CAPT. HALL ASCRIBES DX RECORDS TO ANTENNA

RADIO WORLD

REG. U.S. PAT. OFF.

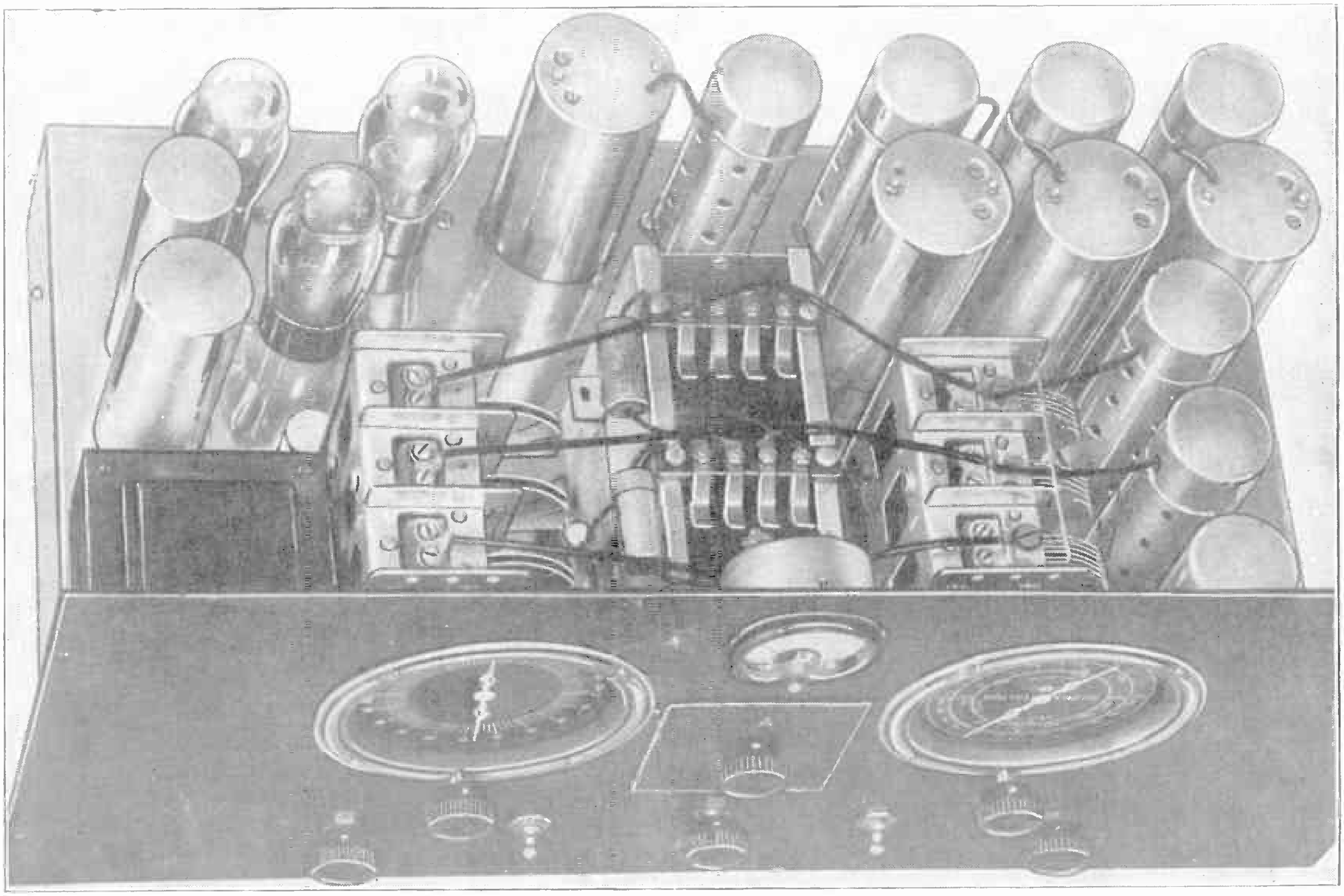
The First National Radio Weekly

660th Consecutive Issue—Thirteenth Year

SHORT-WAVE STATIONS BY COUNTRIES

NOV. 17 1934 15¢ Per Copy

SEPARATE BANDSPREAD DIAL



This All-Wave Receiver Has Drawer-Type Plug-in Coils and Separate Bandspread Condenser and Dial. See Pages 12 and 13.

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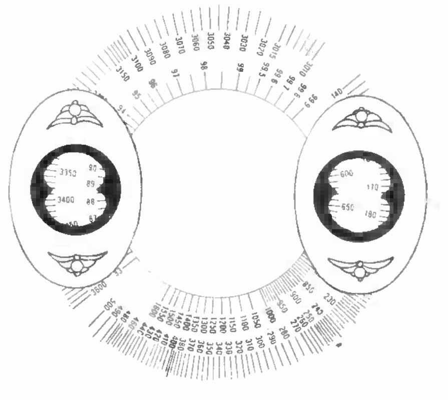
PARTS FOR ALL-WAVE SIGNAL GENERATOR

PARTS for a practically self-aligning all-wave signal generator are now made available for the first time. This instrument is of the "universal" type, and works on a.c., d.c. or batteries, 90-120 volts. It provides modulation on both a-c and d-c uses. On d.c. the modulation is totally removable and also adjustable. On a.c. the modulation is irremovable and not adjustable. The direct-reading frequencies covered, all on fundamentals, are: 83 to 99.9 kc.; 140 to 500 kc.; 540 to 1,600 kc; 1,400 to 5,000 kc; 5,400 to 16,000 kc.

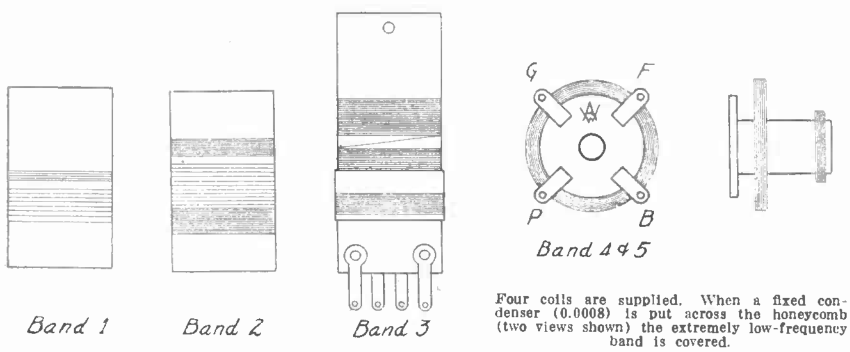
The Foundation Unit for the all-wave Signal Generator, Model 333-AB, enables one to construct this high-class instrument, as it includes the vital and exclusive parts. The remaining parts are obtainable almost any place, or many experimenters will have these about the shop. The generator uses three tubes: a 34 r-f oscillator, a 30 amplifier, and a neon modulator.



The accuracy on the broadcast band is 1 per cent., on the 1,400 to 5,000 kc band 0.5 per cent.; in general averages 1 per cent.

The essential kit of parts for building this generator consists of:

- Precision frequency-calibrated etched metal dial (non-warping).
- Two escutcheons
- Special tuning condenser.
- Three front-panel plates.
- Five-position, three-deck switch.
- Four coils.
- One 800 mmfd. fixed condenser.
- One special neon lamp (modulator)
- One diagram, instructions.
- One knob.
- Three bar handles.



Four coils are supplied. When a fixed condenser (0.0008) is put across the honeycomb (two views shown) the extremely low-frequency band is covered.

INSTEAD of having to consult charts, that strain the eyes and do not permit as high accuracy as a precision frequency-calibrated dial, all you do is turn the switch to the proper numerical position and read the frequency, (5), directly for 83 to 99.9 kc and 3,600 to 3,010 meters; (4), directly for 140 to 500 kc; (3), directly for 540 to 1,600 kc; (2), multiplying 140 to 500 reading by 10 for the 1,400 to 5,000 kc band; (1), multiplying 540 to 1,600 reading by 10 for the 5,400 to 16,000 kc. band.

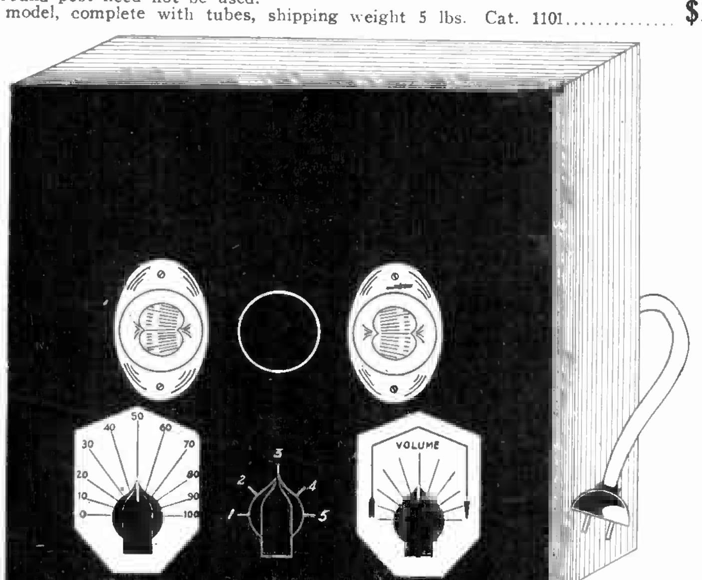
Besides, the generator is frequency-stabilized, to better than one part in 10,000; does not act as a reducer of the sensitivity of the set with which it is worked; is not detuned no matter what it is coupled to; and delivers a husky output, due to the amplifier stage.

Foundation Unit for the all-wave switch-type 333-AB Signal Generator. Cat. 1100, shipping weight, 2 lbs. **$7.50**

WIRED, ADJUSTED, TESTED MODEL

The precision-built model, ready for operation, complete with three tubes, wired, adjusted and tested by experts, may be obtained by those who do not desire to build the generator themselves. The built-up model is in a crinkle-finish metal shield cabinet, and has output and ground posts at rear. Ground post need not be used.

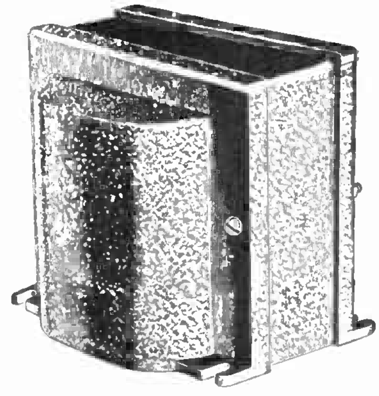
Wired model, complete with tubes, shipping weight 5 lbs. Cat. 1101.......... **$21.95**



Direct Radio Co., 145 West 45th St., N. Y. City

GIFTS FOR YOU

Heavy-Duty Power Transformer

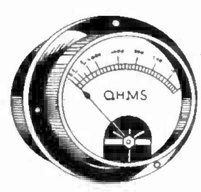


WHY overwork a power transformer, run it hot, get poor results? Here is a power transformer that can be used for any set up to 18 tubes, and with good enough regulation even for Class B. It takes care of 2.5-volt tubes (up to fourteen of them), also one or two 2.5 volt output tubes, whether 2A5s, 47's, 2A3's, etc., and a 5-volt rectifier. Besides, it has a 25-volt winding at 0.6 ampere, so that if you want a second rectifier in a set you may introduce the a-c line voltage to a 25Z5 and take care of the heater from the 25-volt winding. Or, if you want to use four 6.3-volt tubes in series, from this 25-volt feed, you may do so, or even another four such tubes in series, connected in parallel with the other four. There is no other transformer on the market that affords this great versatility.

Primary = 115 volts, 60 cycles.
Secondary X = 14 amps at 2.5 volts, center-tapped.
Secondary Y = 6 amps at 2.5 volts, center-tapped.
Secondary HV = 200 ma at 400-0-400 v. a.c.
Secondary Z = 0.6 amp., 25 volts.

Lug terminals are at bottom. Connection code furnished with each transformer. Shipping weight 13 lbs. Sent express collect on receipt of $7.00 for 60 weeks subscription for RADIO WORLD (60 issues, one each week). Order P-1012. Remit with order and ask for P-1012.

Wide Range of Meters

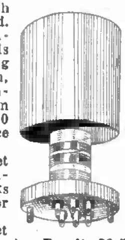


Any one of these d-c meters free with a $1.50 subscription (13 issues, one each week).

- P-1020—0-6 v.
- P-1021—0-50 v.
- P-1022—6 v. charge tester
- P-1023—0-10 amp.
- P-1024—0-25 ma
- P-1025—0-50 ma
- P-1026—0-100 ma
- P-1027—0-300 ma
- P-1028—0-400 ma
- P-1029—0-3-0 v.

If there is any particular meter you desire, and it is not listed, write in for a subscription proposition. In fact, if there is anything in radio that you want as a premium, we will be glad to make you an offer. Write to Premium Editor, Radio World, 145 West 45th Street, New York, N. Y.

Precision Tuning Coils



These coils may be used with condensers of from 0.00035 mfd. maximum to 0.0004 mfd. maximum. The inductances of coils are maintained equal by winding them to an identical axial length, spacing the end turns to accomplish this. The tuning is from 540 to 1,600 kc and from 1,620 to 4,800 kc. To utilize the police band, switching is necessary.

Three equal coils for t-r-f set (for use with three-gang condenser). Remit $2.00 for 16 weeks subscription (16 issues) and order P-1030 sent postpaid.

Four equal coils for t-r-f set (for use with four-gang condenser). Remit $2.50 for 20 weeks subscription and order P-1031 sent postpaid.

