meters

line and make a heavy dot at the juncture. Erase the light lines and continue. The same procedure is followed for all the stations. Note that the vertical spaces are divided into equivalent values of four meters each and the horizontal spaces are divided into units, that is the horizontal scale runs like this: 10, 11, 12, etc. The vertical runs like this: 200, 204, 208, 216 meters, etc. When the scale is finished there should be a curved line, and in no place should this be out of alignment. If the line is not covered you have not calibrated your meter correctly. When you have finished this graph send it to me, care of RADIO WORLD, and I will put on all the corrections that are necessary.

The Absorption Method

Beside the above method of calibrating your receiver there is the absorption method. This method is very simple, but it is not charitable to use in a crowded broadcasting district, as the set has to be in an oscillating condition, thereby causing interference in other receivers. However, the work can be done on a Sunday morning or early in the morning of any week day, when stations are testing for modulation, etc.

Before attempting to do anything with your set, disconnect your antenna from the set. Bring the coil from the wavemeter in inductive relation to the primary of the receiver and set your tube oscillating at a very high pitch. Turn the condenser dial until you tune out the oscillatory click. Keep turning until you hear another click which will be at only a few degrees difference. At this point the station's reading can be marked down on the meter dial. Of course, this can only be done with a receiver of known settings for given wavelengths. Remember, too, that the antenna is disconnected. With a 100-foot antenna, including lead-in and ground lead, the numbers on the dial of the wavemeter condenser will be about five divisions lower than without the antenna. We have now calibrated our wavemeter. To put the meter into use for calibrating a receiver, put the coil of the meter in inductive relation to the antenna coil of the receiver and let the tube oscillate. Tune out the oscillation to the point of clicking. At this point the wavelength of station is at hand.

The Oscillator Wavemeter

The above wavemeters had to be calibrated before they were used, but the oscillating meter is already calibrated and is the hardest of any of the meters to build, as well as the most accurate. See Fig. 3 for the diagram. L1, the oscillator coil, is a 55-turn coil, wound on a piece of tubing 3 in. in diameter, using No. 18 bell wire, and tapped at the 30th turn for the purpose of connecting the A minus. C1 is a .0005 mfd. variable condenser, strictly

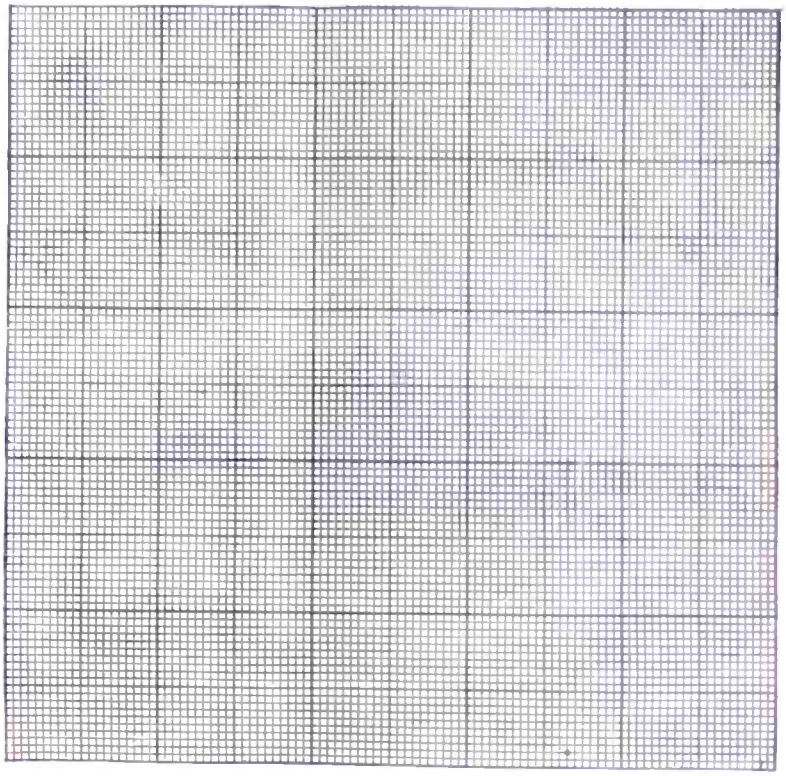


FIG. 2, plotting paper for making a graph. There are 100 major boxes in this graph, each containing 100 small spaces, or 10,000 tiny spaces, all told.

straight line frequency only. Use a 6-ohm rheostat for controlling the filament temperature of the oscillator tube, a 5-watt tube UV202A or a UV201A. The grid lea khas a fixed resistance of 3 megohms. A 6-volt A battery is used to light the filament of the tube. The B battery voltage is variable, anywhere from 100 to 110 volts for the UV201A, and 120 to 150 volts for the 5-watt tube. Usually the more voltage that you put on the plate of the tube the better the tube will oscillate and the more accurate the calibrating will be, as a more continuous note will be heard.

This whole meter can be placed in a 7x10 in. cabinet. The only thing showing on the front of the panel is the condenser dial.

Bring the beginning of the coil to the stationary plates of the variable condenser and also to one terminal of the grid condenser, the other end of the grid condenser going to the grid post of the tube socket. The plate of the tube goes to the positive side of the B battery, the negative end of the B battery going to the end of the coil, this also connecting to the rotary plates of the variable condenser. The rheostat is connected in the positive side of the A battery. Connect the top to A minus.

Put the oscillator coil at a distance of about 40 feet away from the set which is to be calculated, and turn on the filament rheostat of the tube of the wavemeter. Now turn on your receiving set and tune your receiver until you hear a very high pitched whistle in your set. Take great pains in tuning in this signal as it is very easy to miss it and that is the reason that this method is so accurate. Your receiver will have to be in a regenerating condition to receive the signal.

The following table will help you calculate your receiver:

Wavelength	Meter Dial
252 meters	2
341 meters	35
361 meters	45
405 meters	60
455 meters	83
492 meters	98
526 meters (add three more turns on coil; will come in at 100)	

Variations from the above may be found in the meter you make, but the likelihood is small. A 25-foot antenna was used on the receiver, although no antenna on the set will make the calibrating of the set much easier.

The variometer is used as a wavemeter by connecting stator to rotor and leaving the remaining two terminals unconnected. It takes the place of and operates the same as the condenser-coil wavemeter, the device first explained.

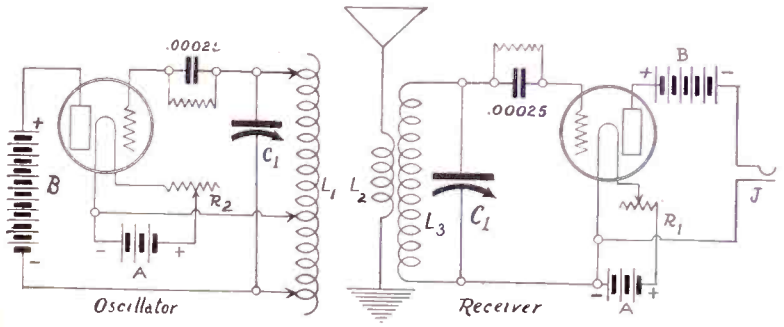


FIG. 3, how the oscillating wavemeter looks in an electrical diagram. As for the receiver, L2 has 10 turns, L3 has 47 turns, wound on a piece of tubing 3" in diameter, with 22 DCC, there being ¼" separation between the windings. C1 is a .0005 mfd. variable condenser. R1 is a power rheostat. The A battery is a 6-volt storage battery. The B batteries have a total output of 150 volts.

New R. C. A. Speaker Worked by a Freely Movable Coil

FAITHFUL reproduction of the deepest organ notes and the highest violin harmonics, without distortion and other defects, has been accomplished in the hornless loud speaker, developed by Chester W. Rice and Edward W. Kellogg of the research laboratory of the General Electric Company, for the Radio Corporation of America. It is only within a limited range that some speakers approach true reproduction. Low notes are either shattered, lost almost entirely, or produced only as overtones. Similarly, horn instruments may unsatisfactorily reproduce high tones.

Sound is produced by vibrations sent through the air as pulsations. The more vibrations per second, the higher will be the pitch of the sound. In the usual telephone receiver the sound is produced by vibrations of a metal diaphragm which is affected by the varying strength of an electromagnet behind it. This type of receiver is satisfactory for headphones, since the air gap between the diaphragm and the eardrum, through which distance the sound vibrations must travel, is small, and diaphragm vibrations of small amplitude are sufficient. For speaker operation, however, the telephone unit must be more powerful and must be coupled with a horn. It may be found that such an arrangement will not reproduce both high and low notes with the same precision, and it is usually the low notes which present the most trouble.

To radiate low notes more effectively there must be more air moved with each swing of the diaphragm. The speaker may me thought of as an air pump. If an air pump which will give a large movement of air with each stroke is desired, a large piston area and a long stroke should be used. The telephone receiver type of speaker may not be suited to the purpose of obtaining a long stroke, firstly, because the movable iron will strike the poles of the magnet if it swings far, and secondly, because it is in an unstable position and with the very flexible diaphragm support which is essential for the long stroke there is not enough stiffness to hold the iron away from the magnet poles.

In the new hornless loud speaker, the familiar moving coil type of drive is employed. If a copper wire is placed between the poles of a magnet, the wire is pushed sidewise when a current is sent through the wire. In an electric motor this phenomenon causes the armature to rotate, and in the loud speaker the same phenomenon gives the desired back and forth motion to the diaphragm.

The wire is wound into a coil, and since it moves parallel to the faces of the magnet poles instead of toward and away from them, there is no limit to the distance it can move. The varying currents from the radio set are passed through an amplifier to the moving coil. The strength of the magnetic force on the coil of copper wire varies with the current, and the coil is thus caused to vibrate. The moving coil is attached to the diaphragm, a paper cone about 6" in diameter.

An important feature of the loud speaker is the baffleboard which surrounds the diaphragm, and which serves as the front of the cabinet. The baffle does not itself radiate sound, but it prevents air from circulating between the front and back of the diaphragm. It is the use of a baffle which makes it possible to dispense with horns without sacrificing the radiation of the deeper tones. The edge of the paper cone or diaphragm is attached to the baffle by means of very thin rubber. As a result of this extremely flexible support the diaphragm resonance corresponds to a tone so low that it can hardly be heard.

THE NEW COIL TYPE SPEAKER, using a paper cone diaphragm, is under admiring inspection by Chester W. Rice (left) and E. W. Kellogg, of the research laboratory, General Electric Co. The speaker, developed for the R. C. A., is operated from the lighting main. The whole outfit consists of cabinet, speaker, rectifier and amplifier. It was developed largely by these two impartial observers.

The cabinet contains, in addition to the speaker itself, a rectifier and amplifier, power for the operation of which is taken from the alternating current lighting circuit. The amplification in one model is sufficient so that, in the case of local stations, very clear speaker reproduction can be obtained from a crystal, provided the latter gives clear headphone reception. It is important that the amplifier used with the new speaker be designed to have ample capacity, since the extension of the range of response of the loud speaker to higher and lower tones makes defects in the remainder of the system more noticeable, particularly roughness and blasting due to overworked amplifiers.

Tests of the hornless speaker show that its use is advantageous for all kinds of radio reception—for talks, solos, orchestral and band music and group singing. In the research laboratory there have been set up loud speakers of many designs, so arranged that by a throw of a switch it is an easy matter to obtain comparisons, as well as a series of tests for any one type.

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THE RADIO SITUATION IN GERMANY

It took 40 years to get 1,000,000 telephone subscribers, but it's certain that many radio listeners are produced in two years—There are 714,352 registered fans now—Broadcast ads cause listeners to shut off sets.

WASHINGTON.

RADIO fans in Germany shut off their sets and refuse to listen in when anything bordering on advertising is broadcast, said Consul C. M. Ravndal, who has just made a report to the Department of Commerce. Every possessor of a radio receiving set in Germany must pay 2 marks a month for a permit to listen in. Of this amount 1.20 marks are credited to the broadcasting station and the other 80 pfennings are retained by the Post Office to defray operation costs, upkeep, etc., for it keeps all records and accounts and collects the dues. Registration and collection are attended to by the fan's own postman.

On February 26, 1925, there were 714,352 registered fans in Germany. Berlin had a total of over 300,000 licensed fans. It has taken approximately forty years to secure more than 1,000,000 telephone subscribers in Germany, whereas in less than two years a like number will be enrolled to hear radio programs.

Government Has Monopoly

Broadcasting is a state monopoly in Germany. Companies were formed for the purpose of broadcasting, and wavelengths from 1 to 800 meters released to them. Fifty-one per cent. of the required capital for these undertakings is contributed by the Government, the remaining forty-nine per cent. by private persons. The broadcasting plant and technical apparatus are constructed and the latter installed by the Post Office Department in whose name and title as sole owner the establishment operates. The companies are obliged to pay a nominal monthly fee for the use of the broadcasting plant, while the Post Office Department is required to enlarge the plants as needs require and to install the latest improvements in broadcasting equipment.

Nine States Operating

Germany now has nine broadcasting companies operating nine main stations and five sub-stations. Three additional sub-stations are now under construction. No additional companies are to be formed as those already in operation are able to cover Germany adequately.

The company's policy for the time being is to offer to the public for their enlightenment purely intellectual and educational programs with entertainment for variety. Great pains are taken in selecting and arranging the programs so that the latter will be comprehensive and yet maintain and increase in attractiveness. Selections which are only the passing whims or fancies of the public are avoided. The management endeavors to broadcast topics and pieces that are worth while and yet not too profound for the average person.