Two equal coils and one oscillator coil for superheterodyne at 175 kc i.f., (requires three-gang condenser). Remit $2.00 for 16 weeks subscription, order P-1032, and three coils will be sent postpaid.

Same as directly above, except for 465 kc i.f. Order P-1033.

Three equal coils and one oscillator coil for 465 kc. i.f. (for a four-gang condenser). Remit $2.50 for 20 weeks subscription and ask for P-1034. Four coils will be sent postpaid. For 175 kc order P-1034-175.

Three doubly-tuned i.f. coils, 465 kc. in aluminum shields. Remit $6.00 for one-year subscription (52 issues), and order P-1036 sent postpaid.

Same as directly above, only for 175 kc. Ask for P-1035.

Signal Generator Parts

Tuning condenser, two coils, two precision fixed condensers, frequency-calibrated disc dial, 3-pole, -four throw switch, knob, two escutcheons, for 83-100 kc, 140-500 kc, 540-1,600 kc, 1,620-4,800 kc, all on fundamentals. Wavelength calibration also is in scale for the low frequency band. These parts comprise the foundation unit for the 333-A Signal Generator. Diagram included in offer. Remit $12 for two-year subscription (104 issues) and ask for P-1037 sent postpaid.

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THIRTEENTH YEAR

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Capt. Hall Discusses Antennas

Noted DX-er Says Records He Establishes Depend Mostly on the Aerial

By Herman Bernard

CAPT. HORACE L. HALL, famous DX-er, attributes his remarkable results mostly to the use of the right aerial. He has been studying aerials for several years and has conducted hundreds of tests. Even to-day, at his home in New York City, which is a rendezvous for DX hunters, he is ripping down and putting up aerials. In fact, he always has at least a half dozen to select from for any use, and they are all allocated to specific uses.

Capt. Hall got his title as a seafaring man, in charge of a ship for the United States Government. He was given practically free reign, and aboard ship, when radio was in its infancy, he started his experiments with aerials. He used to receive instructions by radio to pick up cargoes in various ports. Also he depended on the radio for weather reports.

The Indian Ocean Experiment

"There was a time when we were in the Indian Ocean," he said, "and the ship was steering a course toward the source of the weather reports, a land transmitter. The signals were coming in fine. I went off that course at an angle of about 45 degrees and the signals were tuned out. That was the time that I got initiated. Aerials have been my hobby ever since.

"I have tried all kinds of aerials, including a very large cage antenna, doublets, transmission lines, horizontal L's and the like, and I am frank to say that an antenna of my own design is the one that works best. It is to that I owe the fact that I tune in so many DX stations on short waves, including even transmitters of slight power in remote places, and also receive foreign stations on standard broadcast frequencies. For instance, once I tuned in a station of 300 watts that couldn't be received any too well only a score of miles from the transmitter. And yet my own location was New York City and the transmitter was in Java.

How Come the Chuckle?

"To cite another example, although without giving the name of the large chain. There was to be a rebroadcast on a chain in this country of a special event being transmitted by short wave. The chain had to call off the rebroadcast because receiving conditions were 'unfavorable,' and yet I was bringing in that short-wave station clearly. In fact, I called up the chain headquarters on the telephone and let the chief engineer of one of the large companies listen to the program. He had to admit it was clear reception.

"'Are you really bringing in the station at your home?' this engineer asked. 'I don't hear any motor noises and I know there are plenty of cars operating on York Avenue.'

"'Yes, right in my home,' I said. 'You don't hear the cars because I enjoy noiseless reception, due to my own antenna.'"

The Captain imagined he heard a chuckle, but he could not reconcile a chuckle with the fact that the engineer actually had listened to clear reception of a station that the chain's best short-wave receiver could not bring in without a lot of noise.

Capt. Hall Discusses Engineers

As a matter of fact, the Captain hasn't a very high opinion of the practical use of the engineer in solving a knotty radio problem. He believes that the service men and experimenters know more about radio than the "paper-and-pencil experts," as he calls the engineers.

Once he attended a meeting and some one said that the best radio men were the service men, and that they knew more about radio than the radio engineers.

"That's just what I believe," said the Captain. "I know that there are many problems in radio, but the theorist gets stumped, while the practical man applies his knowledge to the solution of the problem and gets somewhere. If the engineer is both practical and theoretical he is such a rarity I'd like to meet him."

Antennas are things the engineers don't know any too much about, the Captain believes, for he has not yet met anyone who has a better antenna than himself. An effort was made to pry from him the details of the antenna, but he was reluctant to discuss them, even to the point of refusal. He was very polite about it, nevertheless the facts were not forthcoming.

Pretty Much Standard

"It isn't anything astonishing in the way of novelty, in fact it is pretty much an antenna of standard type, with just a little something added to it to improve the results," he said.

The interviewer gained the impression that it was a horizontal L antenna, and that particularly the direction, and the point from which the leadin was taken, were features considered important, although in truth the Captain did not specifically say so. His beautiful wife was sitting close by, taking it all in, but neither by word, glance or gesture did she, either betray the slightest information about the mysterious and reliable antenna that is so close to the Captain's heart.

After the conversation had turned to other radio topics, it came back to the antenna problem, and perhaps it was then that the Captain made some disclosures that may be taken as strongly indicative.

"The direction in which the antenna points is of paramount importance," said the Captain, from the depths of his knowledge of antennas. "I am talking about receiving antennas. I admit I know nothing about transmitting antennas, and since they are tuned to a particular frequency usually, the problem is different.

Sakhalin and Siberia

"I was up against a very tough problem once, that of tuning in a station in Siberia, and later on one in Sakhalin, and as they are very nearly on the same line I had some difficulty, until I strung up two antennas.

"I went up to the roof with my glass (magnetic compass) and, knowing exactly the bearings of the two stations, I pointed one antenna to the Sakhalin station and another to the Siberian station, and then when I went below I was able to switch from one antenna to the other, and get first one desired station and then the other, though the antenna directions were only a few degrees apart. The antennas were pointed so that if a shot were fired, and could carry exactly to the direction and distance, it would have landed right in the intended town. That is how close I point the antenna when it is necessary to do so.

Key to DX

"In general, when I want stations from the West I use the antenna directed to-

(*Continued on next page*)

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(*Continued from preceding page*)

ward the West, and when I want them from the East I use the antenna directed toward the East. And moreover, as I get voluminous correspondence from achievers of DX, I can assure you that all successful DX-ers pay particular attention to the antenna, and there is no unusual DX without unusual antenna precautions."

It might be said that the Captain is not sold on the doublet antenna. He says that the pickup is not very large, for receiving purposes, though emphasizing that for transmission a doublet might be quite the thing, but he doesn't know. That there is some advantage in regard to killing off pickup of noise by use of a shielded or neutralized transmission line he is willing to agree, but especially as he states that one of the big problems is to get away from noise.

"You know, engineers have fallen down on the job of eliminating noise from receivers," he mused. "All the radio engineers have been dead since 1930. More and more sets are being brought out, one noisier than the other. What one enjoys is reception without noise, and it can be accomplished. Why, I get quiet reception where most others fail.

When No Medal Is Deserved

"In fact, if there is any considerable noise I do not count hearing the station as reception at all. The program must come in quietly, clearly, noiselessly, before I will tell any one that I got that station. Tuning in noise is no deed worthy of a medal."

The interviewer said he had an invention of his own, a noise eliminator, as he called it, and that it would greatly reduce the noise, although also reduce the input. It was explained as a device that did introduce such reductions, but that the ratio of the signal to the noise, the important consideration, was increased materially. One of these devices was promised to the Captain, with the intimated proviso that the Captain would reveal his secret about the antenna that gives such fine results. Without committing himself, for the Captain is very conservative, he expressed eagerness to try out this device.

"I've got a National SW-5 of the 1930 design, and it picks up practically all stations more clearly than any other set I ever had," said the Captain. "I even tried a later model of similar manufacture that did not quite come up to that one, and I attribute the difference to the fact that there is a drum dial on the one I use, and the tuning condensers are far apart, while in the subsequent model the tuning condensers were a double gang, sections close together. However, I am no great radio technician," he added quickly, "and so leave the problem in other hands."

He said he would give $100 to any one who would bring in a set that would outperform the SW-5 of which he is so fond. His requirements are that the set bring in the stations as clearly and consistently as that regenerative circuit does. He admitted that on some stations one of the late commercial model all-wave receivers did enable him to hear a few programs that did not come in quite so well on the SW-5, but that these few instances were exceptional, and that the comparison did not run in the same direction for the whole spectrum of tuning.

Sleeps While Others Work or Play

The Captain is a stocky and amiable man, who goes about his DX-hunting wearing white canvas trousers, a collar-attached shirt, with collar button unworried by cloth connection (that is, open-circuited), and in sleeveless comfort that his wife provides for his long hours of vigil.

The Captain reverses the usual procedure of life. When most of us are awake he is asleep. When most of us are asleep he is awake. The reason is the time difference between New York and those distant foreign points in which he is most interested. He stays up all night tuning in stations. One of his pet delights is to hold a station for hours, sometimes for all the consecutive hours it is on the air, provided he is interested in the program. He has music in his heart, and can appreciate the fine music sent out by numerous foreign stations. Sometimes he will tap his foot lightly in rhythmic cadence to the music, ever so lightly, mind you, for the hours are small, and other folk about are asleep.

However, there is often much ado about the Captain's quarters nevertheless, for, as stated, folk DX hunters have the happy habit of showing up. Some of them come from far places of the earth and have been in contact with him by mail and, as senders of programs that he picked up, by radio.

Coffee at 2 A. M.

At 2 a. m. coffee is served, also cigarettes, of both of which the Captain is fond. He smokes almost incessantly during his tuning-in.

"Some persons ask me how I manage to get along with hardly any sleep, when they read of the tuning I do from midnight to past normal breakfast time," said the Captain. "The fact is that I get more than eight hours sleep, only I don't sleep at night. At night I work, and my work is the greatest fun I have ever experienced."

Antenna Length Selection Governs the Effectiveness

There is an intimate relation between wavelength of a radio signal and the length of an antenna. For most efficient operation, the antenna's length should be definitely measured and built accordingly.

As explained in the article, page 5, the Marconi type antenna should be some multiple of a quarter wavelength long and the Hertz type should be some multiple of a half wavelength long.

Accordingly, determine the length of a Marconi type antenna to be operated on 7,000 kc=42.8 meters. As a full wavelength is 42.8 meters, a half wavelength would be 21.4 meters and a quarter wavelength would be 10.7 meters. Reduced to feet, it is found that a half wavelength at 7,000 kc would be 69½ feet and a quarter wavelength would be 34¾ feet.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, ***145 West 45th Street, New York, N. Y.***

John Stanley, 1803 19th St., N. W., Washington, D. C.
Jasper B. Watson, Box 174, Huntersville, N. C.
Edward K. Comstock, 26 Elliott St., Shelbyville, Ind.
A. E. Emery, C.P.R. Communications, Halifax, N. S., Canada.
L. V. Heck, 212 Fourth Street, Fort Wayne, Ind.
L. L. Sullivan, 17 Central Ave., Humboldt, Tennessee.
B. A. Snodgrass, R.F.D. 2, Box 39c, Charleston, W. Va.
George F. Seaman, 636 Monroe Place, West New York, N. J.
J. Smith, 15 Henry Street, Southampton, L. I.
G. M. Titcomb, 100 Main St., Fort Fairfield, Me.
Harold E. Taylor, Supervisor of Transmission, 1365 Cass Ave., Detroit, Mich.
Lewis Vihos, 39½ Commercial St., Glace Bay, N. S., Canada.
Ernest Wagner, 71 Van Riper Av., Clifton, N. J.
Lawrence Colmery, East Liberty, Ohio.
R. W. Engelage, Chamois, Mo.
Fred C. Hartman, Security Barber Shop, Capitol & Virginia Streets, Charleston, W. Va.
E. G. Hosli, 109 Jones St., San Francisco, Calif.
Fred Koehler, 1609 Dexter Av., Cincinnati, Ohio.
C. B. Kolker, 28 Bittuer St., Dayton, Ohio.
Paul Prem, 1065 Spring Garden Av., N. S., Pittsburgh, Pa.
Ed Richter, Jr., 94 W. Tenth St., Ashland, Ohio.

Remote Control of Toy Boats

It's great fun to have a toy boat that you can control from a distance. This can be done by radio. The operation is called remote control.

It is necessary to have a small transmitter. This sends out a radio wave. In the boat there must be a receiver. This, too, may be a small affair, consisting of even one or two tubes, and operated by small batteries.

The fewer the operations to be performed, the simpler the requirements. Suppose we confine ourselves to starting and stopping. We could have a one-tube transmitter, to send out the carrier frequency to which the boat receiver is tuned.

Then the small antenna on the boat receiver will pick up this wave, the receiver will amplify it, and enough voltage will be developed to actuate a relay. This relay will open and close a circuit. Closing the circuit will start the boat. Opening the circuit will stop the boat.

There are several ways of accomplishing the result. One simple way is to have the boat receiver tuned to pick up an unmodulated carrier. When the wave causes the voltage in the boat circuit to rise sufficiently to close a relay the boat starts, and when the transmission is stopped the boat stops. This method in effect uses the transmitter as an on-and-off switch.

So you could sit at a window by the side of a pond and start and stop the toy boat.

More Operations

Once you have mastered the method of starting and stopping of course you can proceed to more extensive operations. You can steer the boat by remote control, and even blow a whistle on the boat. In fact, it would be very easy, if you are sending a tone on the radio wave, to make this tone weakly audible from the boat when the boat is going, while there would be silence when the boat is not under way.

The steering operation requires more mechanical parts, including belts and pulleys. But the principle is the same. Once you can perform one operation by remote control of toy boats you can perform an unlimited number of operations. It depends largely on the size of the boat, or the room on the boat for the extra apparatus.

License Question

To send out the radio wave it is necessary to have a license. This license is issued to amateurs by the United States Government. However, it is lawful for a licensed operator to permit some one else to run the transmitter in his presence. Therefore some amateurs in your neighborhood might be willing to assist you in accomplishing the remote control of toy boats.

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The Trend in Antennas

Hams Drop Marconi Type, Use Doublets for Sending, While Fans Now Use Them for Receiving

By Howard Lee Fraser

IN 1887 Hertz demonstrated to a disinterested world that electromagnetic waves could be radiated through space by means of the electric discharge of a condenser across two metallic plates. He thus laid the foundations for a phase of radio practice as followed today. His classic metallic plates constitute the ancestry of the various kinds of antennas classified today as Hertz types and which utilized two separate conductors to radiate an electromagnetic wave.

About ten years later Marconi elaborated on Hertz's experiments to cover much greater distances, using an antenna of only one wire and with the earth substituted for the other. This was an application of the discovery by Trowbridge in 1880 that electric signals would be conducted through the earth without any metallic conductor connection. This was the start of a host of aerials known as Marconi types. Thus we see that antennas may be either of the Hertz or Marconi type —dependent upon whether the earth is or is not substituted for one of the wires.

The Mushroom Growth

From the days of Marconi's early experiments until several years ago, when short waves became more prominent, the Marconi type of antenna was widely, if not universally, used. This was so since the longer waves required longer antennas and the Marconi type gave adequate results with only one wire compared with the two necessary for the Hertz.

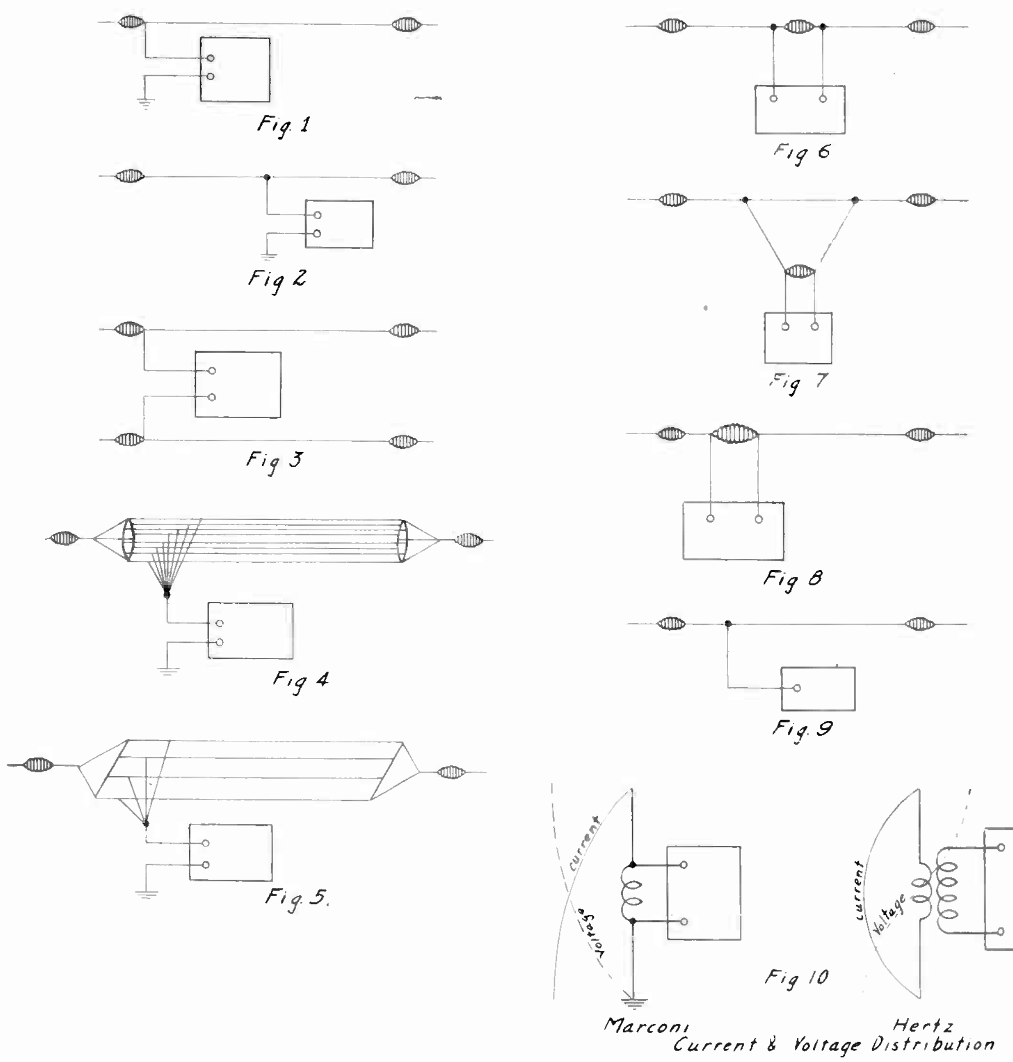
Accordingly, a great variety of Marconi aerials came into fashion which were classified as either of the "inverted L" or "T" types, shown in Figs. 1 and 2. As will be seen, the inverted L is tapped at one end for the lead-in wire to the radio apparatus. In this aerial it is best to tap the higher end. The T type is tapped at the center for the lead-in wire and has an effective length of one-half that of the inverted L when both are of the same total length. It might be used instead of the inverted L because of physical limitations.

During the earlier days of radio it was believed that an antenna should have a high capacity to ground. Accordingly, the inverted L and T types were usually composed of many wires, either as a cage aerial (see Fig. 4) or in a flat-top arrangement (see Fig. 5). It was eventually found that for amateur purposes, single wires were sufficient and the inverted L and T aerial performed with a single wire as well as or better than the numerous wires in cages or flat tops.

Hams Avoid Marconi Type

About this time, a counterpoise arrangement (Fig. 3) also gained a following and was one of the first Hertz types to be reborn. It usually involved an inverted L type aerial wire with a network or single wire directly beneath the aerial and insulated from it and the ground. Its use was recommended when good grounds were not available. Because many locations did not provide good grounds, the counterpoise had many adherents.

Other antenna arrangements of lesser acceptance are the fan type, umbrella type, vertical type, etc. All of these systems worked with a ground and so belong to the Marconi category.



Figs. 1 to 9 indicate various of antennas while Fig. 10 concerns the distribution of current and voltage waves along the two general types of antennas.

Since the modern ham works mostly on short waves, the Marconi antenna seems to have been discarded for the Hertz antenna. The various forms of this antenna are shown in Figs. 6, 7, 8 and 9.

In Fig. 6 will be seen a version of Hertz antenna that modified the old counterpoise arrangement in so far as the wires are now in line rather than one below the other. This version is known as a current-fed Hertz, since the feeder wires are connected to that point in the antenna wire that has maximum current in it. The center of the antenna will offer such a point provided of course that the antenna is one-half wavelength long.

Doublet

Another form of current-fed Hertz is known as the doublet, shown in Fix 7. Here the feeders do not connect directly at the center as in Fig. 6 but at a certain distance from the center depending upon the feeder characteristics. The purpose of this special manner of connecting the feeders to the antenna is to make the impedence across the output of the feeder system match the impedence of the transmission line, thus a maximum power transfer is obtained simultaneously with elimination of radiation by the feeders.

Physical considerations sometimes determine that the current-fed Hertz is not suitable and it may be found that a voltage-fed Hertz fits the available space more readily. Such a system might be that shown in Fig. 8, where the feeders connect to the end of a half-wave Hertz antenna wire. In this case the feeder wires, so-called Zeppelin, are of equal length and while one connects to one end of the antenna proper, the other is dead ended at the insulator. This extra wire is for the purpose of minimizing feeder radiation.

Yet another voltage-fed arrangement is that shown in Fig. 9, where only one feeder

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(*Continued from preceding page*)
wire and one antenna wire are used. This arrangement is rather tricky in that the point where the feeder attaches to the antenna must be just right for best transfer of energy. It has been found that this point is located at a distance from the center equal to 14% of the total length of the antenna. It is apparent that this antenna uses a minimum of wire and thus is more economical.

Rules for Effective Radiation

Most effective radiation from any sort of antenna requires that its physical dimensions be correct so that voltage and current distribution on the wire is suitably disposed. Correctly-designed antennas with consequent correct voltage and current distribution for the Marconi and the Hertz type antennas are shown in Fig. 10. It will be noted that with the grounded (Marconi) type, there are a maximum of current and a minimum of voltage at the ground while current is minimum and voltage maximum at the antenna's highest point. The design requires a length of one-quarter wave. The Hertz type is apparently a half-wavelength long with current minima and voltage maxima at the ends, and a current maximum and a voltage minimum in the center. It has been the usual practice to use these dimensions for these antennas rather than multiples of them.

Important as the antenna is, the importance of the feeders should not be minimized. With poorly-designed feeders, a good antenna wire would be helpless for effectively radiating the signal from a transmitter. The most important aspect of this matter is feeder radiation. Since it is solely the antenna's role of radiating the signal, the feeders should be designed so that they do not radiate at all but only function as a means of transferring the transmitter energy to the antenna.

The Concentric Tubes Gaining

By having two feeder wires running parallel to each other, the field of one tends to neutralize that of the other, so that the net result is that the field around the transmission line is nil. This objective is accomplished in the types of transmission lines illustrated in Figs. 11 to 14. The transposed block arrangement (Fig. 11) reverses the position of the wires at regular intervals, while the rest of the wires are parallel. The purpose of this arrangement is to neutralize any external disturbances that may be induced into the feeders.

The Zepp feed of Fig 12 is merely two parallel wires of practical length. A new feeder arrangement that is slowly being adapted by broadcast stations and other stations where advanced practise is used is the concentric tube method shown in Fig. 13. This feeder has many advantages because of its construction, wherein one side of the line is a conducting pipe of a few inches in diameter while the other side of the line is centrally located within it and insulated from it.

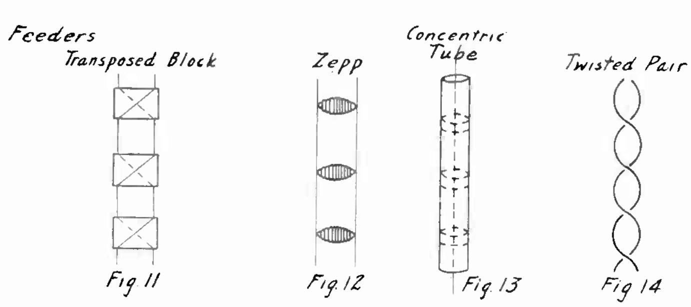
This arrangement is strong, weather-proof and efficient in its transference of energy. A disadvantage, however, is its greater cost.

Lamp Cord Tried

Recent investigations have shown that a very economical means of feeding an antenna can be obtained by means of ordinary twisted lamp cord. The loss in such a feeder may be minimized by specially designed coupling at the transmitter end.

It is apparent from the foregoing that despite the many advances made in the radio field, antennas still cling to the principles laid down by Hertz and Marconi. Of course, many refinements have been introduced and the performance improved, yet we still have to struggle with the problem of an antenna that will prevent static and other undesirable signals from affecting a radio signal. Will the future provide us with such an antenna?

Four types of transmission line feeders in common use at present for receiving and transmitting.



Amateur Dist

Sky Wave Penetration
Wave Quickly

By M. K.

W2

THE average amateur goes about constructing his station limited only by his pocketbook. Such items as coverage or the possible range of his signals are left for discovery after the station is on the air. As time goes by, his coverage becomes more and more a definite quantity through chance contacts with the stations that will hear him. In his indirect manner the coverage of an amateur station is casually discovered. Truly, this is a practical way of getting the answer to "What is my range?," but the why and how are always interesting.

Radio transmission phenomena occur because of the tendency of a wire carrying an electric current to create an electric and a magnetic field around it. With direct currents or low frequency alternating currents flowing, this field does not extend any appreciable distance from the wire. By increasing the frequency of this current, however, we obtain the phenomena of radiation whereby the field is evident over a greater distance.

Ground and Sky Waves

Increasing the frequencies to those encountered in radio results in radiation of signals (which really are a modulated field) in all directions for a great distance. Thus, it is seen that the distance of radiation is directly proportional to the frequency of the exciting voltage. It is for this reason that the ordinary 60-cycle power line does not radiate its energy in similar fashion to a radio antenna and it is also for this reason that the high frequencies in the radio spectrum are becoming more important daily. Incidentally, the usefulness of high frequencies for distance is qualified, since other effects occur which tend to curtail the advantages to be enjoyed. Some of these effects are static, more critical tuning, greater ground wave absorption, skip effects, etc.

Radio wave transmission occurs by propagation of waves of energy along the earth's surface, known as the "ground wave," and by waves of energy through the atmosphere, known as the "sky wave." These waves are subject to absorption in their respective media, the ground wave to a greater degree than the sky wave. It is for this reason that the sky wave will travel a greater distance.

Absorption of Sky Wave

Sky-wave absorption will vary with the degree of ionization of the atmosphere and so it is that greater attenuation of the sky wave occurs during the day than at night. In like fashion, the sky waves will be affected by weather conditions, solar phenomena, and other cosmological occurrences. Thus, changes occur during the day from hour to hour through wide ranges of variation in ionization. It should be evident that the ground wave spends itself quickly and cannot furnish the signal with a distance record. It is the sky wave that carries signals for great distances and so it merits our consideration of the distance ranges of amateur radio waves.