Opposition From Theatres

As elsewhere the introduction of operatic music and theatrical performances in radio has met with objection from those who claim that this will have a detrimental effect on public attendance at the opera and public plays and concerts.

A Reflex for 99 Type Tubes

By L. R. Barbley

THE reflex principle lends itself admirably to portable sets. There the prime consideration is not the tube and battery economy but the space and weight. A reflex will do more than any other set in a given amount of room, hence for portability the double-duty plan, applied to one or more tubes, is decidedly attractive. In a 3-tube set it is generally better to use only one reflexed stage, for the troubles that reside in reflexes are encountered where there is multi-reflexing.

A crystal detector may be used to good advantage in a 3-tube set. Not only does it afford excellent quality of reception, but it permits the omission of another tube. Hence two tubes are "saved" in the hookup (Fig. 1). The results are fine. The set is designed to meet summer conditions and is excellent for camp, country home, auto trips, boat rides and the rest of the recreational media.

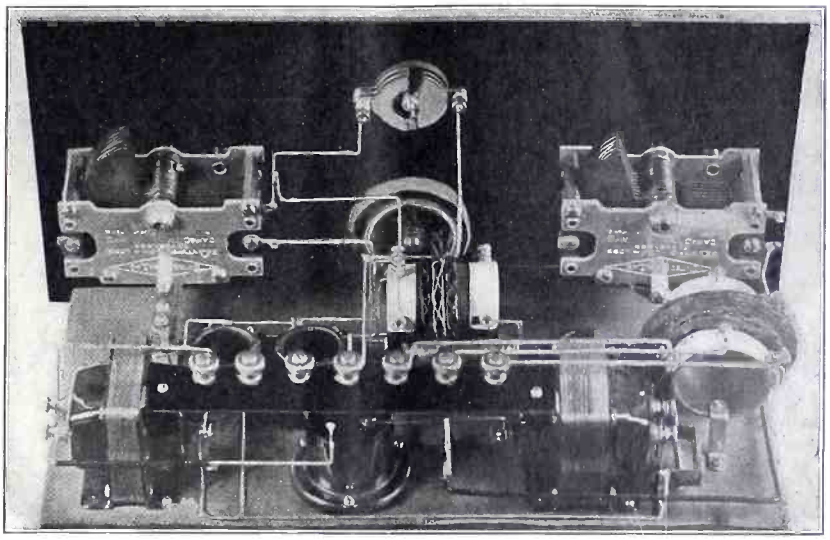


FIG. 1, rear view of the reflex.

The unusual high standard of performance obtained with the circuit described has a number of contributing factors, the most important of which is perhaps the proper design and proper constants of the parts used. There are several requirements which must be met in order to get the most from the 199, 299 and equal tubes. Very few of the popular circuits are designed exclusively for this type.

This reflex circuit owes its high efficiency to a careful consideration of the constants and design necessary to make the 99 type of tube talk up. Consequently we have a powerful, compact set, capable of performance at least equal to, or superior, to many circuits employing a larger number of tubes. It is easy to build, selective, and because of its small size, 7 by 14", can be used readily as a portable set. The circuit itself is a simple reflex, with one stage of tuned radio-frequency amplification preceding a reflexed tube, which serves a double purpose of radio and audio amplification, and is followed by one step of straight audio amplification. No technical skill is needed to build and wire this circuit, and no expensive parts are necessary.

Good Quality Results

As far as quality of reproduction is concerned, this circuit has something to brag about. The cone type of speaker provides an excellent test for determining quality of reception or distortion, and tests conducted with this type of speaker clearly demonstrated its tonal quality to be far above average, and furthermore, it shows fairly equal amplification at all frequencies. This is more or less unusual, since it is well known that where exceptional selectivity is emphasized, the side-bands are more or less cut off. Selectivity at the expense of clarity is not the case with this circuit.

A fixed crystal detector is used because when the other type is employed and adjustment is being made, we invariably encounter an annoying squeal or howl. Not only does a fixed crystal eliminate this noise, but in a sensitive circuit a different point of contact on the crystal changes values. For example, for a given setting of the detector, coupling and tuning are adjusted for a certain wavelength. Should contact be changed to a poorer point on the crystal, the volume will be less and the coupling too close. Vice versa, with a better contact point, coupling will be too loose to ab-

(Continued on page 27) 25

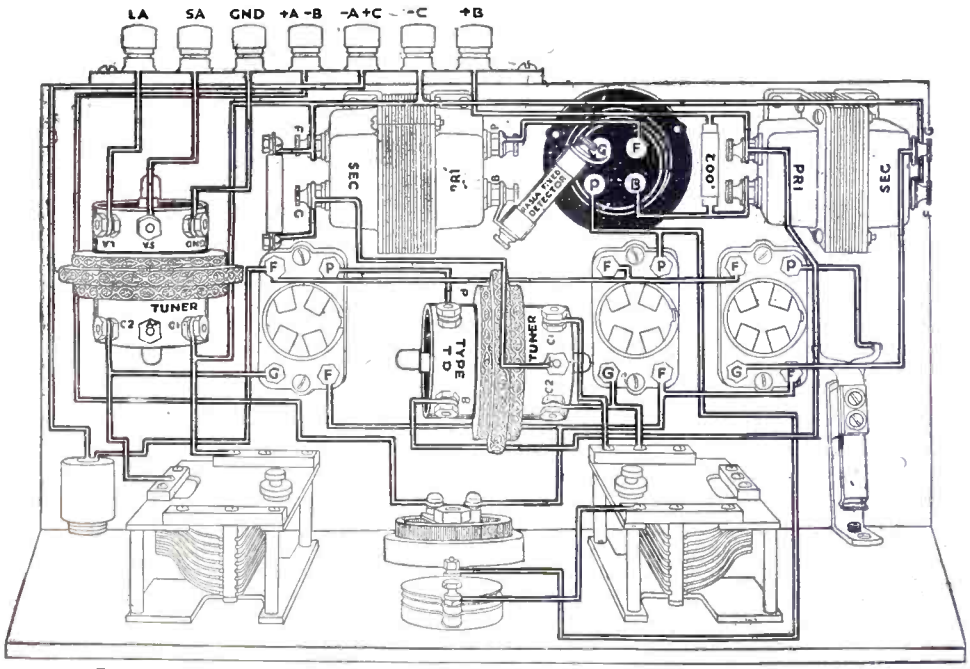


FIG. 2, picture diagram of wiring of the 3-tube volume reflex, designed especially for 199 and 299 tubes.

The Phenomena of Short Waves

By Dr. J. H. Dellinger
Chief, Radio Laboratory, U. S. Bureau of Standards

RADIO is very much concerned just now with what is called fading. The term is probably an inaccurate one; it simply refers to the fluctuations of intensity of signals received from distant stations. It is not so likely to trouble you if the station is within 50 miles, but from that distance up to about 200 miles it is a genuine obstacle to satisfactory signal reception.

The spotlight of radio progress is indeed revealing fading as its chief enemy. For many years fading played a minor role but it has now assumed the part of a heavy villain and has all the other characters in the great drama of radio backed off the boards. This waxing prominence of fading is a relative matter. It is not that fading is any worse than it ever was, but other enemies to perfection of radio reception have been yielding to the onslaught of scientific and experimental progress. We have been finding out what to do about interference of various kinds, that caused by transmitting stations, electric power lines, radiating receiving sets, and even atmospheric disturbances, but we have not yet found how to prevent or to substantially mitigate the irregular variations in the intensity of radio signals known as fading.

Intimates Remedy Is Near

There is a ray of hope. We are rapidly finding out many things about fading and its causes; and such knowledge is the usual preliminary to finding a remedy.

It is interesting that radio broadcasting has been established just in the borderline territory between the low frequencies (or long waves) which have little fading, and the high frequencies (or low waves) which fade badly. Quite likely you have noticed that the shorter wave broadcasting stations generally fade more than those on greater wavelengths. This is important when you consider the problem, a perennial and serious one for the Government, of finding frequencies to assign to new broadcasting stations, finding places to put the numerous tribe of would-be broadcasters. They cannot go to lower frequencies because below the broadcast frequency range the ether channels are few and are pretty well taken by ship and other radio telegraphic use. Broadcasting might go to higher frequencies, as the number of ether channels there is unlimited, if it were not for the unreliability introduced into radio reception by fading. For the immediate future, therefore, broadcasting is in a straitjacket in the band of frequencies which now confine it. It is difficult to see how more stations can be crowded into this limited band without destroying one another. Perhaps the solution to that problem is general acceptance of the view that there are too many stations already and that the multiplication of stations is economically unstable. A happy and easy solution will be attained when we conquer the fading which troubles the higher frequencies.

Fading a Fascinating Study

The causes of fading are becoming known and a most fascinating thing it is to study what happens to a radio wave in traveling from the transmitting station to a listener. What happens depends on the frequency or wavelength. With low frequency waves (high wavelengths) there is little or no fading. Radio didn't use to be troubled with fading, simply because radio work was done on waves of lower frequency than those which are now used for broadcasting. The amateurs were the only exception to this. They operated on frequencies above 1,500 kilocycles (or below 200 meters) and it became increasingly recognized among them that their received signals were subject to peculiar and inexplicable fluctuations. The mystery was why their signals should vary in this unaccountable manner while other radio signals did not.

In order to determine the facts about these fluctuations the Bureau of Standards organized a systematic series of tests, extending over a year, by a large group of amateurs. It was demonstrated that on these frequencies fading occurs in the night and not daytime, that the average received signal strength is much greater at night, that fading is worse the higher the frequency, that weather conditions do not markedly affect fading, and that the amount and nature of fading are not characteristic of either the locality of the transmitting or of the receiving station.

From these facts and others it was possible to derive the following explanation of fading:

In the daytime the radio waves go out from the transmitting station attached to, and sliding along, the ground, just as the electric current comes into our homes sliding along the wires. The waves do not penetrate very far up into the air because of the presence of a sort of electrical screen or barrier produced by the action of sunlight on the atmosphere. At night, however, this electrical screen disappears and the radio waves can penetrate way up into the very rarefied upper parts of the atmosphere, which are permanently in an electrically conducting condition. The radio waves then slide along this upper conducting part of the atmosphere in just the same way that they slide along the earth's surface in the day time, with this difference: In sliding along the earth's surface the waves are rapidly absorbed by the trees, buildings, and other obstacles they meet, while in sliding along the upper atmospheric conducting surfaces they are free from this and go much greater distances. So the short waves, which should go farther theoretically because they are of higher frequency, really do go farther at night. But this upper atmosphere surface is not smooth; it is rough and turbulent like a wave-tossed sea, and these variations give rise to the fluctuations of received signal intensity which we call fading.

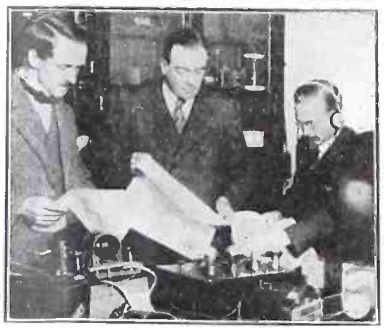
All of this, the investigation and the conception of the explanation, was in 1920. Since then, broadcasting and the use of very short waves have developed. Knowledge has accumulated, and it has verified and extended this explanation. We now know that there is a zone, somewhere between 50 and 150 miles around a transmitting station, in which fading is greater, and average signal intensity is less, than at either greater or less distance. This is the main explanation of so-called dead spots. In this same zone fluctuations of the direction from which the waves reach the receiving station occur. Some of these direction shifts give a direct demonstration of the fact that the waves travel in the upper atmosphere. Some of the most remarkable changes in signal intensity, fading and wave direction occur daily during sunrise and sunset. As the earth's daily rotation makes the surface of separation between daylight and darkness swing over a given locality, the radio waves traveling in the upper atmosphere are actually tilted down and rapid and peculiar fading occurs. For certain very short waves it turns out that there is an electrical conducting surface in the atmosphere which facilitates their transmission of great distances in the daytime, just as happens to other waves at night.

Not everything is known, however, about the mechanism of radio transmission in the upper air. Little is known about the actual electrical conditions up there, and in fact radio experiment has now become the chief source of securing information about the electrical conditions up to a hundred miles above the earth's surface. This is by no means unimportant, aside from radio, because those electrical conditions have a vital influence on terrestrial magnetism and weather. Enough has been learned to give zest to the search for more complete knowledge of radio transmission and work along these lines is in progress all over the world.

Right now a group of university and other laboratories are associated with the Bureau of Standards in a cooperative program of measurements upon radio fading, wave intensity and related factors that will make it more nearly possible to predict just how goodservice will be given by a transmitting station at different distances, times, directions and frequencies.

But broadcasting is not the whole story. On some of the very high frequencies the great distances and other characteristics of night time transmission occur in the day time. A few weeks ago an amateur with a low-power set sent signals on 30 meters in the daytime from Chicago to Hawaii, a mere 4,000 miles. The radio world is ebullient with enthusiasm over short waves. But the fly in the ointment is the varying and unreliable intensity of the received signals. Whether the ultimate solution will have to be the same as the present way of placing all dependence on the local station, it is too early to predict. That there will be a solution, no one doubts.

Strictly Private



J. D. CRESOLM, at the right, is the inventor of a new secret wireless transmitter, which is free from atmospheric interruptions, wavelength changes or the possibility of the signal being "tapped." The others in the photo, taken in London, are, from left to right, C. R. McVittie and P. V. Ford, M.P. (International Newsreel.)

LOW WAVES FOR PROGRAMS WIN SUPPORT

WASHINGTON.

AMATEURS will be allowed to continue to operate within the band below 200 meters at least until the time of the next National Radio Conference, which will probably be in September. This assurance was given Kenneth B. Warner, Secretary of the American Radio Relay League, by Chief Radio Supervisor Terrell. Officials of the Department of Commerce doubt the wisdom of assigning to new broadcasting stations wavelengths below 200 meters until sets that will tune that low are placed on the market. *If the demand for wavelengths continues, however, and manufacturers do not take the initiative in producing low tuning sets, the Department may give out the low wavelengths anyway.* Such a step, it is believed, would compel manufacturers to put out sets that would go that low.

How to Use the AC Light Main

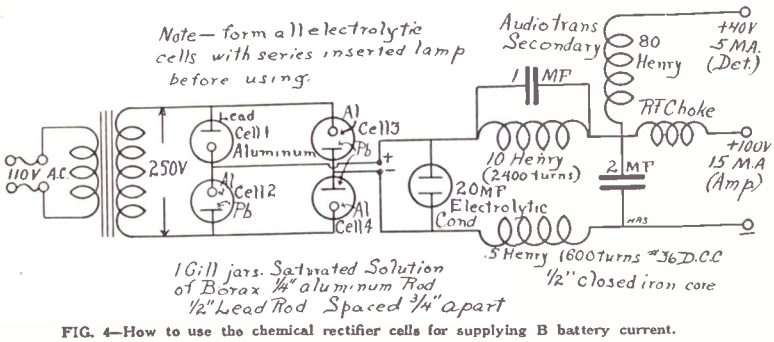


FIG. 4—How to use the chemical rectifier cells for supplying B battery current.

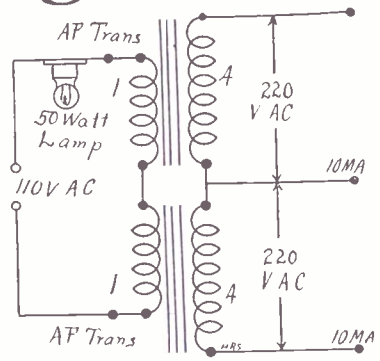


FIG. 5—How to employ an audio-frequency transformer (3 to 1 or 4 to 1 ratio) to step-up current for supplying plate current.

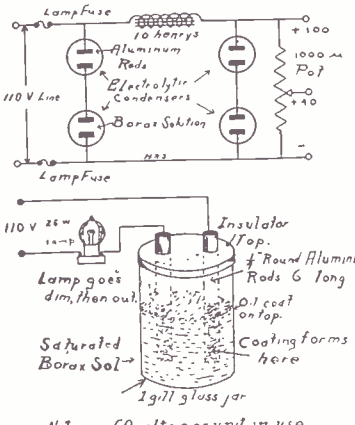


FIG. 8 (top)—How to connect by electrolytic condensers in the 110-volt AC line to use for plate voltage on amplifier tubes only. Note the potentiometer in output lead for regulating plate potential. Bottom diagram (Fig. 9) illustrates how to make a chemical rectifier for use in A and B battery eliminator. A fruit jar may be used for holding the solution.

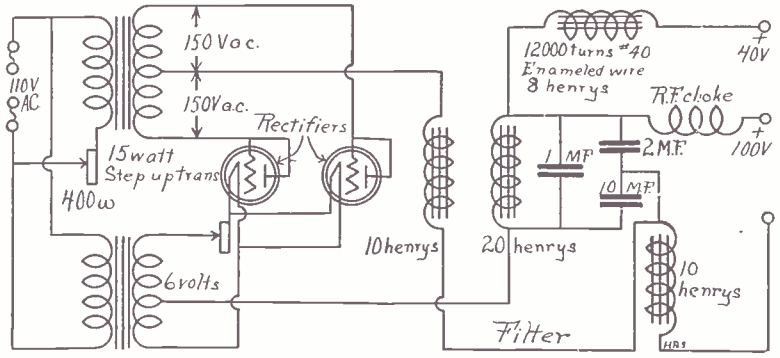


FIG. 6—How to light filaments of UV201A (used as rectifier) with a bell-ringing 6-volt output transformer. Note the rheostat connected in series with the filament to be used as a current regulator.

[Part I of this article on battery elimination, published June 6, dealt with use of direct current mains. Part II, published last week, issue of June 13, was a discussion of hookups for alternating current, concluded in the following instalment, which also winds up the article.]

PART III.

By P. E. Edelman

Electrical Engineer

ASIDE from makeshifts of home-made electron tubes from No. 1158 bulbs from which results may be had, the use of electrolytic rectifiers is practical. These can be made exactly like the electrolytic condenser previously described except that a lead plate is used with one aluminum plate. The forming is done in same manner but the series lamp will not extinguish when the aluminum to lead combination is used. Such rectifier units are on the market as used for charging B batteries. Fig. 4 shows a suitable connection using four cells of this kind. This rectifies both half cycles. Current passes from cell one to cell three, lead to aluminum, lead to aluminum, but on next half cycle cannot go back this way. The other two cells then permit the next half cycle to pass, aluminum to lead, aluminum to lead. The result is that for each half cycle, current passes in the same direction through the middle bridge output of this circuit. This direct flowing current can be filtered and used as usual. The cells are thus used in alternate pairs, one pair rectifying while the other acts as an electrolytic condenser, and then reversed.

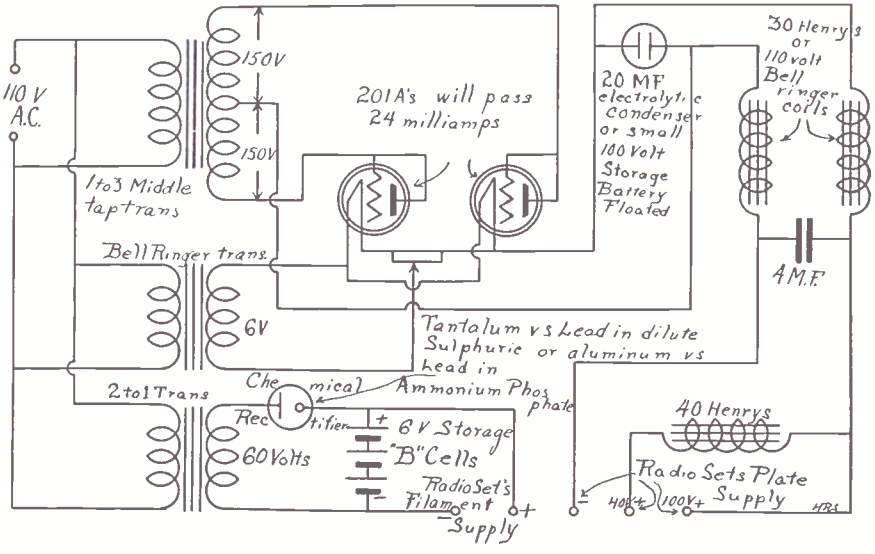


FIG. 7—A complete hookup of a rectifying unit to supply A and B battery current. Note that this unit may be made from the parts around the house.

This is probably the best home-made arrangement, inexpensive and simple. When oil is floated on top of the small cells, a unit will run for a long time without attention. Water can be replenished as required and after prolonged use, the aluminum plate can be scraped clean, the borax solution replenished all fresh, the plates reformed, and the procedure continued as before. Four such cells of 1 gill size require little room. If obtainable, tantalum-lead cells might also be used. Aluminum lead cells need to be kept formed in order to rectify satisfactorily. Tantalum-lead cells do not.

The transformers are used to get proper voltage and current capacity economically and also to insulate the rectifier unit from the grounded main line. If suitable, step-up transformers cannot be found, they can be made by using two ordinary audio-frequency, one to three or four ratio amplifying transformer coils. (Fig. 5). With a good closed core, one primary winding of such a transformer

(Concluded on page 23)

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.

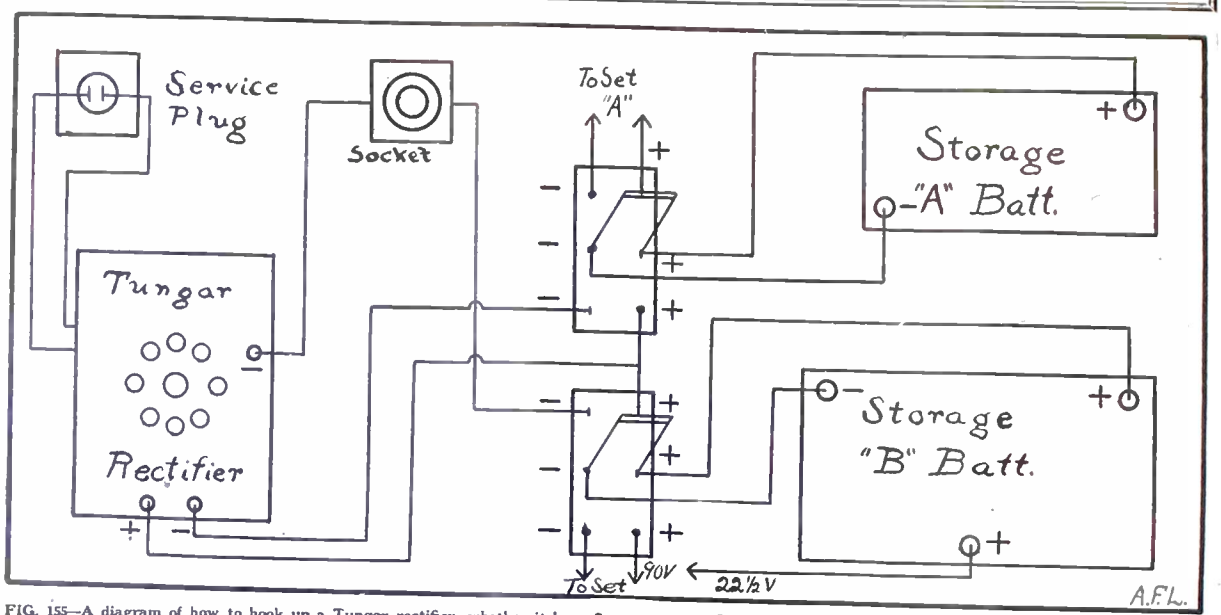


FIG. 155—A diagram of how to hook up a Tungar rectifier, whether it be a 2-ampere or a 5-ampere charger or any other bulb rectifier, to charge either your A or B battery. Both should not be charged at the same time. Note the socket in upper left-hand corner, in which a 75-watt lamp should be inserted for purposes of charging the storage B battery, provided it is of the Edison element type.

WOULD YOU please give me a diagram showing how to hookup my A & B batteries to my Tungar 5-ampere re-charger?—C. H. Parson, New York City.

Fig. 155 shows the diagram.

* * *

I WOULD like to have a circuit diagram of a 4-tube receiver employing one stage of tuned radio-frequency, a regenerative detector, and 2 steps of audio-frequency amplification, with Hedgehog transformers. (2) I would like to know what is the best portable super-hetrodyne for the layman to build, employing UV199 tubes.—Ralph F. Cooper, Route 1, Box 294, Miami, Fla.

(1) See circuit diagram of The Diamond of the Air, issues of April 4, 11, and 18. (2) Get a kit and a ready-made portable cabinet, such as several firms make. We can not undertake to pass on the comparative merits of commercial kits.

* * *

IN THE Lindheim 1-tube Reflex, May 30th issue, RADIO WORLD, should not the top of L4 go to the gridp ost, and not to the ground posts (page 4, col. 3)—Forrest I. Johnson, 29 Grand Ave., New Haven, Conn.

Yes.

* * *

I HAVE built the "2 Control DX Reflex," and find a persistent howling of the first tube, unless I keep the temperature of the filament very low. The grid leak does not affect the reception at all.—A. H. Schultz, Bethesda, Md., R. F. D. 2.

Get yourself a good variable grid leak. Reverse the tickler windings, put a .001 mfd. from the beginning of the tickler winding to the B minus. Connect the end of the L1 to the end of L2 and connect this to the A minus and ground.

* * *

I DESIRE to ask a few questions on the 'Diamond of the Air' described in RADIO WORLD of April 4, 11 and 18: (1) Can an Erla RFT be used in the set instead of the antenna coils described by Herman Bernard? (2) I would like to know whether the circuit described in the May 23 issue is better than the one described April 4. If they are the same, and function the same, what is the difference? (3) How much better, if any, is the 4-tube than a 3-tube circuit? (4) Does the addition of one stage of radio-frequency to regeneration do more than the mere use of regeneration itself? (5) Can I use General Radio AFT No. 285 for first stage, audio, ERLA 3½ to 1 for last stage? (6) Can all of the rheostats be Bradleystats? (7) Can the set be assembled in a 7x18" cabinet? (8) I want to construct the 3-dial set for use with and without loop. Can I do so? (9) In constructing the set described in April 4 issue does Mr. Bernard advise using the 100,000 ohm resistance mentioned in May 23 issue, as well as other resistances mentioned therein?

(1) No. (2) No; same circuit; only difference is May 23 has a control less. (3) About 12 per cent. on DX; no difference on locals. (4) Yes. (5) Yes. (6) Yes. (7) Yes, but with harmful crowding. (8) Yes. (9) See Mr. Bernard's article in this issue, where he discusses this resistance.

* * *

I AM planning to hook up The Diamond of the Air, as described by Herman Bernard in the April 4, 11 and 18 issues of RADIO WORLD. (1) Could I use five WD12 tubes with good results? (2) Could I use three tubes for the Daven Resistance Amplifier? (3) Could I hook up two .0005 mfd. variable condensers together to make it a 2-control set? (4) Will the Bruno coils work well?—J. Clighorn, 288 Clementina St., San Francisco, Cal.

(1) Yes. (2) Yes. (3) Yes, by gearing. The double condenser is easier. See the May 23 issue of RADIO WORLD. (4) Yes.