Fig. 1 indicates the manner in which radio propagation occurs. Though the diagram shows only one side of the antenna, it should be understood that signals emanate in all directions from the antenna, similar to the radiation of light from a hemisphere of the sun's surface. The quick dissipation of the ground wave is evident. Were it not for a provident Nature, radio communication would be limited to this range, since all other waves would continue outward into space away from the earth, never to return.

The Ionosphere

However, due to the presence in the earth's ether of layers of ionized gas—known as the Kennelly-Heaviside layers and as the ionosphere—the sky waves are reflected back to earth to furnish man with useful signals and an enhancement of his radio efforts. Yet, this blessing is not completely perfect, since the Kennelly-Heaviside layers are in a continual state of change. These changes occur with wide variations from hour to hour due to solar influences.

The sun's radiation will change as it affects the earth and its atmosphere due to the changes in the earth's position with respect to the sun, resulting in the seasons and day and night. Thus, we might justly expect that radio signals will be affected from hour to hour and so we find that experiments verify this theory.

Experiments also lead to the belief that, considering two layers, the lower layer starts at about 50 miles above the earth's surface while the second layer starts at about 150 miles. Evidence seems to suggest further that the lower layer is ionized by some corpuscular bombardment of solar origin while the second layer is ionized by ultra-violet radiation from the sun. From the radio viewpoint, however, it suffices to picture the upper atmosphere as two ceilings concentric with the earth,

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ance Ranges

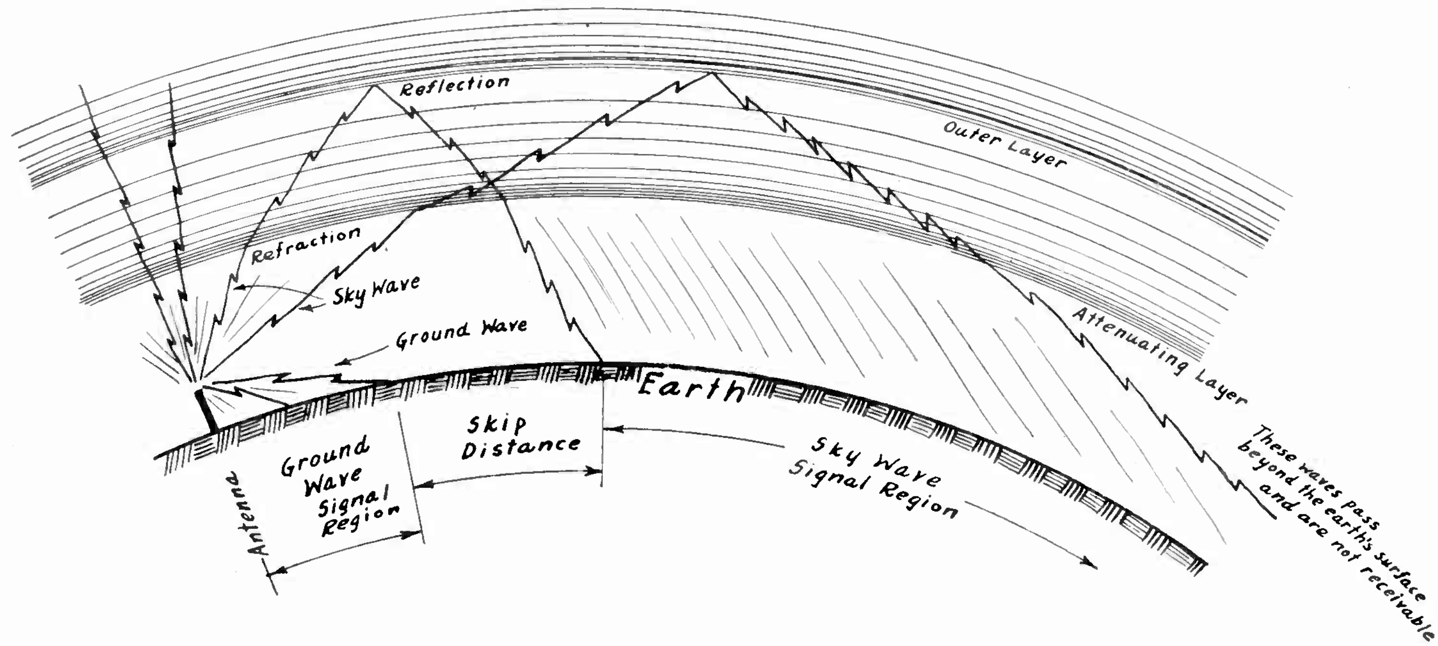
Tabulated—Ground Dissipated

Kunins

DPS

stood that skip effect is not as noticeable on the lower frequencies, due to the stronger ground wave and the weaker sky wave associated with these frequencies. This quiet region, the "skip distance," may be several hundred miles wide and will vary continually due to the unceasing changes occurring in the Kennelly-Heaviside layers. Beyond the skip distance, sky-wave radiation is received with useful intensity.

With our present knowledge of propagation conditions, it is not readily possible to postulate any formulae or make any tables or charts that could be used to determine distance ranges over any path



Radio signals are radiated from an antenna along the ground and through the atmosphere. The waves along the ground do not get very far whereas those that travel through the air traverse great distances.

whose reflecting and refracting powers vary with the sun's position relative to the earth.

High-Angle Radiation

Sky-wave radiation, occurring at all angles to the earth's surface, emanates from an antenna system. When the angle is ninety degrees to the earth, the wave will shoot up vertically into space and continue outward without reflection. It will penetrate the Kennelly-Heaviside layers and be lost from the earth. All the waves that shoot off the antenna between this 90-degree angle and what is known as the critical angle will be lost to us in this manner. Incidentally, the waves in this region are commonly known by the term "high-angle radiation." This sort of radiation, perhaps, may be of some use in signalling to other planets but at present its value is nil. Accordingly, the tendency in modern design of short-wave antennas is to avoid those types that give high-angle radiation and to provide systems which propagate energy at low angles. At the ultra high frequencies, radiated waves will not be reflected from the K-H layer at all at any useful angle but will continue out into space beyond the layer, or pass tangentially beyond the earth. That portion of the sky wave radiation which occurs below the critical angle will be reflected by the Kennelly-Heaviside layers in varying angles according to the radiation angle, the surface angle of the layers at the point of reflection, and the refraction within the layers. These reflections will then spatter the earth with readily audible signals, shown in Fig. 1. The K-H layer is not a plane surface but rather consists of many curved surfaces, perhaps not unlike a beaded surface. Accordingly, radiation reflections will occur at various angles due to the variety of angles in the layer surface.

Skip Distance

Between the region where the sky wave becomes audible and the weakest ground wave exists is a space where no signals can be heard from the antenna under consideration. It is thus that the phenomenon known as "skip effect" manifests a dead space, devoid of signals, around a high-frequency transmitter, even though signals are audible thousands of miles away. This strange fact is illustrated in Fig. 1. Incidentally, it should be under-

approximate quantitative picture may with any close accuracy. However, an have some advantages over one purely qualitative. Accordingly, a correlation of experiments on this subject is here in tabulated. The values indicated are based on graphs prepared by the National Bureau of Standards and are very approximate, since they represent much interpolation upo nthe work of a number of independent experimenters and as such show rough average values. These data have been evolved on the basis that the radiatd power is 5 kilowatts and that a non-directional antenna is used.

Conformity to Given Cases

Of course, there are no amateur stations licensed for 5 kilowatts and so this table

(*Continued on page* 9.)

		Summer		*Winter*	
Frequency		*Day* [*Miles*]	*Night*	*Day* [*Miles*]	*Night*
1750 kc.		150	800	150	800
3500 kc.		75	1125	75	1125
7000 kc.	GW	0-30	0-40	0-30	0-40
	SW	750-270	500-5600	250-1100	1250-12500
14000 kc.	GW	*	*	*	*
	SW	450-1500	2500-12500	1000-3750	**
28000 kc.		*	*	*	*
56000 kc.		*	*	*	*
400000 kc.		*	*	*	*

GW = Ground wave. SW = Sky wave. *No data available. **Signals are reflected from the K-H layer at such an angle that they do not strike the earth again. In other words, the sky wave is not reflected back to earth, and communication is possible only with the ground wave causing what is known as the quasi-optical effect.

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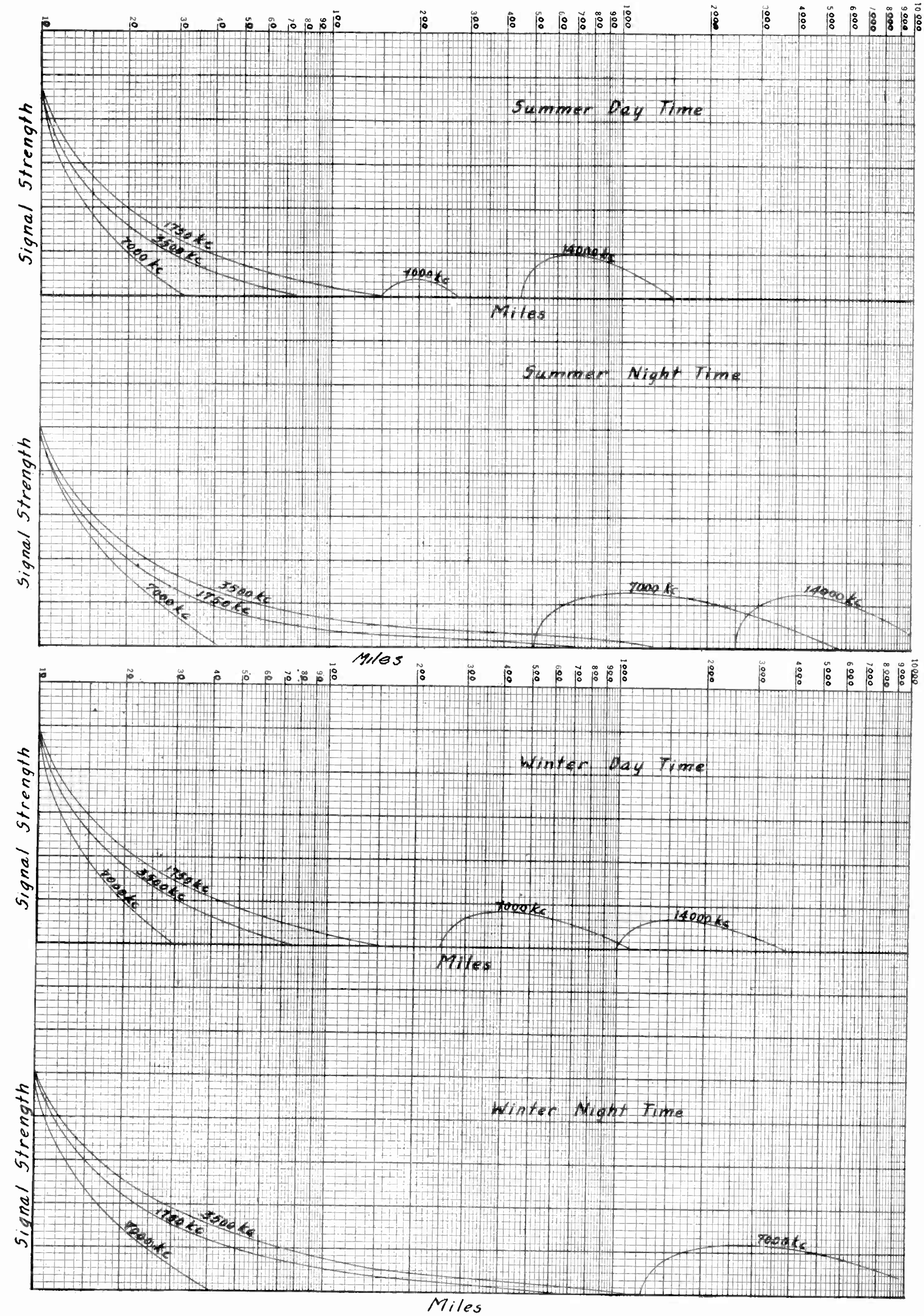

Variation of signal strength with distance is shown for the most popular ham bands. These data represent rough averages but, nevertheless, serve to show graphically the effect of skip distance. The effect of season and day and night is also evident.

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Improvement of a Generator

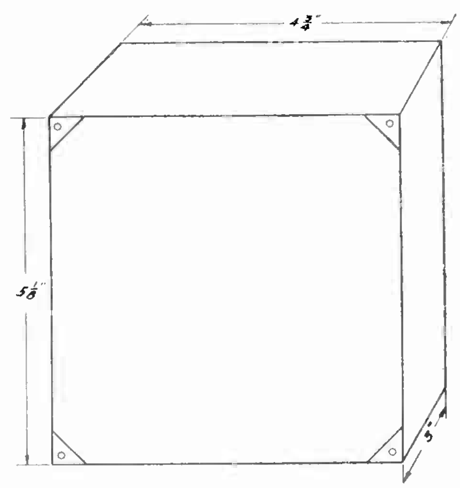
How the 30-N Circuit Was Adopted to Wider, Better Uses

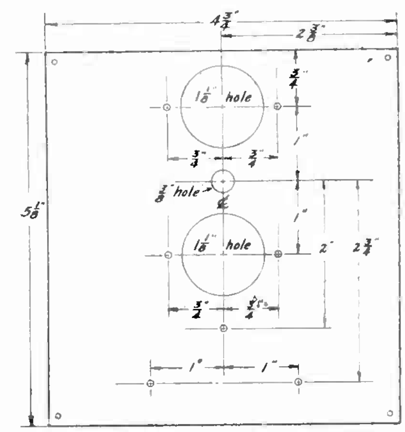
By Herman Bernard

THE drawings on the opposite page are for the mechanical and electrical construction of a small, inexpensive signal generator, using the 335 scale, fundamentals of 109 to 200 kc. The circuit is much the same as the one used in the Model 30-N, which this supersedes.

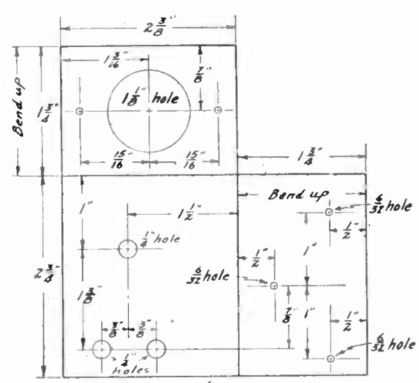
The reasons for the change are: the intermediate frequency is put at a low limit of 109 kc instead of 135 kc, so that some of the sets using lower than 135 kc can be serviced; the scale is now made practically straight frequency line; the principal intermediate frequencies not on the fundamental are taken care of by harmonics in such a way that makes confusion impossible; there is a wavelength scale as well, for the fundamental, and also there is an arbitrary scale of 0-180 degrees. The reason for the degree scale is to be able to record the dial position for any odd frequency in which the user may be interested and to measure dial distances.

Incidentally, it has been possible to improve the accuracy, because a relatively large fixed condenser, about 100 mmfd., is put across the tuning condenser. Since the resultant curve is practically straight, compensation may be introduced by a slight shift of the dial position before permanently screwing down, in constructing the instrument.

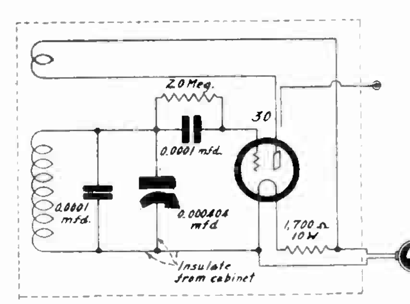




All small holes $\frac{6}{32}$



Small holes $\frac{6}{32}$



The Two-Position Method

The intermediate frequencies imprinted on the scale (where higher than the fundamental, hence harmonics are used) are 250, 260, 400, 465 and 480 kc. Only once does 250 kc appear, as the second harmonic of 125 kc is used, and an i-f channel intended for 250 kc could not be tuned to 375 kc very well. In fact, it could scarcely be expected to go much beyond 300 kc. For the same reason 260 kc appears only once on the scale, as the second harmonic of 130 kc is used.

However, as higher intermediate channels are to be measured, they might be excited by generations at different positions of the fundamental scale of the oscillator, due to different harmonic orders of different fundamentals. It is this very condition that gives rise to the danger of confusion due to the use of harmonics. However, by using consecutive harmonics of different fundamentals, and inscribing the desired intermediate frequency on a tier or arc reserved for that purpose, confusion is made impossible.

All one has to do, for instance, to peak at 465 kc is to turn the generator dial knob until 465 kc is read, then turn the knob some more until 465 kc is read the second time, when again there will be a response in the receiver. Under those conditions the channel is peaked at 465 kc and at no other frequency. For instance, under the 116.25 and 155 kc positions of the fundamentals the number 465 appears

(*Continued on next page*)

Computation of Ground-Wave Range

(*Continued from page 7*)

is not directly applicable. Further interpolation would be necessary, if you are to reduce these values for application to the power at your station. Such calculation is very complicated since there is no simple relation between distance range and radiated power.

This is so because of the great variety of terrain and consequent gamut of absorptive influences that waves meet in transit. However, since the table is fundamentally approximate, further approximations might not mar its value, and so it might be indicated that a very rough relation for this purpose might be: distance range is roughly proportional to the square root of the radiated power. And on this basis a range for your transmitter might be computed. As an example, suppose you radiate a power of 50 watts. Our relation is $d : \sqrt{P} :: d^1 : \sqrt{P^1}$ where the d is distance range and P is the power radiated. Taking the 150 miles range in the 1750 kc band for this operation, we find $150 : : \sqrt{5} :: d^1 : \sqrt{.05}$, which boils down to

$$d^1 = \frac{150\,(\sqrt{.05})}{\sqrt{5}} = 15 \text{ miles}$$

Use Table for Sky Wave

It has not been attempted to reduce this table down to amateur powers because of the great variety of such powers being used. If you are interested in applying this idea to your transmitter, the reduction may be accomplished as illustrated in the example just given. This reduction will only be applicable to the ground wave since the sky wave will not be absorbed to the same degree. It would probably be just as well to retain the sky wave figures for all powers since power will not determine the point where the reflected wave will strike the earth though it will affect the reflected signals strength. A table revised for power will therefore affect only the groundwave values.

No revision of the formula for particular amateur powers is practical, for the sky wave, as the foregoing table gives all the practical data on that, the only difference for smaller power being that the signal is weaker.

In conclusion, it might be stated that a study of the Kennelly-Heaviside layer may well develop into an interest in meteorology, weather forecasting, geography, geology and astronomy—all worthwhile for development into hobbies which can very well augment the pleasure and education derivable from an amateur radio.

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(*Continued from preceding page*)
each time. If a channel assumed to be somewhere around 465 kc is peaked on the basis of generation due to one such dial position, e.g., 116.25 kc, quite likely the assumption is correct, as the fourth harmonic of 116.25 kc is 465 kc. But if one turns the dial to 155 kc and then gets the response again, he is sure that the peaking is at 465 kc, because there was no response due to any intervening position of the dial as it was moved from 116.25 to 155 kc, the third harmonic of which yields 465 kc. Hence error is precluded.

This same method is worked for 400, 450, 465 and 480 kc. By extra polation the same system can be applied to other intermediate frequencies in the "four hundreds," because the two bars for a frequency somewhat near the one that concerns you at the moment may be used as approximate guides. That is, attain a response from to the correct dial setting o the fundamental, due to dividing some desired i.f. by a whole number, then note approximately the number of degrees away the recorded position of the nearest frequency is. The 0-180-degree scale is used for this comparison. Then when the second response point is encountered for this special i.f., the setting should be almost exactly as far away from the second bar of the recorded i.f. as was true in the first instance. This holds because the calibration of the frequencies on the dial closely follows a straight frequency line.

Broadcast Band

The frequency span calibrated is 200/109 or 1.83, selected because then the line was practically straight, that is, separating bars for equal frequency differences were practically equally apart. It so happens, also, as an advantage, that on the fundamental this separation is 1 kc. and is very plainly readable as such. In fact, a separation to 0.5 kc can be estimated very closely.

The broadcast band has not been put on the scale because of the wide separation between bars or reduced frequency ratio that makes it impossible to cover the broadcast band from end to end on any one harmonic order. However, for the lower end of the broadcast band. to 1,000 kc. use the fifth harmonic, simply multiplying the scale reading by 5. Also by that method the wide separations show up nicely, 5 kc differences being registered. For the rest of the band use the eighth harmonics, say, 880 to 1,600 kc, multiplying the readings by 8.

Here, at the higher broadcast frequencies, it is possible to run into confusion, simply by using eighth harmonic orders. or the tenth (1090-2,000 kc). But it is easy to avoid all confusion for any frequencies, including short waves. by ascertaining the harmonic order of a fundamental and multiplying the fundamental by that order. Indeed, that is the way that the high accuracy of the generator is communicated even to high-frequency measurements, meaning short waves. and the determinations may be made in frequencies and wavelengths.

Correct Use of Harmonics

Let us consider frequencies, using a method that may be adopted any time you are in doubt about an harmonic order.

First Step: Turn the generator to some position that creates a response in the receiver. Note the generator fundamental frequency.

Second Step: Slowly turn the generator knob in either direction until the next response is heard in the unmolested receiver. Note the generator fundamental frequency.

Third Step: As two different fundamental frequencies have been read, one is higher than the other. Subtract the smaller from the larger.

Fourth Step: Divide the difference into either of the two frequencies previously read, and the answer is the harmonic order of the other.

Fifth Step: As a check-up, divide the same difference into the other number, getting a new harmonic order (which will be 1 higher or 1 lower than the previous harmonic order), and the product of this new order and the other read frequency must be the same as the product in the previous example. That is, the unknown frequency is the same. And it is now known.

A Case Worked Out

Example:

The generator is set going and turned until a response is heard anywhere on the dial. Read the fundamental frequency. It is, say, 150 kc. Turn the generator knob. The next response is due to 160 kc. Of course harmonics of 150 and 160 kc are actuating the receiver. Which harmonics of which?

The difference between 160 and 150 is 10. Divide 10 into 160, the answer is 16. Therefore the harmonic order (not of 160 but) of 150 kc is 16. The product of 16 and 150 is 2,400. Hence the unknown is 2,400 kc or 2.4 mgc.

Check: Divide the same difference, 10, into the other fundamental, 150. The answer is 15. Therefore the unknown is the fifteenth harmonic of 160. The product of 15 and 160 is 2,400.

Suppose the accuracy of the generator is only 1 per cent., although it can be better than that. The readings of the fundamentals used are therefore accurate to 1 per cent. The harmonic order determinations are 100 per cent accurate. Therefore the accuracy of any unknown frequency is never any poorer than the accuracy of the generator itself. That is why this particular method so capable commends itself to users of generators who are keen for accuracy.

Higher End of Broadcast Band

For intermediate-frequency use it is necesasry that the generator be present to yield a particular frequency, and the direct frequency calibration of the dial scale for this purpose enables that advantage. For determining frequencies to the highest in the broadcast band the harmonic orders may be followed, using the fifth to 1,000 kc, as already explained, and this part of the measurement enables presetting. But for frequencies 1,000 kc to 1,600 kc, presetting may be attempted, either on eighth or tenth harmonics, but in the cause of surety and accuracy the setting selected should be compared for correctness. The same method just outlined is followed in a slightly different form.

Problem: To peak a receiver at the broadcast frequency of 1,450 kc.

Solution: Select some fundamental on the generator that is an easy sub-multiple of 1,450 kc. Obviously 145 kc is the easiest you can find. Well, set the receiver in the region where you know, at least to an approximation, that the 1,450 kc position should be, and set the generator at 145. You intend, you see, to use the tenth harmonic of 145 kc. Now, if you turn the generator dial to a lower frequency the next response will be due to a next higher harmonic order. So, $10 + 1 = 11$, and you must get the next response, turning to lower frequencies, when the generator reaches 1,450/11 or, 132 kc, closely.

If the response comes in right near 132 you are all right.

If the generator is turned to higher frequencies than 145 kc, the harmonic order will be lower, i.e., the ninth for the next response, and the position should be 161 kc, closely. The effect and the test are the same either way. If you have to move beyond the intended and infallible second position, the set is tuned higher than 1,450 kc, and if you don't have to go all the way to the calculated next response point, the set is tuned to higher than 1,450 kc. So adjust the set accordingly, using 145 kc, as you were probably one harmonic off, in either direction.

A Little Preaching

These two phases of the same method of using harmonics should be studied and well learnt by everybody. Study of harmonic theory is not the most interesting work because one has to concentrate. It is hard sometimes to follow what is being said or written, but it is dangerous to success to be dreamily unaware of the great significance of the newly-developed harmonic technique. Often you would wish you could invoke the simple formula —which is one just as easy to remember as it is to forget—because sometimes you may desire to measure frequencies very, very much higher than those of any generator you have, and would have to buy or build a separate generator for the purpose, and go to the pains of calibrating it perhaps, whereas if you knew the formula all this extra work would be spared, and you could use a present generator.

When the frequency of the unknown has been ascertained, which may be done either for purposes of station-finding or for any other sort of frequency measurement from 109 kc up, it may be desired to know what the wavelength is.

If the wavelength is on the fundamental frequency span of 109 to 200 kc, the wavelength may be read directly from the dial. The wavelength calibration is given special consideration on an outside arc, for for 1,500 to 2,700 meters, in steps of only 10 meters. Just as the bars could be far apart for 1 kc, they are far enough apart for 10 meters, even in this high-wavelength range. So there is ease of reading.

Ascertaining Wavelengths

We have just ascertained some frequencies. One was 2,400 kc. Another was 1,450 kc. Let us find out the wavelength equivalent of these frequencies right from the dial, and also, just for the sake of completeness, add a couple of high frequencies, 11.5 mgc and 19.5 mgc.

To make the operations uniform, convert all megacycles to kilocycles by multiplying by 1,000. So we are considering 1,450, 2,400, 11,500 and 19,500 kc.

When we were considering 1,450 kc we used a fundamental of 145 kc, as it was easy to follow the decimal system. Let us do that again. Look at 145 kc. The frequency in mind therefore is ten times as high as the one we are reading on the dial. Therefore the wavelength equivalent will be only one-tenth of what we shall read. Hence simply turn to 145, read the wavelength as 2,070 meters, and the wavelength of 1,450 kc is therefore 207 meters.

No So Far Off

We can not read 2,400 kc at one-tenth its value, as the scale does not go that high, so use one-twentieth of 2,400, also easy, because division is by 10 and then by 2. The frequency to read is 120 kc, the frequency for which we want the wavelength is twenty times greater. Read the wavelength of 120 kc as 2,500 meters. Divide by $10 = 250$ meters, and by 2, and the answer is 125 meters. The Bureau of Standard conversion chart, accurate to better than one part in 99.99, gives the wavelength of 2,400 kc as 124.9 meters.