* * *

WILL YOU please give me complete data as to how many turns there are on Neutroformers, also what capacity are the variable condensers for the diagram which appeared in the May 30 issue of RADIO WORLD, on page 16?—J. B. Elton, 501 S., Denver, Kansas City, Mo.

All the coils are wound on forms having a 3" diameter, and with number 22 DCC. The antenna coil and the L2 are wound on a piece of tubing 3" in diameter, antenna coil having 10 turns and L2 having 45 turns, ½" spacing being left between the two. All the other coils, L3, L4, L5, L6, are wound in same except that the taps are taken from two of the secondaries at the 15th turn. The condensers are .0005 mfd.

* * *

I WOULD like a sketch showing how to mount my 3 pancake coils in variable fashion.—L. C. Plainton, Brooklyn, N. Y.

See Fig. 156 for sketch.

* * *

PLEASE tell me how to build a vario-

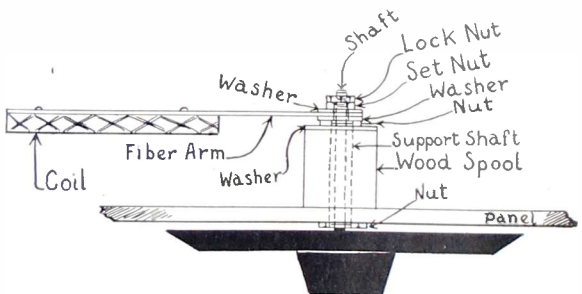


FIG. 156—A sketch showing how coils, which one is desirous of making variable, may be mounted inside the cabinet, with a few simple articles which may be lying around the house.

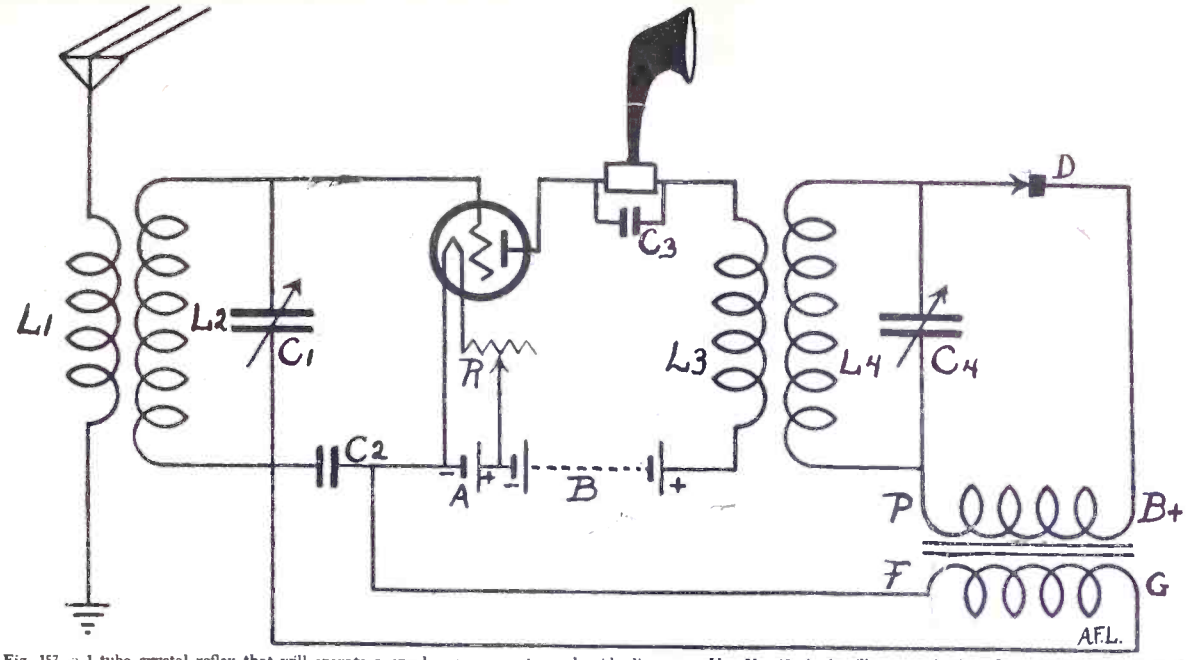


Fig. 157, a 1-tube crystal reflex that will operate a speaker on very strong locside diameter. Use No. 22 single silk covered wire. L2 consists of 46 turns, b the secondary. Then continue winding the remaining 16 turns of the secon. C1 and C4 are .0005 mfd. each. C3 is .002, C2 the smallest capacity fixed con al stations. This set is non-regenerative. L1L2 is a spider-web coil, 5½" out- ut after 20 are put on the primary, L1, 10 turns is wound simultaneously with ary. L3L4 is wound the same way, except that L3 has 13 turns instead of 10. denser you have.

meter.—S. T. Sakarian, La Baracaldesa, Balboa, Spain.

Take a form 3½" in diameter, wind 36 turns of No. 24DSC, leave ¼" and wind 36 turns more. This is the stator. For the rotor, take a form 3" in diameter, wind 28 turns of the same wire that you used for the stator, leave ¼" and wind 28 more turns. This means that there are 56 turns on the rotor and 72 turns on the stator. Through the center of these coils run a shaft 3/16" in diameter. To make the rotor hold on the shaft, drop some solder on the brass tubing, before the tubing enters the shaft hole and again after it has pierced the shaft. Use just enought for security.

* * *

A DIAGRAM of a 1-tube crystal reflex is requested.—Thomas G. Fellowes, Spokane, Wash.

See Fig. 157.

* * *

HOW CAN I magnetize my phones from a dry cell and an electromagnet?—Olin G. LeRoy, Palmyra, N. Y.

There is not enough power in a single dry cell to charge up the electromagnet. At least 110 volts would have to be put into such a magnet.

* * *

PLEASE GIVE me a hookup of the Diamond of the Air. I want to use an antenna. Give the statistics on how to wind the coil.—A. W. Benda, Corydon, Ia.

The complete data on how to wire the set and picture diagrams were published in the April 4, 11 and 18 issues of RADIO WORLD. See Herman Bernard's article in this issue.

* * *

I WOULD like to build White's DX set, which was explained in the Dec. 6 issue of RADIO WORLD. What number Litz wire may I use and where can that wire be bought?—F. L. Henker, Elizabethville, R. I.

Use 28-strand No. 20 Litz wire. It can be purchased in any large electrical or radio store, e. g., Stanley and Patterson, West and Hubert streets, N. Y. C.

* * *

PLEASE GIVE the list of parts necessary to build the "3-tube Neutrodyne Using The Reflex Plan," described in the May 16 issue of RADIO WORLD.—G. T. Leonard, 83 Knox Ave., Mt. Oliver Station, Pittsburgh, Pa.

The radio frequency transformers L1, L2, L3, L4,c an be bought or they can be made. If they are bought, any standard make tuned radio-frequency unit will be all right. The taps can be brought out according to the description in the text. N, the neutralizing condenser, is an X-L variodenser, type N, C1, C2, are variable condensers having a capacity of .0005 mfd. C3 is a .00025 mfd. fixed condenser, C4 is a .001 mfd. fixed condenser, C5 is a .002 mfd. fixed condenser, C6 is a .002 mfd. condenser. R1, R2, R3, are all 6 ohm rheostats, R4 is a variable grid leak (from 1/3 of a megohm to 10 megohms): the first AFT. is a 9 to 1 ratio AFT., the second AFT. is a 3 to 1 ratio AFT., J1 is a double circuit jack, J2 is a single circuit jack. Use five UV199 tubes throughout. A 7x18" panel and cabinet to fit, UV199 sockets (five), terminal strip, two dials, for three 4½-volt A batteries, two 45-volt B batteries.

* * *

COULD I use a 6-volt bell-ringing transformer in conjunction with the electric light circuit and then rectify this current so as to use it for the purpose of lighting the filaments by tubes?—J. Heard, Jr., 645 Lucilla Drive, Baton Rouge, La.

Yes, but you will not be able to filter the current perfectly enough for the purpose of receiving broadcast signals clearly. You will always hear an AC ripple. This is caused by the peculiarities of the line circuit. If anyone in the house starts to use an electric iron or a vacuum cleaner your filter will cease to function.

* * *

WILL THE WD 12 tubes work well in the 4-tube 5 dial DX set described by Capt. Peter N. O'Rourke in the March 21 issue?—C. P. Musser, Cleveland, O.

They will work very satisfactorily. You will have to use four 1½-volt cells in parallel. If you intend to use a 6-volt storage battery a 50-ohm rheostat will be necessary.

* * *

I AM building Capt. Peter V. O'Rourke's set described in the March 21 issue of RADIO WORLD, and I am using the Ambassador Master Coil, wound with Litz wire, for L1, L2, L3. There are 10 turns on the primary and 42 turns on the secondary. In constructing a

(*Continued on page 27*)

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and we will enter your name on our subscription and University lists by special number. Put this number on the outside of your envelope addressed to RADIO WORLD (not the enclosed return envelope) and also put it in your queries and the questions will be answered the same day as received.

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Her First Set a Success

HAVING read Herbert E. Hayden's 2-part article on how to build a 1-tube portable set, Miss Elsa Wells, of New York City, thought she'd try her hand at making the set. It was her first attempt, but she figured that anybody who could "purl one and drop one" could build a set, if Mr. Hayden's explicit method of exposition was the guide. Her luck was excellent—or, rather, her skill was effective. The tiny set tuned in stations far distant. It was so simple to succeed that now she is thinking of attempting a Super-Heterodyne. A photo agency got wind of her feat and the accompanying picture, taken on the roof of her home, is the result. She is proud of the little set and would not part with it under any conditions—that is, not for less than $15 cash, or two tons of cigar store coupons!

"My Pet Portable"

"A GREAT LITTLE SET, though I built it myself," Elsa Wells exclaims, exhibiting her Model 1-B Portable. "It's my pet." This is the set described constructively by Herbert E. Hayden in the May 16 and 23 issues of RADIO WORLD. It is a 1-tube set on a 5½x7½" panel, only a scant armful. (Underwood & Underwood.)

BOSKY DELLS PLAY TRICKS ON RECEIVERS

AS yet we cannot eliminate static. There have been many instruments on the market for the reducing of these strays, but none accomplishes elimination. Receivers are now so designed that there is enough signal strength received in the set to overpower all the static most of the time.

If you have a portable receiver which volume on distance, use the loop as anuses a loop and you do not get enough tenna, that is, attach the end of the loop winding to the antenna pose, and the other post in the set to the ground, leaving the beginning disconnected. Moist earth near which the set is located will afford a good ground. Do not make the leads too long, as you wish to conserve all the energy that you can. A long ground lead may make the set inefficient.

Usually a 5-tube set will work well as a portable. There are the 3- and 4-tube reflexes which give you the volume of a 5- or 6-tube set.

There are many areas of the country that have differing affects on radio signals. In some places signals can hardly be heard although the location, at first glance, might be thought a great place for radio reception. But due to ore around the place where the set is installed a possible dead spot exists. I had a radio set installed in Tannersville, N. Y., the altitude being nearly 2,000 feet above sea level. The reception was very poor, caused by an air pocket right over the hotel where the set was installed. As soon as I took the set down to the village radio store it worked great on a poor antenna. (The man didn't fix the set, either). So you see you take a chance when you take a set to the country. There might be something very small that hinders results. I do not mean to discourage any person from taking a set on vacation. I always take one. What I do mean is that you should not be disappointed if the set does not work as well as somebody said it should. (L. W.)

WFBH TO USE 1,000 WATTS

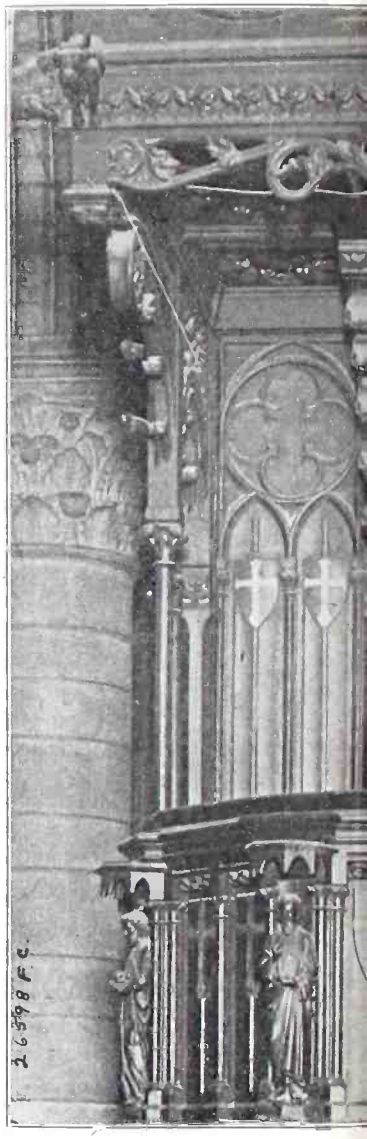
STATION WFBH, New York City, will continue broadcasting from the Hotel Majestic and will not move its transmitting equipment to Richmond Hill, L. I., as was reported. The station has renewed the lease on the broadcasting quarters in the hotel for an indefinite period. Under the new arrangement, the station may broadcast any kind of material and the hotel will not attempt to censor the program.

Closed a Few Days

Because of a disagreement between the management of the hotel and the station officials as to the kind of program being offered, the station ceased operating for a few days.

The broadcasting studio and reception rooms are on the first floor of the hotel and the transmitting room is located on the roof. It is believed that in a short time the station will increase its power to 1,000 watts.

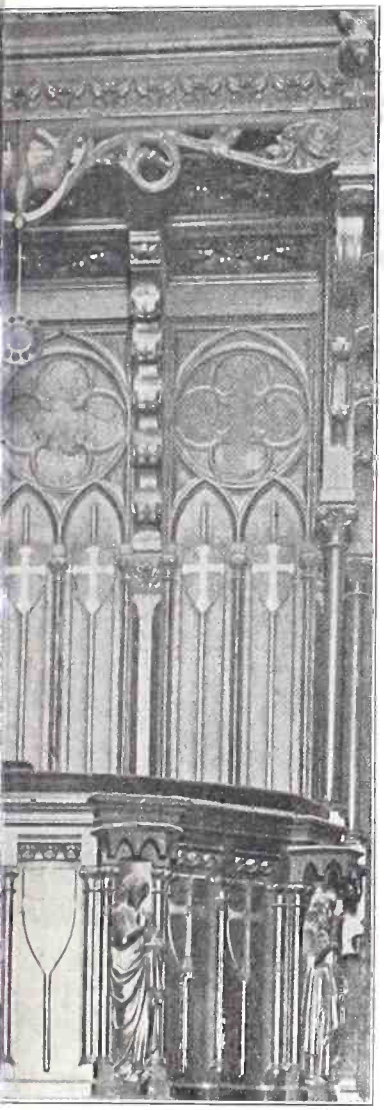
Microphone



THE CATHEDRAL OF NOTRE DAME, one an edifice of great religious repute, now has a conservatives to the inclusion of broadcasting overcame this. The microphone is perched unde the organ recitals, choir work ar

REPRESENTATIVES of the sixteen Chicago and six nearby radio broadcasting stations have se they would not tolerate any further "interference" from that body. The broadcasters were invite visability of conducting a poll on the wishes of listeners-in regarding complete silence of all twen been silent for more than two years, having agreed among themselves to observe Mondays, before The two leaders of the factions, are shown in the center front row, Alderman Arvey, (dark suit, w left) of WTAS, who led the station directors' fight. Others in the photo are George E. Carlson, c president of the Radio Listeners-In Association; Jack Nelson, of WJJD, and Bob O'Neill of WE no jurisdiction. (Underwood & Underwood.)

Notre Dame



architectural monuments of world-wide fame and phone. There was some opposition by European ties in the temple of worship, but wiser heads uiches and is the instrumentality for broadcasting aching. (Underwood & Underwood.)

notice on Mayor Dever's radio commission that Chairman Jacob M. Arvey to discuss the ad- stations each Monday. Chicago stations have nmission came into existence about a year ago. glasses) and Charlie Erhstein, (at Alderman's T; Jerry Sullivan, of WQJ; Frank McDonald, he directors claim the Mayor's commission has

Bernie's Lead Is Stronger

BEN BERNIE and his orchestra, who broadcast from WEAF, continue to strengthen their lead in RADIO WORLD'S test to determine whom its readers regard as the best radio entertainer of 1925. This steady occupancy of first place is an exception to the rule in previous popularity contests conducted by RADIO WORLD. S. A. Rothafel, of the Capitol Theatre, New York City, otherwise "Roxy," is second, Karl Bonawitz, WIP, third, and the Happiness Boys, WEAF, fourth. Therefore WEAF is feeling pretty confident, with entertainers in first, second and fourth places.

There is nothing conclusive about this standing and any week may show an upset. Ben Bernie should not regard this comment as personal.

Contest Rules

1. The votes in RADIO WORLD'S 1925 contest to determine the radio entertainer entitled to the popularity gold medal may be cast by filling out the coupon as published weekly in RADIO WORLD. One coupon entitles the sender to one vote. The coupon should be properly filled out and mailed. Anybody subscribing to RADIO WORLD (a new subscriber or one renewing an existing subscription), may cast as many votes as are represented by the total number of weeks of the new or renewed subscription. In addition, as the coupons are published, the subscriber may use them for sending in one vote on each such coupon. When subscribing, cast your total subscription votes by specifying the candidate in the subscription order.

2. This contest closes July 31. The last coupon will be published in the July 25 issue.

3. In case of a tie, a gold medal will be awarded to each contestant so tied.

One of the Leaders

ROXY is holding second place in RADIO WORLD'S popularity contest. In appreciation of support by RADIO WORLD readers he specially autographed the above photo with his famous greeting.

WHAR MOVES INTO CLASS B

ATLANTIC CITY station WHAR has been transferred from Class A ot B, and is now operating on a wavelength of 275 meters, with 500 watts power.

* * *

STATION WABL, until recently at Storrs, Connecticut, has been moved to Mansfield, in the same State, and is now operating with new call letters of WCAC.

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. 11—6/13. **FILL OUT THIS COUPON AND MAIL NOW!**

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.

WBOQ, Richmond Hill, N. Y., 236 (E. S. T., D. S.)—7:30 P. M. to 11:30.

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 to P. M. to 9; 11 to 12; 12:30 to 1:30; 4:30 to 5:30; 6:30 to 9:30.

WHT, Chicago, Ill., 238 and 400 (C. S. T., D. S.) —11 A. M. to 1 P. M. (238 meters); 7 to 8:30 (400 meters); 8:45 to 10:05 (238 meters); 10:30 to 1 A. M. (400 meters).

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, 453 (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.

WQJ, 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; 3:30 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.

WBOQ, Richmond Hill, N. Y., (236 (E. S. T., D. S.)—3:30 P. M. to 6:30.

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.

WHT, Chicago, Ill., 238 and 400 (C. S. T., D. S.) —11 A. M. to 1 P. M. (238 meters); 7 to 8:30 (400 meters); 8:45 to 10.05 (238 meters); 10:30 to 1 A. M. (400 meters).

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.

WQJ, 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 10:00; 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, Shanandoah, Iowa, 288 (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.)—11 A. M. to 12:30 P. M.; 4 to 5; 7 to 8.

CKAC, Montreal, Canada, 411 (E. S. T.)—4:30 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.

WHT, Chicago, Ill., 238 (C. S. T., D. S.)—9:30 A. M. to 1:15 P. M.; 5 to 9.

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.

WOCL, Jamestown, N. Y., 275.1 (E. S. T.)— 9 P. M. to 11.

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 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.
WHT, Chicago, Ill., 238 and 400 (C. S. T., D. S.)—11 A. M. to 1 P. M. (238 meters); 7 to 8:30 (400 meters); 8:45 to 10:05 (238 meters); 10:30 to 1 A. M. (400 meters).
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.
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.
WMCA, New York City, 341 (E. S. T., D. S.)—3 P. M. to 5; 6:30 to 7:45; 8 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.
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 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.
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; 6 to 10.
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 10.30.
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.
WBOQ, Richmond Hill, N. Y., 236 (E. S. T., D. S.)—3:30 P. M. to 6:30.
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.
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.; 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.)—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.
WHT, Chicago, Ill., 238 and 400 (C. S. T., D. S.)—11 A. M. to 1 P. M. (238 meters); 7 to 8:30 (400 meters); 8:45 to 10:05 (238 meters); 10:30 to 1 A. M. (400 meters).
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.
WMCA, New York City, 341, (E. S. T., D. S.)—3 P. M. to 3:45; 4 to 5; 6:30 to 12.
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.
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; 6 to 7; 8 to 10.
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.
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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.
WBOQ, Richmond Hill, N. Y., 236 (E. S. T., D. S.)—3:30 P. M. to 6:30.
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 12:30 P. M.; 2 to 4; 7:30 to 11.
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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 5:30; 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.
WHT, Chicago, Ill., 238 and 400 (C. S. T., D. S.)—11 A. M. to 1 P. M. (238 meters); 7 to 8:30 (400 meters); 8:45 to 10:05 (238 meters); 10:30 to 1 A. M. (400 meters).
WJY, New York City, 405 (E. S. T., D. S.)—7:30 P. M. to 11:30.

(Concluded on page 24)

A THOUGHT FOR THE WEEK

A YEAR ago RADIO WORLD had a story suggesting the use of 600 meters as the intermediate frequency and making any set a "super" by adding the oscillator. The same thing is now being suggested as new by "Radio Broadcast," using the same arrangement.

—R. P. CLARKSON, in the N. Y. Sun Radio Section, June 6, 1925.

RADIO WORLD

Trade Reg. U. S. Pat. Off.

The Last Consecrating Radio For Dealer, Jobber, Distributor and Manufacturer

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

TELEPHONES: LACKAWANNA 6076 and 2063
PUBLISHED EVERY WEDNESDAY
(Dated Saturday of same week)
FROM PUBLICATION OFFICE
HENNESSY RADIO PUBLICATIONS CORPORATION
ROLAND BURKE HENNESSY, President
M. B. HENNESSY, Vice-President
FRED S. CLARK, Secretary and Manager
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EDITOR, Roland Burke Hennessy
MANAGING EDITOR, Herman Bernard

SUBSCRIPTION RATES

Fifteen cents a copy. $6.00 a year. $3.00 for six months. $1.50 for three months. Add $1.00 a year extra for foreign postage. Canada, 50 cents.

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%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

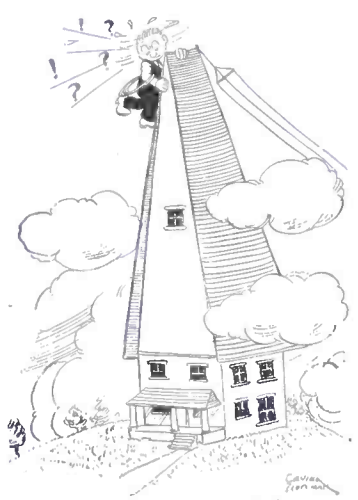
CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum, 10 words. Cash with order. Business Opportunities, 50 cents a line; minimum, $1.00.

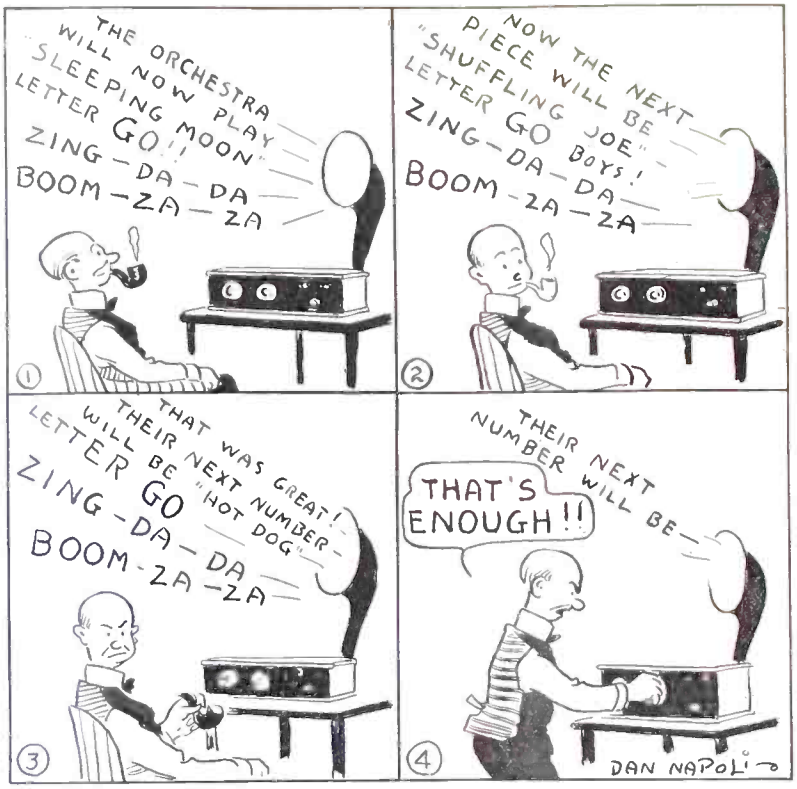
Entered as second-class matter, March 28, 1922, at the Post Office at New York, New York, under the act of March 3, 1879.

JUNE 20, 1925

It Feels Thus To Us



Anyway, the Dial Affords Variety of Choice



Stations Make a Secret of Their Short-Wave Work

IT has been the general thought that all the stations operating on short waves had regular broadcasting periods, and a desire to be heard on short waves, but investigation disproves the assumption. The stations operated by the General Electric Company, the Westinghouse Electric & Manufacturing Co., and A. H. Grebe & Co., are doing most of the program transmission on short waves. The type of operation is called remote control or relay work.

There are no special wavelengths that these stations operate on, as these stations state they are engaged in experimental work only. For instance, KDKA relays programs to KFKX on 94 meters, and KFKX in turn broadcast the program on its standard wave of 286 meters. However, this program on short waves may be picked on a special receiver although the program was not sent out on a short wave with the intention that it be used for the broadcast listeners' enjoyment.

The Government has not assigned special low wavelengths to these stations, hence they might be on the air on about seven different short waves in a week, or even in a few hours. These stations have an X call, which is an experimental call and which entitles the owner to send out signals on any wavelength, for scientific tests and not for entertainment alone.

The air is full of radio sations transmitting on short waves, including code, of course, and a great deal of scientific data thus is obtained, the entertaining value being incidental.

On the low waves the signals are very loud, in fact KDKA has been received regulary at RADIO WORLD'S laboratories, on a loud speaker, using nothing more than a one UV201A tube in a regenerative set. The circuit was described by Herbert E. Hayden in the June 13 issue of RADIO WORLD.