For 11,500 kc still use the decimal system, set the pointer to 115, note that the unknown is 100 times what the pointer shows, read the wavelength of 115 kc as 2,610 meters (nearly), and divide by 100. The answer is 11.5 mgc equals 26.1 meters.

The last case is that of 19,500 kc. That is 100 times 195. Read the wavelength of 195 kc as 1,540 meters (nearly), divide by 100, and the answer is 15.4 meters. The Bureau of Standards chart gives 15.38 meters.

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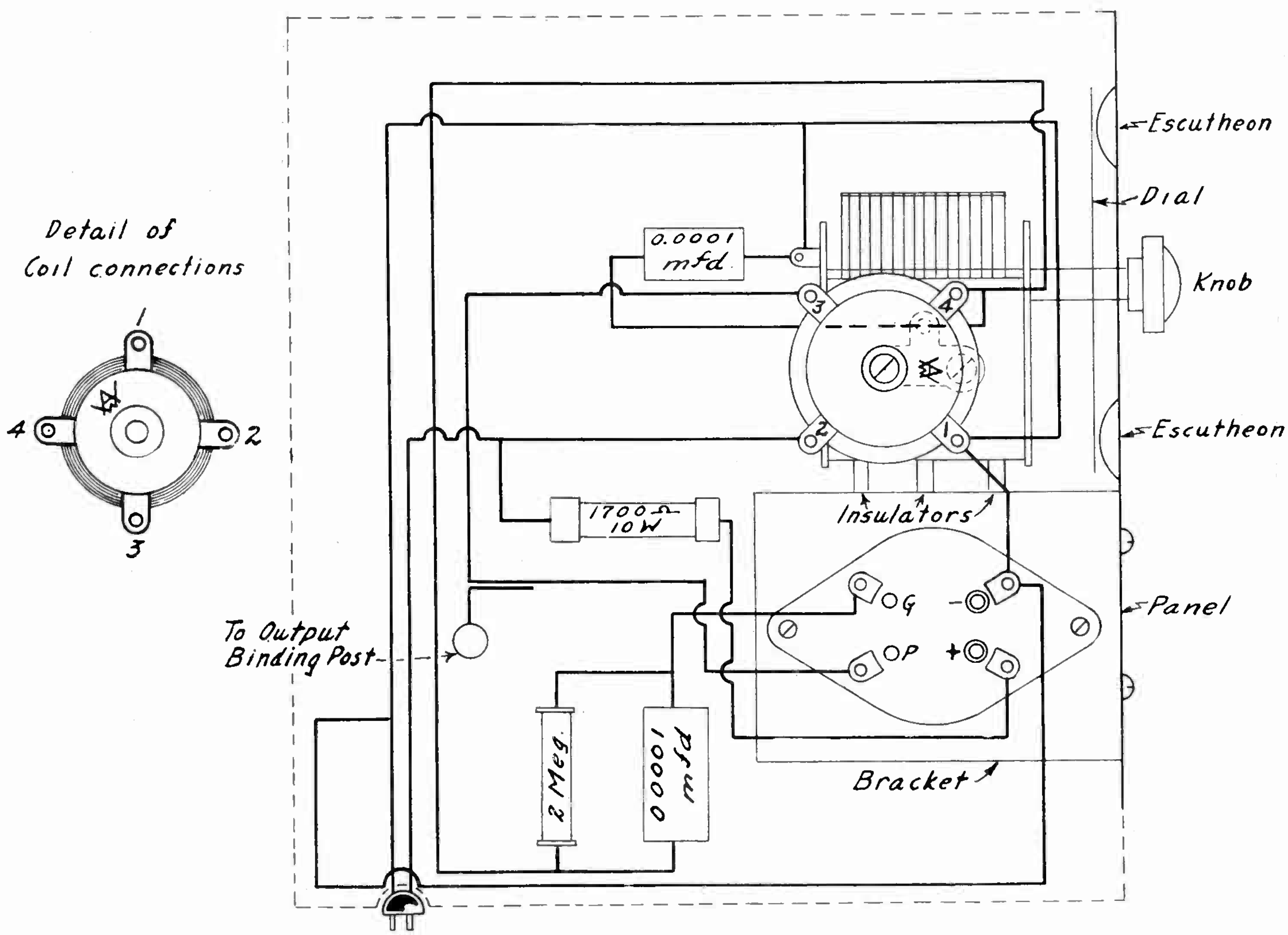
Picture Diagram of Simplest Generator



Pictorial diagram of the wiring of a small generator that amply furnishes accurate frequencies for intermediate channels, and also enables broadcast-band peaking. The frequencies are direct-reading for the intermediate purposes. For broadcasts harmonics are to be used, and for short waves likewise. A simple, accurate harmonic method is outlined in the text.

A three-sided bracket is used as the basis of the mechanical support, a hole in one side accommodating the socket, the bottom of which is seen in the pictorial diagram above. By means of three screws the bracket is affixed to the front panel, while the tuning condenser is fastened to the third side by means of screws through insulators. The object of providing insulation is to avoid conductive connection of the shield box to the line, which otherwise would result. This cabinet is represented by the dotted line, and may be grounded.

The coil form has a threaded hole for 8/32 machine screw. If one of the stator-fastening screws of the tuning condenser is removed, and any sort of short collar introduced, such as two or three washers, the coil will be held far enough from the frame to avoid interference, and a 1-inch long screw may be passed through the coil form and into the threaded bed of the stator of the condenser. Then the coil position will be as shown in the diagram above, with tickler toward the metal.

The condenser is directly driven by a knob, and there are two escutcheons, one above, the other below the knob, and each escutcheon has two indexes.

Wiring Suggestions

The wiring is explicit and simple. The connection of output to generator is determined by the capacity of the small condenser formed by running a short length of wire from output post along the plate lead. It is all right to twist a few turns of this output-post wire around the plate lead to form the condenser. Then the part of the wire leading from plate to coil forms one plate of this small condenser, and the wire to output post, so far as related to this plate lead, the other condenser plate. For twisting usual wire, the capacity is about 3 mmfd. per inch.

Even a few turns will give resultful coupling. If stronger coupling is desired, use more turns, or you may run 3 inches or so of each wire side by side, naturally insulated, inside a piece of spaghetti tubing.

The two fixed condensers are 0.0001 mfd. The tubing condenser happens to be just 0.000404 mfd., with no manual trimmer.

Lining Up

After the circuit is wired, the lining up is done by tuning in a station of known frequency, and beating the generator with that station at or near the high-frequency end, that is, 200, 199, 198 kc. etc.

Suppose you can tune in a station on 1,000 kc. There should be a beat due to the fifth harmonic of 200 kc. Or if the station is 980 kc the beat would be due to the fifth harmonic of 196 kc, so use that position. The condenser is left near minimum capacity, where it produces this beat in conjunction with the coil and tube, and then the scale is moved until the desired reading exactly coincides with the index. Then the scale is fastened. That is the adjustment for the high frequency end.

Next turn to the low-frequency end, and use 109, 110, 111, 112 kc etc., the lowest practical, depending on the station that beats with a tenth harmonic of the generator. If the frequency is 1120 kc then the reading should be 112 and if the reading is too high (say, 115), then insert a series condenser between grid connection of the tuning condenser and the joint of leak-condenser-coil. This capacity may be around 0.05 mfd. and is not critical. But if its inclusion proves advisable, there might have to be a slight readjustment, by dial relining, at the high-frequency end.

Use of Generator

For use at the i-f level, connect a wire from output post of generator to the circuit to be tested. This usually means connection to plate of the first detector. Remove the antenna connection from the set.

For broadcast use, leave the antenna disconnected from set, and connect a wire from generator output post to set antenna post. This wire also will usually be sufficient for receiver antenna, to serve station-beating purposes. For stronger beats wrap a few turns of the antenna wire around the generator output wire.

Frequencies are direct-reading for i-f. For higher frequencies use the harmonic-order method previously **outlined.**

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SIMPLICITY, SOUNDNE

All-Wave Superheterodyne Pr

By Samu

Chief Engineer,

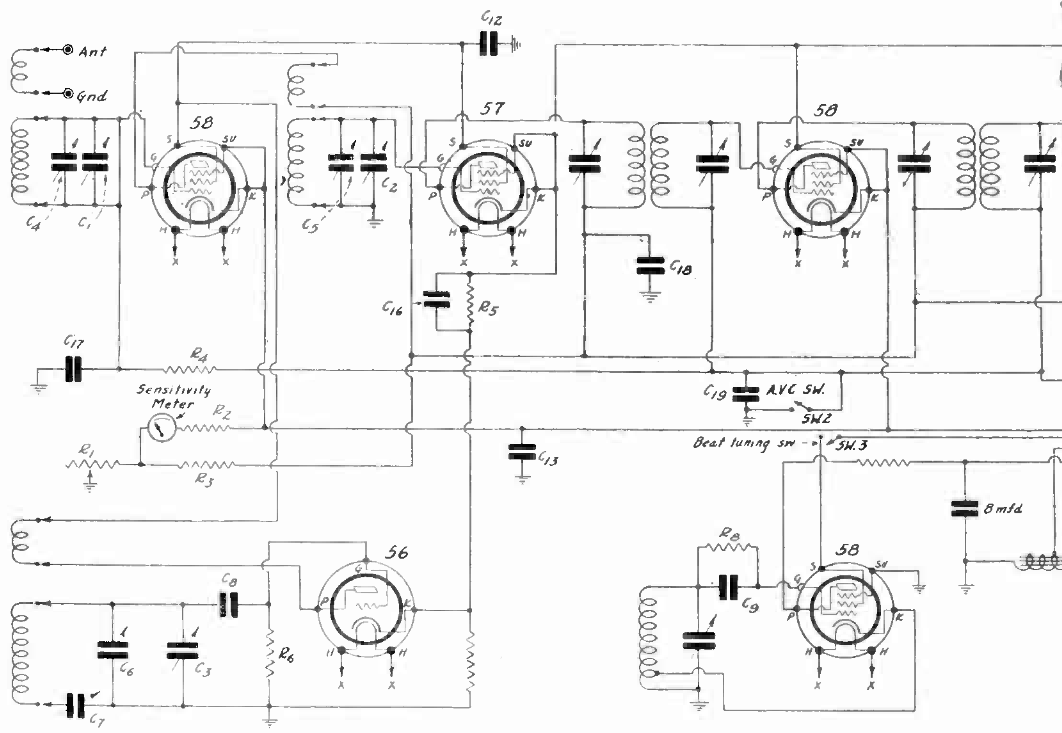
IT is not for mere intention of introducing a variety of gadgets that the modern all-wave receivers have more controls than their broadcast predecessors of inferior performance. In the operation of the receiver the advantages are realized with a fullness of appreciation that is a compliment to the advance of radio technique.

Therefore when the author set about to design a ten-tube all-wave superheterodyne, he had certain objectives in mind, although they all consolidated into one general goal: the attainment of maximum reception.

To achieve the maximum of results there had to be a minimum of waxing and waning, and therefore automatic volume control was introduced. But there are occasions of steady reception, even on short waves, when a.v.c. therefore is not needed, and as such control is always at the expense of sensitivity, a switch was included so that a.v.c. could be cut in and out at will. Also there was automatically provided a means of checking up aurally on the effect of a.v.c. For unsteady signals it certainly contributes a steadying effect, and any ear will appreciate this.

The plug-in coil method was retained, as it has proven very effective. The convenience of using drawer-type construction, with each of the three coils for a band in one mechanical container, but separately-shielded, requiring only one operation of plugging in, instead of three operations, was naturally retained, as it proved popular and effective last year.

In a sense, this solution is also the avoidance of another difficulty, for the coils not in use are nowhere in or near the tuned circuits, and those dismaying trapping effects, resulting in dead spots, are completely avoided. There just aren't any dead spots.



A ten-tube all-wave receiver, from which all parts were excluded save the common screen lead (S) of the intermediate amplifiers should be

The Airplane Dials

The tuning positions repeat themselves very well with this type of coil construction, which can be verified any time by comparison of the tuning meter with the frequency-calibrated dial.

The right-hand airplane dial is calibrated in frequencies, and hence is direct reading, and the scale holds for minimum capacity setting of the three-gang bandspread condenser. This bandspread capacity is very small indeed, and contributes a vital improvement, since hard-to-bring-in stations are not passed over, and exact resonance, for maximum signal and minimum noise, is readily attained. Without this true bandspread adjunct it is difficult to conceive that so many, many stations could be tuned in from all over the world.

The left-hand airplane dial is of the usual type, without any save the arbitrary numerical calibration, because the main tuning dial is relied on for the frequency attainment, and the bandspread for closer tuning, a sort of stretching of the close ones over a wider hpysical area. This is like providing a microscope for bacteriological study. The effect is on the ear rather than on the eye, and we would be tempted to call a bandspreading device of this type a microphone, were there not another meaning already for this word.

The inclusion of a tuned-radio-frequency stage is taken for granted in all high-class receivers. The signal thereby is made larger compared to any interference, including that special form of interference peculiar to superheterodynes, known as image interference.