The stations sending out programs make a mistake in discouraging fans from trying to hear them on short waves. This discouragement takes the form of keeping secret the hours on the air and the wavelength. Even though the hours are uncertain, it would be well to give the fans some inkling, as well as to give some data on the sudden shifting from one short wave to another. Many fans attribute the sudden silence to fading or signing off. The experimental and scientific value of the work would be enhanced by fan co-operation. Reports from many listeners would augment the data obtained from engineering channels. The fear that the sale of broadcast wavelength receivers might drop on that account is ill-founded.

Let the secrecy end.

RADIO WORLD HOOKUPS ACCLAIMED THE BEST

Fans Shower Praise on O'Rourke, Anderson, Wright, Warren, Winner and Bernard — "Sin and Shame to Allow Such a Magazine as RADIO WORLD to Be Published," Says Lone Dissenter, Condemning Rofpatkin's "Reflex for Novice," the Efficiency of Which Delighted Others.

A LITTLE more than a year ago RADIO WORLD began a studied effort to present tried and tested hookups every week as the main attraction of the magazine, specially emphasizing these technical features, presented in a variety appealing to the novice and the initiate. About that time many hookups were appearing in various radio magazines, including freak circuits that worked poorly and standard circuits with ruinous mistakes in diagrams. The whole radio magazine field has improved much since then. RADIO WORLD, recognizing the great importance of scientific accuracy, was first to engage a special staff of contributing experts to insure painstaking description of the most efficient circuits. All work was checked up by another force of radio engineers. The public response was splendid from the start. Letters of praise poured in. Now they arrive in greater quantity than ever, despite theoretically adverse conditions due to seasonal effect on radio interest.

One Wrong Out of 672 Diagrams

Of several hundred circuits presented in fourteen months, only two did not meet with uniform success, due to constructional difficulty in one case and, in the other, to a mistake in the diagram. As the record stands, there was a mistake in one diagram out of 672 published, and the error was acknowledged and rectified two weeks later. Thus, any one building a set described in RADIO WORLD gets what virtually amounts to free insurance. The error factor eliminated to a degree never before equalled in a technical publication, public confidence in RADIO WORLD has increased tremendously, until now no magazine enjoys greater confidence of its readers.

The experts whose work has helped to make this achievement possible include Capt. Peter Vincent O'Rourke, distinguished radio expert, former ship wireless operator and, during the war, a trusted navigator of U. S. craft in submarine zones. Capt. O'Rourke possesses a most unusual gift of clear exposition. He has a constant eye to the needs of the novice. Every set he describes is one he has actually constructed and tested for several months. He is now being praised by more readers than any other contributor.

J. E. Anderson, consulting engineer, whose work often attracts the interest of those far advanced in the science, is another ruling favorite. Every set he describes is one he has actually constructed and tested for several months.

Praise Is General

Other contributors, such as Lewis Winner, Percy Warren, Feodor Rofpatkin, Brewster Lee, Charles H. M. White, Thomas W. Benson, Dennis J. O'Flaherty, Neal Fitzalan, Wainwright Astor, Knollys Satterwhite, H. E. Wright, Herbert E. Hayden, Sidney E. Finkelstein and Raymond B. Wailes, also have won much praise. Herman Bernard, whose Diamond of the Air is one of the most popular and efficient DX circuits of the day, is another whose work is appreciated.

Every set any one of these experts has described in RADIO WORLD is one he has actually constructed and tested for several months.

If you want to be right, follow RADIO WORLD, the model of reliability.

Following are a few of the many results attested by letters received.

* * *

Bernard's Claims for Diamond Too Tame, Says Radio Expert

RESULTS EDITOR:

I GAVE advisory aid on building a Diamond of the Air to a friend of mine who, like myself, is a consistent reader of your valuable magazine. He purchased all good parts, such as Bremer-Tully condensers, Benjamin sockets, National Velvet Vernier dials and two Kellog audio transformers. The coils were wound Lorenz type (basket weave), and the results are far beyond expectations. Herman Bernard is very tame in his remarks concerning the performance of the set. I built one for myself two weeks ago, and it also performs wonderfully. Tonight we tuned in Davenport, using the outside aerial, on loud speaker, and it could be heard all over the house. I am so well pleased with the results from RADIO WORLD'S hookups, also the clear manner in which Mr. Bernard and J. E. Anderson write, that I can hardly wait for each new issue.

E. L. GROSS,
Radiotrician.
1148 Roberson St., Reading, Pa.

RESULTS "EXCELLENT" FROM 4-TUBE DX SET

RESULTS EDITOR:

I WISH to compliment RADIO WORLD on the general quality of the hookups it publishes. Unlike many technical and semi-technical papers, you leave nothing to the imagination, all details of construction being clearly and ably explained.

I built Capt. Peter V. O'Rourke's 4-tube DX 3-control set (March 21), and the results are so excellent that I have received several requests to duplicate it.

ALBERT C. LEITH.

Ruston, La.

* * *

FINDS ONE-TUBE DX SET EDUCATIONAL MEDIUM

RESULTS EDITOR:

HAVING constructed a Capt. Peter V. O'Rourke 1-tube DX circuit, published Dec. 6, I would recommend it to all beginners in radio as the simplest,

(*Continued on page* 30)

"No Chance to Fail Following O'Rourke's Instructions," Says Novice Won to Radio by Captain's Articles

RESULTS EDITOR:

YOUR issue of Dec. 6, 1924, Capt. Peter V. O'Rourke's DX set, started me in radio. The results obtained were so good, the instructions so plain and thorough, there was no chance to fail. I have followed the Captain's articles in your magazine and have had all the results I've been led to expect.

My latest set is the "4-Tube, Three-Control DX Set," (March 21). I use UV199 tubes on the audio and radio sides and WD12 as detector. The coils are home-made, diamond-weave type. Results:—Fine tone quality, quiet operation, selectivity, distance and good volume.

For the person wishing a quality set, easy to construct, easy to operate, and inexpensive to build, this set is the best bet.

I've pulled in WEAF, WGY, KDKA and WREO and other Eastern stations with enough volume on the speaker to be heard all over our part of the house.

MANUEL M. SILVA,
Colfax, Cal.

MR. DX HOUND

A Character Created by Radio World Artist

By HAL SINCLAIR

NEW DATE FOR PARLEY

WASHINGTON.

THE date of the International Exposition of Wireless Telegraphy at Geneva has been advanced to September 9 to 20, to bring it within the period of the Assembly of the League of Nations, Consul R. D. Longyear advises the Department of Mommerce.

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 .....

A. R. Basden, Geff, Ill.
W. J. Evans, Box 257, Yonkers, N. Y.
Hanifan Radio Shop, Waterville, O. (Dealer).
A. D. Turnbull, R.E., 57 Union St., N. S., Canada.
William J. Nicholson, Apollo, Pa.
Albert Bourget, 2284 Notre Dame West, Montreal, Canada.
D. Coulter, 16 Brummel Ave., Toronto, Ontario, Canada.
A. S. Riffle, 7 Western Ave., Emsworth, Pa.
E. J. Pakes, Petersburg, Neb.
Hub T. Franz, Medford, Wis.
Leonard Summer, Box 92, Coalfield, Tenn.
Geo. O. Sutton, 733-35 North Central Ave., Knoxville, Tenn. (Dealer).

New Corporations

Talker Products Co., East Williston, Nassau 367 Fulton St., Brooklyn.)

Telephone Corp. of America, New York, radio horns; $10,500,000 and 100,000 shares without nominal or par value. (Registrar and Transfer Co., Delaware.)

Reeps Radio Corp., N. Y. C., $25,000; M. A. Hilderbrand, F. V. Hanson, G. Levitt. (Attys., Rothensal & Heermance, 132 West 31st St.)

Maurice Radio Corp., N. Y. C., $5,000; J. H. and G. Avazian, G. C. Dahlbender. (Atty., D. Simsarian, 160 Bway., N. Y. C.)

Packard Radio Service Corp., N. Y. C., $6,000; S. M. Lazarus, T. S. D'Vorkin. (Atty., L. H. Sanders, 1 Madison Ave.)

B. J. Alonzo Radio Corp., N. Y. C., $10,000; J. Alonzo, J. Catinella, L. M. Kaplan. (Attys., Catinella & Catinella, 277 Broadway.)

CAPITAL INCREASES

Sturges Multiple Battery Corp., New York City, $1,500,000 to $3,000,000.

THE RADIO TRADE

De Forest Co. Infringes Patent on Thoriated Filament, R. C. A. Charges in Suit

THE Radio Corporation's reasons for creating a special detective bureau and keeping tabs on the De Forest Radio Company were disclosed in affidavits submitted on a motion in New Jersey Chancery Court to have the injunction against the R. C. A. dissolved or modified. Infringement by the De Forest Company of the patents on thoriated tungsten filament for vacuum tubes was charged. The court modified the injunction to permit the R. C. A. to use data obtained through its detective bureau in a previous suit brought by the R. C. A. against the De Forest Company. The original injunction prohibited any use of this material. As modified, the injunction stands.

The Radio Corporation, which has control over the use of the thoriated tungsten filament invention in certain fields, alleges that an arrangement is in effect by which the De Forest Company obtains the filament illegitimately from the Radio-Craft Company. To get proof of this fact, it was asserted, the detective campaign against the De Forest Company was instituted.

The papers submitted by the Radio Corporation of America include an affidavit by E. W. Ryan, a former employee of the De Forest Radio Company, who swore as follows:

"When I left the De Forest Radio Company, F. L. Hunter, then Superintendent of the vacuum tube manufacturing department, had an interview with me and told me that for legal reasons he would request me not to inform any one that the De Forest Radio Company was using thoriated tungsten filaments in the commercial manufacture and sale of vacuum tubes. He requested me to state, if I was asked about the matter, that thoriated filaments were used only in their laboratory for experimentation. This was not a true statement of facts, and I understood that Mr. Hunter was attempting to prevent the Radio Corporation from knowing that its patents on thoriated filaments were being infringed."

In an affidavit Ira J. Adams, patent lawyer for the Radio Corporation of America, said:

"During the past three years the infringements of the patents aforesaid, particularly the Armstrong, Fessenden and De Forest patents, have been very numerous. The manufacture of devices infringing the Langmuir (thoriated filament) and De Forest patents has in nearly all cases been carried on secretively in basements and lofts where detection and observation are difficult.

"The 'bootleg' and other infringements and violations of the rights of the defendant increased at such a rapid rate that the Radio Corporation finally secured an electrical man by the name of John S. Harley to enter its employ and devote his time to the running down of these infringers and violators. Mr. Harley was attached to the patent department and was under my supervision. He has made many investigations of 'bootleg' infringements, fraudulent imitations of the trademarks and trade names of Radio Corporation, and as a result of his discoveries a large number of injunctions issued for violations of the aforesaid De Forest patents and indictments and convictions have been obtained on account of the fraudulent imitations referred to."

THE DIAMOND

LIST OF PARTS

One RF coupler, L1L2.
One 3-circuit tuning coil, L3L425.
One .001 mfd. double condenser (each section .0005), C1.
Two single-circuit jacks, J1 and J2.
One grid leak, 2 megohms, R3.
One grid condenser, .00025 mfd., C2.
One fixed condenser, .001 (C3).
Two rheostats, R1, R2.
One 7 x 18" panel.
One 3-gang socket strip, or 3 separate sockets.

ACCESSORIES

Two No. 6 dry cells, one 4½ C battery, two 22½-volt midget B batteries, three WD12 tubes, aerial, lead-in wire, insulators, lighting arrestor, speaker, earphones, cabinet.

(*Concluded from page 4*)

ception of distant stations, however, the tickler setting is critical. This is true of every regenerative set.

The panel layout as shown (Fig. 2) is self-explanatory. It is to be read in conjunction with the assembly plan, shown below it (Fig. 3). The parts may be located in respect to both diagrams because they are in perpendicular alignment.

USE OF AC

(*Concluded from page 4*)

can be directly connected across the line in series with a twenty-five watt lamp, or two primaries can be connected without the series lamp. Using the two primaries in series and the two secondary windings, to get a middle tapped secondary, the voltage from a one to a four ratio set will be doubled. For lighting filaments of home-made electron tube rectifiers, a bell-ringing, six-volt output transformer can be used. For lighting UV201A or UV202 tube as rectifier, a bell-ringing 6-volt output transformer can be used, but a series connected filament rheostat should be used as a current regulator. (Fig. 6).

Telephone condensers can be used for filter condensers, because when a transformer is used there is no dangr of direct short circuit on the main line. The coils for plate voltage supply need not have large current carrying capacity and can be made by winding five thousand turns of No. 36 DSC wire on an iron laminated core ½-inch square by 2 inches long. Suitable iron choke coils can also be had ready made on the market, but it is not necessary to use the large sizes employed in transmitting sets. Audio transformer coils can be used. The 110-volt side of a bell-ringing transformer can also be used and usually has about 30 nenrys inductance.

Fig. 7 indicates a unit suitable for use with average five-tube set and employing two regular amplifier tubes as rectifiers. Notice that the filament side of the rectifiers goes to the plate side of the radio set tubes.

You will notice that the most economical arrangement seems to be to have separate convertor units for the filament supply and for the plate supply, because one requires high voltage and small current where the other uses heavier current and much lower voltage. The alternating current power used is small and need not be more than fifty watts total, or the amount taken by an average sized incandescent lamp. It is possible to use much less than this, as the real requirements of a five-tube set employing 201A type tubes comprises less than 11 watts. A loss of ten watts in a convertor unit is not important in such apparatus. Thus, a 25-watt unit is feasible for most sets.

In mounting up a unit for power supply, keep all parts well insulated. Resistors, etc., which heat up, must be mounted to avoid fire danger. The use of arrangements insulating the tube power supply from the main line is best, because ground troubles are avoided. Units using small storage cells or chemical rectifiers require replenishment of water from time to time, and should be kept in a protecting rubber jar so no liquid will spill around furniture, etc. Units using electron tube rectifier will be most reliable when standard tube as UV201A is used, rather than makeshift such as the No. 1158 auto bulb. The other tubes available may be considered experimental rather than practical at present, though they can be used as indicated. When a rotary convertor unit is used, preferably it will be kept in a separate box cushion mounted against vibration sounds, rather than in radio cabinet. Heater units are also best kept separate out of the radio cabinet. If neatly mounted in a rubber base or box the rectifier units may be made up compactly for use in radio cabinets or they can be placed in a separate box.

When not used, the main line snap switch or plug connector should be disconnected to OFF position.

THE KEY TO THE AIR

(Concluded from page 19)

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.

WMCA, New York City, 341 (E. S. T., D. S.)—3 P. M. to 4:45; 8 to 12.

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.

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 9.

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.

Coming Events

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 Exposition Grand Central Palace, N. Y. C. Write American Radio Exp. Co., 522 Fifth Ave., N. Y. C.

Sept. 9 to 20—International Wireless Exposition, Geneva, Switzerland.

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. 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.

APRIL EXPORTS INCREASE

SHIPMENTS of American radio apparatus continue to expand. The trend of exports for the first four months have manifested a distinctively upward tendency, foreign sales for the period totaling $2,720,127 as compared with $1,222,685 for the same period last year. Exports during April 1925, totaled $853,148 compared to $299,903 for the same month last year.

HOW TO BUILD A NEUTRALIZED LOOP, by Frank Freer. Send 15c for May 2 issue, RADIO WORLD.

A 3-Tube Portable Reflex

(*Continued from page 11*)

sorb any additional energy, resulting in the tube oscillating, or necessary retuning. A good fixed crystal with a predetermined contact eliminates these undesirable features.

It is understood that in many circuits of this type the first tube receives only a part of the load, so to speak, the reflexed tube receives more because it is doing double duty, and the output of both tubes is forced on the last tube, with resultant overloading and distortion. Only by proper design, and this brings us back to proper constants, can the entire load be distributed as equally as possible, thereby making each tube carry its full share. Hence the reflexed stage is the second. A method has been provided for absorbing, or neutralizing surplus energy, to control the oscillations at any wavelength. Maximum efficiency in any receiver lies just below the point where the circuit is ready to break into oscillation. A balancing condenser is used in this circuit.

Referring to the schematic wiring diagram, notice that in the stage of straight radio-frequency amplification, a tuning unit is used, consisting of a conventional primary, untuned or aperiodic, with a tap for use with a long aerial. The secondary is tuned with a .0003 condenser. This coil may be made without tap, a 3½" diameter tubing being used. The turns are primary 12, secondary, 57; wire, No. 22SCC. A special 199 coil was used in the reflex step. The primary is connected in the usual manner and the secondary shunted also tuned by a .0003 condenser, but only a part of the secondary winding is used in the grid circuit. Selectivity and sharp tuning are the results of using the secondary in this manner. The 5 plate balancing condenser, used in conjunction with the remainder of the secondary winding and the plate of the reflexed tube, acts as a volume control. It is essential for selectivity because it enables you to bring the circuit into an oscillating or near-oscillating state with excellent control.

The impedance of the fixed crystal is matched by the interstage Rasla RF transformer, allowing efficient couplnig at this point. The audio transformer used in the reflex stage has a low primary impedance, which also equals that of the crystal. It is essential in this circuit that a .00025 by-pass condenser be connected across the secondary of the transformer.

A short outdoor aerial is essential for this set, when an outdoor aerial is used. About 60 feet, including the lead-in, will be found most satisfactory. Indoor aerials, telephone connections, or even a loop with one side grounded, will give excellent results. Even when a short outdoor aerial is used it is advisable to try a .00025 fixed condenser in series with the antenna. A long aerial of the outdoor type will keep the set from working at maximum, for it will not allow the circuit to operate near its oscillating point, which is particularly true on the higher wavelengths. The circuit diagram shows a negative bias applied to the grid of the first tube, to the grid of the reflexed tube through the reflexed audio transformer, and to the grid of the last tube. The use of a C battery is not optional, but is absolutely necessary in this circuit for good results. The rheostat is placed in the positive A battery lead.

The picture diagram shows the correct layout of parts, as does the photo and no attempt should be made to alter it, unless a larger panel is used.

Wire as follows: From the binding post marked plus A run a wire to one side of the rheostat, the other side of the rheostat is connected to the F plus markings on each socket. The F minus terminals of the three sockets are joined together and connected to one side of the filament switch, the other side

Condenser Stops Oscillations

of the switch being connected directly to the A minus binding post. The wiring of the two antenna and ground terminals is clearly indicated. To wire the first grid circuit from C1 on the first coil two wires first large tuning condenser and continuing arerun, one to the variable plates of the to the F side of the reflexed audio transformer, and from there to be continued to the C minus binding post. C2 is connected to the fixed plates of the first condenser, also to the first socket grid terminal. The second tuner, type TD special 99, is connected as follows: Join the P terminal to the first socket terminal marked P, then connect B terminal to the binding post marked B plus 90 volts. C1 is connected to the variable plates of the second condenser, and from this condenser terminal the wire is run to the fixed plates of the 5-plate condenser. C2 is connected to the fixed plates of the second condenser and to the second socket grid terminal. The terminal A minus on this tuner is connected to the G terminal of the high radio transformer. To connect the fixed RF Transformer, join the P terminal to the second socket P terminal, the lead is also run from the terminal of the second socket to the fixed plates of the second condenser and to the second socket grid terminal. The terminal A minus on this tuner is connected to the G terminal of the high ratio audio transformer. To connect the fixed RF Transformer, join the P terminal to the second socket P terminal, the lead is also run from the P terminal of the second socket to the variable plates of the 5 plate condenser. The B terminal is connected to the P terminal of the second audio transformer. Connect the G post to one end of the crystal detector, the F terminal is connected to the P terminal of the high ratio reflexed audio transformer. The F terminal on the primary side of this audio transformer is connected to the other end of the crystal detector. A .00025 fixed condenser is connected across the secondary terminals of the high ratio audio transformer. The B terminal of the second audio frequency transformer is connected to one side of the open circuit jack, and to the B Plus 90 volt binding post. A .002 fixed condenser is connected across the primary of this second audio-frequency transformer. The grid terminal of the second audio transformer is connected to the G terminal of the third socket. The other end of the transformer, marked F, is also connected to the C minus binding post. The P terminal of the last socket is joined to the open side of the jack, and the wiring is completed.

Rasla Matched Parts

The circuit is the one used in the new 3-tube Rasla reflex. For the aerial coil the Tuner may be used; for the reflex coupling the TD Special 99 Tuner, and for the fixed RFT the CR transformer, all Rasla products. These are the watched parts referred to.

LIST OF PARTS

One 7 x 14" panel.
One 7 x 13" baseboard.
One fixed R F transformer.
One Turned RF transformer.
One Rasla TD Special 99 Tuner.
One fixed Crystal.
One 5-plate condenser.
One high-ratio audio transformer.
One low-ratio audio transformer.
One 20-ohm rheostat.
Three 199 sockets.
Two .0003 Condensers (15 to 17 plates).
One .00025 fixed condenser.
One .002 fixed condenser.
One open circuit jack.
Two 4" dials, vernier.
One battery switch.
Seven binding posts.
Terminal post strip.

THE RADIO GALLERY

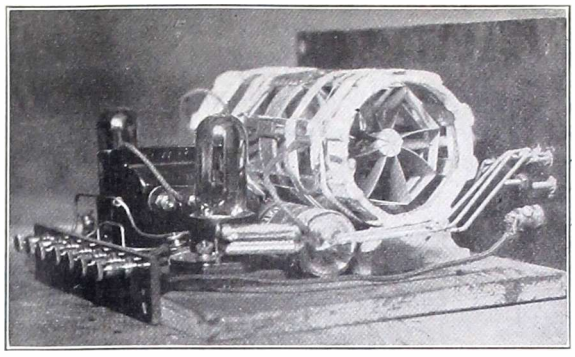
IF you have built a set, send in one or more photographs of it to The Radio Gallery, RADIO WORLD, 1493 Broadway, New York City. Fans who make the neatest sets will be awarded a place on the Set-Builders' Roll of Honor. Any set that you yourself built will meet requirements. If possible, send hookup,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

THE RADIO GALLERY:

ENCLOSED please find photo of my set using the 1-A Portable hook-up. You will note the skeleton forms, which are made of glass stator, and paddle-wheel-shaped fibre rotor. The glass is "double diamond," 1/8" thick and 3/8" wide, which, when attached to a 3" supporting ring at each end, makes exactly 3¼" outside diameter. An extra ring is placed in the middle to stiffen the glass under the strain of winding, but it is not necessary to secure or fasten it in any way. The end rings are marked off in eight equal divisions before attaching the glass strips, the corners of which are filed and sand-papered smooth. Adhesive tape is the best to fasten the skeleton, as friction tape loses its grip in a few weeks.

And she sure works, even New Orleans coming in with excellent volume, although it is 2,000 miles in an air line and summer conditions prevail; and every time I sit down to it I add some new stations to my list.

A. M. PARKER,
11623-88th Street,
Edmonton, Can.



The photo referred to in A. W. Parker's letter (published in column at left) is shown here. It is his 1-A Portable, built on lines laid down by Herbert E. Hayden (March 28, April 4 and 11 issues). Readers should send in photos of sets they build.

THE RADIO UNIVERSITY

(*Concluded from page 15*)

matched RFT, how many of number 20 DSC should I put on a 3¼" bakelite tube for the primary and for the secondary? This is called L4, L5.—C. L. Knaefler, North Wales, Penn.

There are 12 turns on the primary and 47 turns on the secondary.

* * *

I WOULD like to know how to build a wavemeter, the constants of the meter being only a variable condenser and a fixed coil, as I do not wish to go to the extra expense of buying a buzzer.—L. N. Netramily N. Y. C., N. Y.

See the article in this issue by Lewis Winner.

* * *

SINCE THE new WCCO station has opened up, it is very difficult for me to tune them out. I have tried out various methods and have failed. Could you suggest something? My set spills over a great deal. I am using 110 volts on the plate of the tubes. Is this too much?—R. W. Weston, 3523 Bryant North, Minneapolis, Minn.

(1) Put your antenna at right angles to the station, and then insert a wave trap, which should consist of a coil of 50 turns shunted by a 23 plate variable condenser, and put in series with the antenna. (2) Decrease the plate voltage to about 67½ volts, and use a variable grid leak.

Chemical Sidelights on Radio

By Dr. Charles B. Hurd

Assistant Professor of Chemistry, Union College, N. Y.

THE metal, copper, is of such importance in the electrical industry as to be indispensable. Copper, for instance, as prepared from the ore by the chemical process called smelting, contains impurities which seriously injure its electrical properties. Thus, in order to obtain the purest copper such as is used in all radio sets and nearly all electrical machinery, the impure metal must be further refined. The impure copper in the form of platus is placed in a solution where, by passing an electric current through the solution, the copper is caused to dissolve from the impure plate and to deposit on a thin sheet of very pure copper. In the electrochemical process the impurities are thus left behind and the resulting copper is 99.95% pure. It is this product which is used on the coils on your radio set, on the magnets of your loud speaker or telephones, in the bus wire connecting instruments and in many other places in your instruments and connections.

Tungsten Put to Use

Some of the chemical elements are uncommon and are or have been scientific curiosities. However, the chemist has painstakingly studied these elements, and their properties are well known. It has usually been only a matter of time before uses for them have been found. Tungsten was found to be a rather rare metal, very hard and brittle, with a high melting point. Then it was discovered that by suitably working the tungsten, it could be made into wire from which filaments for incandescent lamps were made. Many types of vacuum tubes use tungsten filaments.

A vacuum tube works because the hot filament gives off electrons, those small unit charges of electricity so important in all electrical processes. Some metals, such as thorium, give off these electrons much more readily than does tungsten. Hence, if thorium is present on the surface of the tungsten filament, as in thoriated tungsten, it is no longer necessary to heat the filament to such a high temperature to give off the proper number of electrons per second, the lower temperature resulting in a longer life for the vacuum tube. Some burn filaments too brightly and destroy the coating of thorium on the surface of the tungsten filament, after which the tube becomes poorly sensitive or "dead." If, in addition, you have been working the tube for a long time at too high a temperature, the thorium may have been all driven out of the tungsten. If such is the case, the tube is ruined. But if you have only driven away the thorium from the surface, you can, by burning the tube very brightly for a very short time, with the B battery disconnected, cause some of the thorium still remaining in the interior to come out on the surface of the tungsten. Your radio service man will show you just how to do this. The tube will then work efficiently once more. Some other elements show this ability to give off electrons easily, such as the rare alkalin metal caesium. A similar but commoner alkili metal, sodium, is used in one type of vacuum tube.

As the manufacture of vacuum tubes was developed demands were made for metals of unusual properties, for grids, plates and other metal parts. In some tubes the metal nickel could be used, but other tubes, requiring metal of different properties, developed a use for the rather uncommon metal molybdenum. This metal is commonly used in vacuum tubes.