Moreover, there is a separate oscillator tube. The pentagrid converter tube was tried, and worked well, but at frequencies higher than 10 mgc it became progressively more difficult, as frequencies increased, to prevent the modulator and oscillator from locking, so that only the oscillator frequency resulted. This reduced the sensitivity and selectivity a great deal, and moreover spoilt the frequency calibra-

LIST OI

C1, C2, C2—.00032 3-gang main tuning condenser.
C4, C5, C6—.000025 3-gang special bandspread condenser.
C7—Trimmers in various drawer coils.
C8—.00004 mmfd. condenser.
C9—.001 mfd. condenser.
C10—.001 mfd. condenser.
C11—Variable capacity tone control.
C12—.15 mfd. by-pass.
C13—.5 mfd. by-pass
C14—.01 mfd. by-pass.
C15—.01 mfd. by-pass.
C16—.001 mfd. by-pass.
C17, C18, C19, C20, C21, C22, C24—.1 mfd. by-pass.
C13—.5 mfd. by-pass.
T1, T2, T3—465 kc Litz wound I-F.
T4—Audio beat oscillator, I-F.
R1—12,000 ohms—R-F volume control.
R2—300,000 ohms.
R3—50,000 ohms.
R4—350,000 ohms.
R5—10,000 ohms.
R6—100,000 ohms.
R7—250 ohms.
R8—100,000 ohms.
R9—3,000 ohms.
R10—.5 meg.

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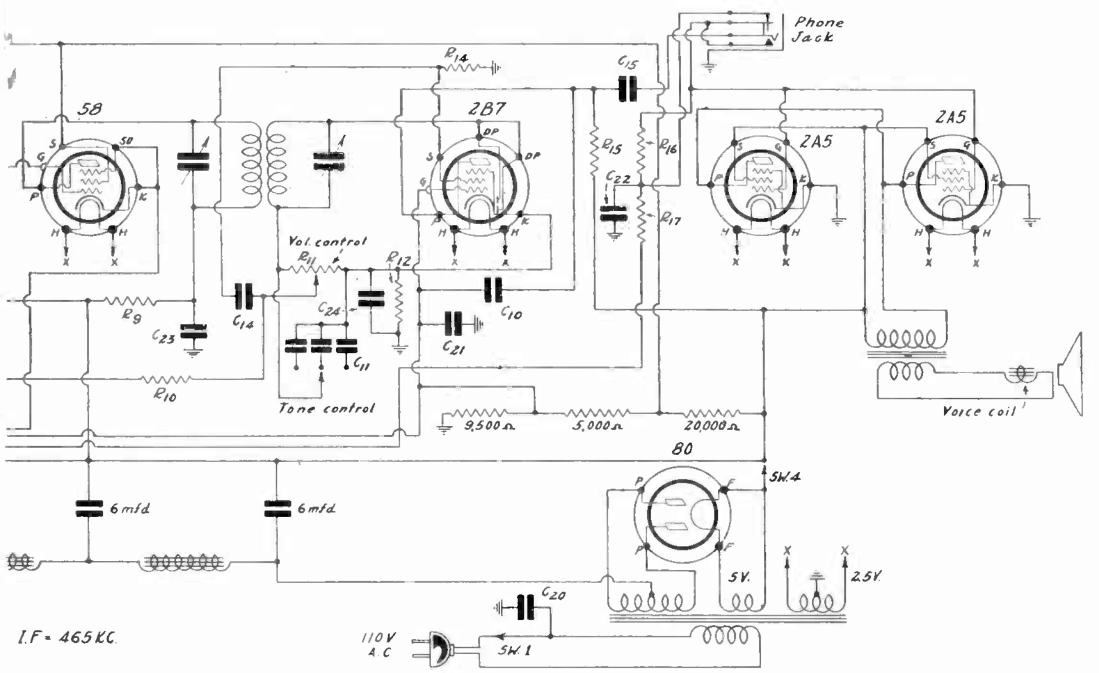
SS, IN A 10-TUBE SET

ovides Exceptional Sensitivity

el Miller

Postal Radio



se that contributed materially to the improvement of performance. The joined to the screen (S) of the 57, second tube from upper left.

tion, as when locking set in, the inductance and capacity relationships of the circuits, on which the calibration depends, were upset.

Nevertheless, electron coupling is advantageous, as it is practically non-frequency-discriminating, therefore it was retained despite the use of a separate oscillator tube, but the coupling was made weak enough to keep the two circuits individual and separate for frequencies up to the highest for which the dial is calibrated, and that means to the highest in which anyone has any present interest for program reception.

The 56 is known to be a splendid oscillator, and the tube was selected after others had been tried. The 58 was used for r-f amplification at the signal-carrier level, or pre-selector stage, while the modulator was selected on the basis of maximum sensitivity, hence the 57 was chosen. The input to the 57 was kept low enough not to overload that tube, hence there is no trouble from harmonic distortion causing mysterious appearance of responses at greatly off-frequency positions, which may be ascribed in nearly all instances to second-harmonic trouble.

The plate voltage on the oscillator is the same as the screen voltage on other tubes in the mixer and i-f amplifier, and so the open line above the suppressor of the 57, in the diagram, representing the common screen lead, should be connected to the screens of the 57 and the 58 to left.

Besides the local oscillator there is a beat-frequency oscillator, to yield an audio tone. This may be used for station-finding, as there is a response every time a carrier is "crossed," and with this warning one may turn off the beast oscillator, and carefully tune in the desired station right on the nose. Also the beat oscillator enables reception of unmodulated keyed c-w.

There is a sensitivity control associated with the r-f and i-f biasing, and audio volume control, governing the input to the a-f channel, and also a capacity tone control, whereby different values of fixed capacity are cut into second detector load circuit. This special method of tone control has the advantage of increasing the rectification efficiency, the more capacity is cut in, so that while the greater capacity reduces the amplitude of the higher audio frequencies, the remaining audio tones are themselves stronger, so we have tone control without consequent general diminution of volume. The advisability of tone control are a corrective for static effects, by attrition of audio tones in the frequency region of the interference, is well authenticated by this time, and needs no further discussion.

There are two stages of high-gain intermediate-frequency amplification, feeding a 2Z7 tube, the output of which serves as the driver of the two 2A5 tubes. The rectifier is an 80. The tenth tube is, of course, the beat-frequency oscillator, a 58.

Earphone Jack Provided

There is an earphone jack, always a splendid aid to those who like to tune in DX when others are asleep.

The receiver is built with precision and skill in the commercial model. The wiring underneath is of the cabled type. The arrangemet of parts on top can be seen from the front-cover illustration. This arrangement has won much admiring comment from users and others, and besides works in the direction of electrical efficiency.

Although the receiver is a ten-tube affair, high-gain, high-powered, tone-true, sensitive, selective and economical of operation, the circuit itself is a very simple one, as the diagram shows. Nothing of doubtful value has been included, and many parts that were present in experimental models were omitted.

PARTS

R11—250,000 ohm **Audio volume control.**
R12—800 ohms.
R13—20,000 ohms.
R14—350,000 ohms.
R15—100,000 ohms.
R16—1 meg.
R17—1 meg.
R18—Variable tapped resistor.
M—Otois milliameter.
SW1—Power switch.
SW4—Plate supply switch.
SW2—A. V. C. switch.
One 30-henry choke.
One dynamic speaker field tapped.
One S.P.D.T. closed circuit phone jack.
One drawer coil socket (Postal).
Four triple drawer coils (Postal).
Two 6 mfd. Dry Electrolyctic condensers.
One 8 mfd. Dry Electrolytic condensers.
One power transformer.
One drilled Chormium chassis.
One crackled finish front panel.
Ten tubes.
One ant. ground bindingpost.
Seven tube shields.
Ten tube sockets.
One speaker socket.
Six knobs.
One 4" calibrated illuminated aeroplane dial.
One 4" bandspread aeroplane dial.

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Short-Wave Stations Listed Georgraphically

[The numbers to right of calls are frequencies in kilocycles. To reduce to megacycles, move point three places to left. To change frequency in kilocycles to wavelength in meters, consult table on page 17, September 29th issue.]

Algeria		
Constantine	F8KR	6667
Argentina		
Buenos Aires	LSI	9800
Buenos Aires	LSN	9990
Buenos Aires	LSQ	19500
Buenos Aires	LU5CZ	7080
Monte Grande	LSX	10350
Australia		
		3080, 6010, 11710 11880, 12482, 15310—Reserved
Lyndhurst	VE3LR	9580, 15230, 21540
Melbourne	VK3ME	9510
Sydney	VK2ME	9590
Sydney	VKZME	9590
Sydney	VLK	10525
Austria		
Vienna	OER2	6072
	OER3	11801
Belgian Congo		
Buta	OQT	6030
Basankusu	OQU	6120
Belgium		
Russylede	ORK	10330
Bolivia		
La Paz	CP5	6080, 9120
Brazil		
Marapicu	PSK	8185
Rio de Janeiro	PRA3	8186
Rio de Janeiro	PRF5	9500
Canada		
Bowmanville, Ont.	VE9GW	6090
Calgary	VE9CA	6030
Halifax, N. S.	VE9HX	6110
Montreal, Que.	VE9DN	6005
Montreal, Que.	VE9DR	6005
St. John, N. B.	VE9BJ	6090
Vancouver, B. C.	VE9CS	6070
Winnipeg, Man.	CJRO	
Winnipeg, Man.	VE9DR	11720
Winnipeg, Man.	VE9JR	11715
(Private experimenta ations)		1620
China		
Shanghai	XGBA	21550
Shanghai	XGBD	9579
Colombia		
Barranquilla	HJA3	6425
Barranquilla	HJIABB	6450
Barranquilla	HJIABG	6030
Bogota	HJ3ABD	7400
Bogota	HJ3ABF	6250
Bogota	HJ3ABI	6045
Bogota	HKE	7220
Bogota	HJN	6060
Cali	HJ5ABD	6480
Cartagena	HJIABD	6116
Cartagena	HJIABE	6116
Bogota	HYJ	13650
Costa Rica		
Manizales	HJ4ABB	7210
Medellin	HJ4ABE	5952
Bogota	TIEP	6710
Cartago	TIRA	6080, 9590
San Jose	TITR	11790
San Jose	TIX	5880
Cuba		
Habana	CMCI	6005, 6040
	CCC	6010
Czechoslovakia		
Prague	OKIMPT	5145
Denmark		
Blaavand	OXB	1622
Lyngby	OZP	1595
Skamlebak	OXY	6060, 6070, 9520
Dominican Republic		
Santo Domingo	HI1A	6280
Santo Domingo	HIZ	6320
Santo Domingo	HIX	6000, 5953
Ecuador		
Guayaquil	HC2RL	6676
Quito	HCJB	4110
Riobamba	PRADO	6620
Federated Malay States		
Kuala Lumpur	VSZAB	6000
Kuala Lumpur	ZGE	6135
France		
Pontoise	15250, 11900	
Paris	Colonial Radio	0585, 11845, 11880, 11905
Paris	FLA	11710, 11720,
Paris		17765, 11905, 15243, 15295, 21490
	FYB	10578
French Indo-China		
Saigon	F3ICD	11780
Saigon	F3LCD	6116
Germany		
Konigswusterhausen	DJA	9560
Konigswusterhausen	DJB	15200
Konigswusterhausen	DJC	6020
Konigswusterhausen	DJD	11760
Konigswusterhausen	DJE	17760
Konigswusterhausen	DJL	15110

Gold Coast		
Takoradi		6080
(Holland: See Netherlands)		
Honduras		
Tegucigalpa	HRB	6005, 11740
Hungary		
Budapest	HAP2	4165
Szekesfehervar	HAS3	15370
Szekesfehervar	HAS5	17130
India		
		15290, 15160—Reserved
Bombay	VUB	9565
Calcutta	VUC	6110, 9575, 11870
Iraq		
Baghdad	YID	13410
Italy		
Vatican City	HVJ	15120
Rome	I2AO	6060, 5550, 5720,
Rome	I2RO	6980, 9630, 9780
Japan		
Tokio	JYS	9840
		6100, 11800, 9550 —Reserved
Tokio	JVT	6750
Tokio	JVM	10740
Kenya		
Nairobi	VQ7LO	6060
Madagascar		
Tanarive	FIQA	5690
Mexico		
Mexico City	XDE	11500
Mexico City	XETE	9600
Mexico City	XEBT	6020
Morocco (French)		
Rabat	CNR	8035, 12830
Mozambique		
Lourenco Marques	CR7AA	3543
Netherlands		
Huizen	PHI	11730, 17775
Hilversum	PCJ	9590
Kootwijk	PGD	6020, 6025, 6030
Netherland India		
Bandoeng	PKIWK	6120
Bandoeng	PLV	3190, 3186
Bandoeng	PMY	3183, 5170
Batavia		2383, 6120, 9540, 9550, 9580, 11770, --860, 15150, 15300
Cheribon		1615
Makassar	PNI	8760
Malang		1570
Semerang		4370
Soerabaya		6040
New Zealand		
Christchurch	ZL3ZC	6000
Wellington	ZL2ZX	6060
Nicaragua		
Granada	YNGRG	6664
Managua	YNA	6035, 11890
Norway		
Jeloy	LCL	6990
Jeloy	LCN	7835
Jeloy	LCO	13980
Peru		
Lima	OA4AC	7820
Lima	OA4AD	9700
	OA4B	7160
	OCN	6235
Philippine Islands		
Manila	KZRM	6140, 9570, 11840
Poland		
		6140, 11740—Reserved
Posen	SRI	9493, 9570
Warsaw		15275, 6115, 17780, 21480
Portugal		
Lisbon	CTIAA	9600, 15350
Lisbon	CTICT	3750, 12229
Reunion		
St. Denis		6000
Rumania		
Bucharest	YOI	6000
Russia		
Kharbarovsk	RWI5	4270, 4273
Moscow	RNE	12000
Moscow	RV59	6000
Moscow	REN	6610
Moscow	RW72	6610
Tachkent	RRRR	11740
Spain		
Madrid	EARIIO	6976
Madrid	EAQ	6045, 6110, 6070
Madrid		9545, 9860, 11810
Aranjuez		15265, 19720
Barcelona	ESJ25	6000
Straits Settlements		
Singapore	ZHI	6012
Sweden		
Karlskrona	SCJ	1530
Motala	SASH	6065