Magnesium Cleans Gases

To remove the gases from the so-called "hard tubes," efficient vacuum pumps are used. Yet the finising touches are put on

"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 2-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 2-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. Wallen.
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.
April 4—The Diamond of the Air (Part 1), by Herman Bernard. What the New Sodion Tube Is, by Sidney E. Finkelstein. Sets for the DX Devotee, by Lieut. P. V. O'Rourke.
April 11—Audio Hookups for Fine Volume and Quality as Well, by Brewster Lee. The Diamond of the Air (Part 2), by Herman Bernard. 1-Tube Distance-Getting Sets, by Lieut. P. V. O'Rourke.
April 18—The Diamond of the Air (Part 3), by Herman Bernard. The 7-Tube Pressley Super-Heterodyne (Part 1), by Thomas W. Benson. An Easy D Coil, by Jack Norwood.
April 25—A 3-Tube, 2-Control DX Reflex, by Brewster Lee. Trouble Shooting Article on Diamond of the Air, by Herman Bernard. Wiring the Pressley Set (Part 2), by Thomas W. Benson.
May 2—The Twinplex, by J. E. Anderson.
May 9—A Set to Cut Static, by Feodor Rofpatkin. Toroid Circuit with Resistance AF, by E. J. Sidney. A Push-Pull AF Amplifier, by Lt. Peter V. O'Rourke.
May 16—A 3-Tube Reflexed Neutrodyne, by Percy Warren. The Baby Portable, by Herbert E. Hayden. One Tube More for Quality, by Brewster Lee.
May 23—Powerful 3-Tube Reflex Receiver, by H. E. Wright. The 2-Control Diamond (Part 1), by Herman Bernard.
May 30—Wiring the 2-Control Diamond (Part 2), by Herman Bernard. 1-Control Neutrodyne, by Sidney E. Finkelstein. Making Your Set Tune the Entire Wavelength Band, by J. E. Anderson.
June 6—The Smokestack Portable, by Neal Fitzalan. A and B Battery Eliminators, Using DC (Part 1), by P. E. Edelman. A Wavemeter, by Lewis Winner.
June 13—Simple Short-Wave Circuits, by Herbert E. Hayden. A Simple Push-Pull Rheostat, by A. C. G. Force. A and B Battery Eliminators, Using AC (Part 2), by P. E. Edelman. A Portable Super-Heterodyne, by Wainwright Astor.

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Why Some Tubes Look Silvery

the vacuum by vaporizing metallic magnesium within the bulb. This is equivalent to boiling the metal and allowing it to condense on the walls of the bulb. It had long been known that magnesium would unite with the oxygen and nitrogen of the air. This magnesium, which is called a "getter," cleans up the gases. The metallic magnesium which has condensed on the walls of the tube gives a shiny, mirror-like surface. Yet in the short time necessary for the magnesium to reach the walls of the bulb the metal has combined chemically with and removed the gases, giving a high vacuum.

Most of you are using batteries of various kinds as A, B or C batteries. Have you realized that in each battery a chemical reaction is running, furnishing electrical power for tubes, loud speaker or phones? Batteries are, in general, of two kinds: primary and storage batteries. In the primary battery, such as the dry cell, certain chemicals are consumed during the life of the battery. The battery consists essentially of a zinc cylinder, a solution of ammonium chloride and a carbon rod. The carbon rod is surrounded by a layer of material called a depolarizer. When not in use, the chemical reaction goes on very slowly. But as soon as current is drawn from the cell, the zinc dissolves in the ammonium chloride solution. As the materials become used up, the battery becomes weak and soon holes appear in the zinc. As the zinc chloride which oozes out is corrosive (it is often used as a flux for ordinary soldering) an old battery should not be allowed to stand on the furniture or rugs. The B battery and A battery are essentially the same, except for size, number of cells and current available.

Action of Storage Cell

In the storage cell, electrical energy put into the battery during the charge causes a certain chemical reaction to take place. In the lead battery, sulphuric acid is set free during the charge and the acid being heavier than water, the density of the solution increases. By using a hydrometer, the progress of the reaction is observed until the reaction is completed. The battery is then said to be charged. It is now capable of giving out electrical energy at the expense of its stored-up chemical energy. But, while a discharged dry cell is thrown away, the storage battery may be charged again and again.

Let us emphasize the importance, in the development of these ideas, of the co-operation between chemist, physicist, electrical engineer and radio engineer. To the chemist must go the credit for the discovery and preparation of elements and compounds. It is he who supplies the materials, such as tungsten, thorium, molybdenum, magnesium and many others. The physicist and physical chemist have been mainly responsible for the discovery of properties of substances which have been utilized by the electrical engineer in investigational work and in the design and production of electrical machinery. The radio engineer has been able to avail himself of all the data of the others and to add development work of his own.

(Broadcast through WGY, Schenectady, N. Y.)

O'Rourke's 4-Tube DX Set and 2-Tube Reflex Lauded

(*Continued from page 21*)

cheapest and most educating set I have ever known. My dial readings follow very close to those of my home-made Neutrodyne, and by using the same curve I was able to set it direct to any station within 950 miles' radius. I can get the local on a loud speaker, using 45 to 60 volts on the plate. I made the following changes: Leaving the grid condenser as in the diagram, but placing the grid leak between grid and +A battery. If a variable grid leak is not handy, use a 4-megohm leak. Condenser C_2 I placed between ground and +A, using a .00025 mfd. condenser. The set is very selective; in fact, a vernier on the 23-plate condenser could be used to advantage. I used both the cylindrical and basket-weave coil with equal results, but found the space allotted too small. A 7x9" panel will give more room.

Altogether, I use the set for experimental purposes and find it the best ever.

AUG. LARSEN.

20 Bloomfield Pl., Rochester, N. Y.

* * *

TONE QUALITY DELIGHTS "4-TUBE DX" BUILDER

RESULTS EDITOR:

I HAVE built the 4-tube 3-control DX set by Capt. Peter V. O'Rourke (March 21) and it is one of the best sets for tone I ever heard. I used basket-weave coils and No. 22 DCC wire, Bremer-Tully variable condensers and Jefferson transformers. The tubes used were of the 1999 type with 45 volts on the detector and 90 volts on the amplifiers.

RICHARD GAGE.

Hallstead, Pa., R. D. 2.

* * *

TWO-TUBE BLUEBIRD REFLEX LAUDED BY "MR. AND MRS."

RESULTS EDITOR:

WE have a Bluebird Reflex (by Capt. Peter V. O'Rourke, Feb. 7 issue), and it is a real selective set, working the speaker fine.

We heard the last Metropolitan concert for this season over KDKA. We get numerous stations on earphones. It reflexes perfectly. It is all Mr. Bernard claims for it.

The Bluebird for happiness.

MR. & MRS. FRANK GOSSITT,

R 4, Independence, Mo.

* * *

THREE-TUBE NEUTRODYNE SURPRISES SET-BUILDER

RESULTS EDITOR:

I HAVE built the 3-tube reflexed Neutrodyne outlined by Percy Warren (May 16) and must say it is more than I expected of a 3-tube set. I followed out instructions to the letter. It tunes sharply and it has brought in stations from 273 meters up to 546 meters very clearly on talker. Sixteen and one-half volts seems to be all it wants on detector, but I use 90 on amplifier. I use Karas Harmonik transformers and Rathbun condensers. I have built numerous sets from RADIO WORLD hookups.

W. G. KAHLER.

Box 3, Route 15, Mt. Healthy, O.

* * *

POWERFUL REFLEX WINS EIGHT-YEAR MAN

RESULTS EDITOR:

AS I have been playing with receiving sets for 8 years, I must drop you a line in recognition of the good work that you have been doing. I get RADIO WORLD from my druggist and sure enjoy it. I try out almost every diagram that you print. For a 3-tube outfit that will give you what most 5 and 6-tube outfits do, I give thanks to H. E. Wright for his Powerful 3-Tube Reflex (May 23). I have 20 turns on L1 with a tap at the 14th turn, with 55 turns on my secondary coils (17-plate condensers).

I live 9 miles from WWJ and WCX—L1 20 turns for WCX, L1 14 turns for WWJ. With L1 20 turns, I have received WEAF, WGY, WGN, KDKA, WEAR, WLW, WOC, WOS, KSD, WRED, WWI, and many more, all on the speaker.

Now I am going to build the Diamond of the Air. It will be done in a day or two, with all low-loss parts. I am going to compare the results of the 4-tube outfits and let you know which one I like best.

HARRY G. HEYART.

15 Josephine St. E, Ecoire, Mich.

* * *

"WINNER A WINNER," FAN'S SERIOUS PRAISE

RESULTS EDITOR:

I READ all the articles in RADIO WORLD and I think J. E. Anderson is worthy of the praise he got; but I want to commend Lewis Winner's articles on Efficiency in Radio (May 23 and 30). There are few writers on this new science who can frame their thoughts so one can really organize their knowledge. Winner's meth-

RESULTS

HOW have you fared with circuits built according to specifications published in RADIO WORLD? *What do you think of the work of the respective contributors? Write to Results Editor,* RADIO WORLD, 1493 *Broadway, New York City.*

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Described by Herman Bernard in the April 4, 11 and 18 issues, with trouble-shooting in the April 25 issue. That is the 3-control set.

The Diamond as a 2-control set, using a double-condenser, was described in the May 23 and 30 issues. If you are going to build the 2-control set, be sure to get the four other numbers also, for full information.

Either set works fine on loop or outdoor aerial.

Get your full measure of enjoyment from radio reception by building this set. Just the thing for fine summer reception.

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3-Circuit Tuner You Log Is Best, Says a DX Fan

od of imparting his ideas is new and a winner. Let's have more of Lewis Winner.

FRANK E. WHIPPLE,
Attorney-at-Law.
311 Majestic Bldg., Detroit, Mich.

* * *

TUNER YOU CAN LOG HIS IDEA OF THE BEST

RESULTS EDITOR:

THIS is to let you know what results I have had with the Three Circuit Tuner That You Can Log (by Herman Bernard, Nov. 8 issue).

While the circuit is old, I believe that it is the best of the regenerative class. The set was built from the diagram in RADIO WORLD, with the exception that self-supporting basket weave coils were used.

The following stations were brought in on the speaker: KDKA, KFKX, KFNF, KYW, KFMX, WCAE, WCBD, WSMB, WCCO, WCEE, WCX, WDAF, WBZ, WEBH, WEAO, WEBW, WFAA, WGN, WGR, WGY, WHA, WHAD, WHAS, WHO, WJJD, WLS, WLW, WMAQ, WOAW, WOC, WOO, WOS, WQJ, WREO, WSAI, WSB, WTAM, WTAS, WWJ, CNRO, CNRT, WMAK, WEAF, KSD, WBCN, WOAN, KFIZ, WKAR, KOA, WBAV, WKRC, WHAZ, WSUI, KFUO, WOAI.

FRED M. BULLOCK.
Evansville, Wis.

* * *

"SIN AND SHAME" EXPOSED IN A FEW FRANK WORDS

RESULTS EDITOR:

I WISH to tell you in a few frank words that it is a sin and a shame to the radio public that such a magazine as RADIO WORLD is allowed to be published, as the hookups in your magazine are absolutely no good.

I recently completed my second trial of using the reflex circuit by Feodor Rofpatkin, published in the Feb. 21 issue of your magazine. The best that I can do with the set after many trials, changing the different parts of the hookup as you suggest on this circuit, is to get a very faint sound on distant music and not much better on the local stuff. The variable condenser on the plate tuning coil is absolutely useless in the set. I have tried different crystals, tested all condensers and other parts for defects in them. The set is wired absolutely according to your drawings, as I have had this set checked and tried by several men well versed in radio, and it is no better than a crystal set. Your hookups are just as much a fake as the mustach on the inventor's picture.

E. S. HANCOCK.
1161 S. High St., Columbus, O.

P. S.—You may publish this letter in your magazine.

* * *

"REFLEX FOR THE NOVICE" GIVES EXCELLENT RESULTS

RESULTS EDITOR:

I CONSTRUCTED Feodor Rofpatkin's 1-Tube Reflex for the Novice, Feb. 21 issue, and have had excellent results with it.

EMIR A. GAW.
5720 Keith Ave., Oakland, Cal.

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A SIMPLE 1-TUBE DX SET FOR THE NOVICE, by Percy Warren. Send 15c for May 23 issue, RADIO WORLD.

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

THE BLUEBIRD REFLEX 2-tube earphone marvel by Capt. Peter V. O'Rourke. Send 15c for February 7 issue. RADIO WORLD, 1493 Broadway, New York City.

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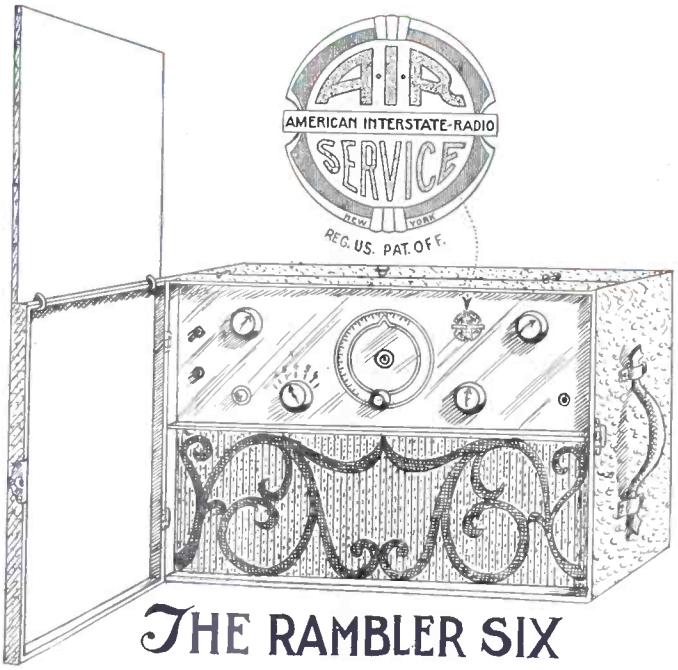

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