Switzerland		
Prangins	HBJ	14560
Prangins	HBL	9595
Prangins	HBO	12030
Prangins	HBP	7797
Prangins	HBQ	7444
Union of South Africa		
Johannesburg	ZTJ	6122
United Kingdom		
Daventry	GSA	6050
Daventry	GSB	9510
Daventry	GSC	9580
Daventry	GSD	11710
Daventry	GSE	11860
Daventry	GSF	15140
Daventry	GSG	17790
Daventry	GSH	21470
Rugby	GBC	8860
Rugby	GBD	4270

United States

Alabama		
Birmingham	WPFM	2414
Arizona		
Phoenix	KGZ5	2430
California		
Bakersfield	KGPS	2414
Berkeley	KVP	1712
Fresno	KGZA	2414
Pasadena	KGZB	1712
Los Angeles	KGJX	1712
San Diego	KGZD	2430
San Francisco	KGPD	2414
San Jose	KGPM	2470
Santa Barbara	KGZO	2414
Tulare	WPDA	2414
Vallejo	KGPG	2422
Colorado		
Denver	KGPZ	2442
Florida		
Jacksonville	WPFG	2442
Miami Beach	W4XB	6040
Georgia		
Atlanta	WPDY	2414
Columbus	WPFI	2414
Illinois		
Chicago	W9XA	6080, 11830, 17780
Chicago	WPDB	1712
Chicago	WPDC	1712
Chicago	WPDD	1712
Downer's Grove	W9XF	6100, 17780
Highland Park	WPFD	2430
Indiana		
Fort Wayne	WPDZ	2470
Gary	WPFL	2470
Hammond	WPFJ	1712
Indianapolis	WMDZ	2442
Kokomo	WPDT	2470
Richmond	WPDH	2442
Iowa		
Cedar Rapids	KGOZ	2470
Davenport	KGPN	2470
Des Moines	KGHO	1543
Des Moines	KGZG	2470
Sioux City	KGPK	2470
Kansas		
Chanute	KGZF	2450
Coffeyville	KGZP	2450
Topeka	KGZC	2422
Wichita	KGPZ	2450
Kentucky		
Louisville	WPDE	2442
Louisiana		
Baton Rouge	KGPY	1567
New Orleans	WPEK	2430
Shreveport	KGZQ	1712
Maryland		
Baltimore	WPFH	2414
Massachusetts		
(Portable)	WPEV	1567
Arlington	WPED	1712
Arlington	WPEP	1712
Boston	WEY	1558
Boston	WIXAL	6040, 1525, 11790, 21460
Fairhaven	WPFN	1712
Framingham	WMP	1567
Middleboro	WPET	1712
Lexington	WPEL	1567
Millis	WIXAZ	9570
Newton	WPFA	1712
Northampton	WPEW	1567
Somerville	WPEH	1712
Michigan		
Belle Island	WCK	2414
Detroit	WKDT	1558
Detroit	WPDX	2414
East Lansing	WRDS	1567
Flint	WPDF	2442
Grand Rapids	WPEB	2442
Grosse Point	WRDR	2414
Highland Park	WMO	2414
Lansing	WPDL	2442
Muskegon	WPFC	2442
Saginaw	WPES	2442

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Minnesota		
Minneapolis	KGPB	2430
St. Paul	WPDS	2430
Missouri		
Kansas City	KGPE	2442
St. Louis	KGPC	1712
Nebraska		
Omaha	KGPI	2470
New Jersey		
Bound Brook	W3XAL	6100, 17780
Bound Brook	W3XL	17310
Hackensack	WPFK	2430
Toms River	WPFF	2430
Wayne	W2XE	6120, 11830, 15270
New York		
Auburn	WPDN	2458
Buffalo	WMJ	2422
Mt. Pleasant	WPFW	2414
New York	WPEE	2450
New York	WPEF	2450
New York	WPEG	2458
Rochester	WPDR	2450
Schenectady	W2XAD	15330
Schenectady	W2XAF	9530
Syracuse	WPEA	2458
North Carolina		
Asheville	WPDV	2458
Charlotte	WPFS	2458
Ohio		
Akron	WPDO	2458
Cincinnati	WKDU	1712
Cleveland	WRDH	2458
Columbus	WPDI	2430
Dayton	WPDM	2430
Mason	W8XAL	6060
Toledo	WRDQ	2470
Youngstown	WPDG	2458
Oklahoma		
Oklahoma City	KGPH	2450
Tulsa	KGPO	2450
Oregon		
Klamath Falls	KGZH	2442
Portland	KGPP	2442
Salem	KGZR	2442
Pennsylvania		
Newton Square	W3XAU	6060, 9590
Philadelphia	WPDP	2470
Pittsburgh	WPDU	1712
Pittsburgh	W8XK	21540
Reading	WPFE	2442
Saxonburg	W8XK	6140, 9570, 11870, 15210, 17780
Swarthmore	WPFQ	2470
Rhode Island		
East Providence	WPEI	1712
Pawtucket	WPFV	2470
Woonsocket	WPEM	2470
Tennessee		
Johnson	WPFR	2470
Knoxville	WPFO	2470
Memphis	WPEC	2470
Texas		
Beaumont	KGPL	1712
Dallas	WKDW	1712
El Paso	KGZM	2414
Houston	KGZI	1712
San Antonio	KGZE	2506
Waco	KSW	1712
Wichita Falls	KGZL	1712
Utah		
Salt Lake City	KGPW	2470
Washington		
Aberdeen		2414
Seattle		2414
Tacoma	KGZN	2414
Washington, D. C.		
	NAA	6120, 9550, 11730, 15130, 21500
	WPDW	2422
West Virginia		
Charleston	WPHI	2490
Clarksburg	WPFP	2414
Wisconsin		
Milwaukee	WPDK	2450
Vatican City		
	HJV	15120
Venezuela		
Caracas	YVIBC	6110
Caracas	YV3BC	6150
Maracaibo	YV2AM	7200
Maracaibo	YV5BMO	6072
Maracay	YUR	9175

NEW EDITION (1934)
"THE RADIO AMATEUR'S HANDBOOK"

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PRICE, $1.00, POSTPAID

RADIO WORLD, 145 West 45th Street, New York, N. Y.

Increases Reported in Employment, Wages, Profits

Seasonal increase in radio factory employment during August, 1934, is reported by the Bureau of Labor Statistics of the Department of Labor following a slight decrease in radio employment last July.

During August, 1934, sixty radio and phonograph establishments reported employment of 39,063 employees. Of these seven factories reported wage increases to 935 employees. This compares with reports from fifty-four radio establishments in July, 1934, reporting employment of 36,761 employees, without any wage increases during July.

During August, 1934, per capita weekly earnings of the reporting companies were $18.04 as compared with $17.78 in July, an increase of 1.4 per cent, and 6.6 per cent above August, 1933.

Average hours worked per week during August, 1934, were 33.4 compared with 31.9 during July, a decrease of 6.2 per cent, however, from August, 1933.

Average hourly earnings during August, 1934, were 53.9 cents as compared with 54.4 cents during July, but an increase of 20.2 per cent over the average hourly earnings in August, 1933.

An increase in radio exports during both July and August is reported by the U. S. Department of Commerce, Electrical Equipment Division. Exports of receiving sets during August totaled 41,047 with a value of $1,096,674, as against 34,909 sets in July valued at $1,030, 693.

Tube exports in August totaled 625,-719 valued at $306,865, and 916,624 tubes at $469,491 in July. Exports of loud speakers during August were 7,968 units valued at $22,751, as against 15,270 units in July valued at $40,270. Exports of radio parts and accessories during August were valued at $422,901, compared with $462,966 in July.

Separate Radio Code Delayed

Developments in negotiations for separate code operation for the radio industry were reported to Radio Manufacturers, Association, Inc., by Arthur T. Murray, chairman of the RMA Set Division and code supervisory agency for set manufacturers, and Bond Geddes, executive vice-president and general manager. Progress on the radio code matter is continuing but is delayed by recent NRA reorganization and new policies, following the resignation of General Hugh S. Johnson as Federal administrator. New labor, price-fixing and other policies are being developed by the new NRA administration.

Indications are that the 36-hour week for manufacturers under the electrical code will continue. Formal application has been made to NRA by the electrical industry for increase of the work week from 36 to 40 hours. It is possible that a formal order providing for such extension may be approved but with an accompanying order indefinitely suspending the 40-hour provision, thus continuing the 36-hour week until after further consideration by NRA. An electrical code authority committee will meet with the NRA in a short time and further revision of the electrical code, including overtime and other labor provisions and additional trade practices, also is expected soon. Another NRA decision, of interest to radio manufacturers and also distributors in early prospect, is that regarding recent orders of the radio wholesalers' code authority.

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Radio University

ANSWERS to Questions of General Interest to Readers. Only Selected Questions Are Answered and Only by Publication in These Columns.

Pentagrid Tubes

DOES THE PENTAGRID converter tube inclusion necessarily mean advanced design, especially due to the resultant electron coupling, and if so why are separate local oscillators used?—L. C.

The pentagrid converter tubes, like the 2A7 and 6A7, represent an advanced design over the use of the super-pliodynatron, normally called the dynatron, which was the previous practice where tube economy was desired. The dynatron was unstable and besides the circuits used resulted in plenty of squealing. Electron coupling is advantageous, but possibly some day a tube will be designed whereby the coupling remains right for the band served. At present the coupling is rather tight, so that at frequencies much higher than 10 mgc the modulator input tuning and the oscillator tuning tend to become one. This locking is very disadvantageous, for the benefit of a tuned stage is lost, at least, whereas by use of a separate oscillator, electron coupling still may be preserved, but it may be more readily adjusted to a value that is not too tight for the high frequencies, though for the low frequencies it might be less than desired, but that does not matter much. In the broadcast band, for instance, there is plenty of gain to spare, due to the heavier and steadier signals laid down.

* * *

Short-Wave Converter

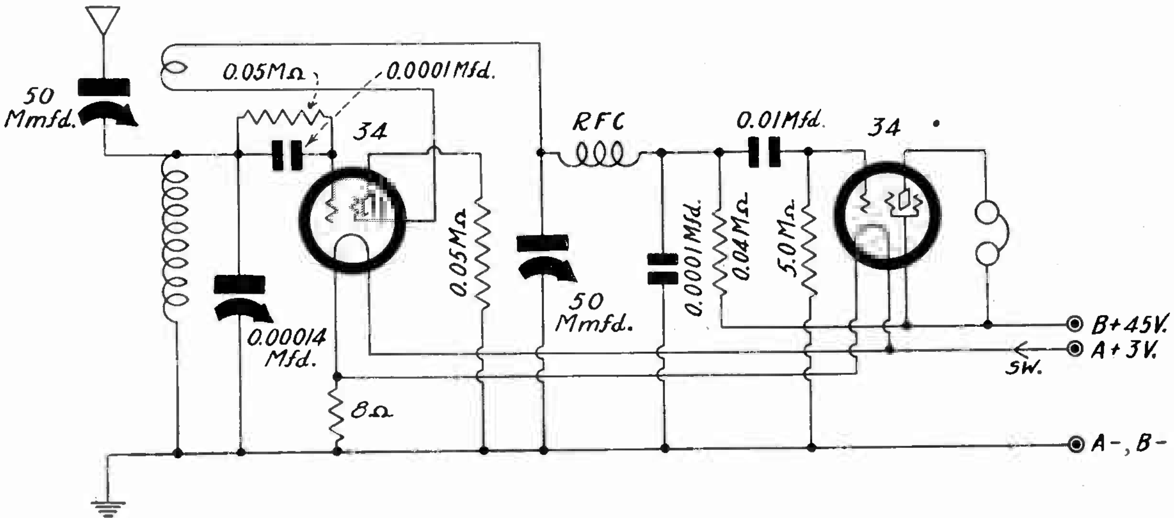
THERE IS an abundant market for a good short-wave converter. Now that sets are more sensitive no doubt converters will prove more popular. There wass too much grief in the early models. Do you think that a good converter can be built without a pre-selector stage?—K.L.

If the receiver's fixed frequency is high enough, the improvement in image rejection is about on a level with the introduction of a pre-selector, or tuned-r-f stage. Even so, the pre-selector might be included for the high i-f condition. One reason for avoiding the extra tuned stage is coil complications. It is sufficient for general purposes simply to have the modulator and the oscillator tuned. The i-f, or fixed receiver frequency, may be a bit beyond the highest in the broadcast band. This is not as quiet a region as 650 kc etc., nor as selective, but image trouble is greatly reduced, and locking is minimized. This way signals of higher-frequency carriers come in more reliably, anyway. Many get excellent results from converters. Others get poor results. Much depends on the converter, of course, but as much on the set. The usual run of t-r-f sets may not be selective enough in the region indicated. Older models even would not tune to such a high frequency. Then one also must see that if ganged tuning is used that the tracking is good. Poor tracking often results, due to use of identical plug-in coils. For at least the two lower-frequency short-wave bands the oscillator secondary inductance should be reduced. Experiment will yield the answer to the number of turns to take off.

* * *

Special Use of Tube

WHEN THE USUAL plate is grounded and the screen is used for feedback, does the screen-grid tube function as such, or as a triode?—W. D.



Special use of a screen-grid tube, with usual plate seemingly grounded through a medium resistor. However, current flows through this resistor, hence the value should not be such a high resistance as to impair tube performance.

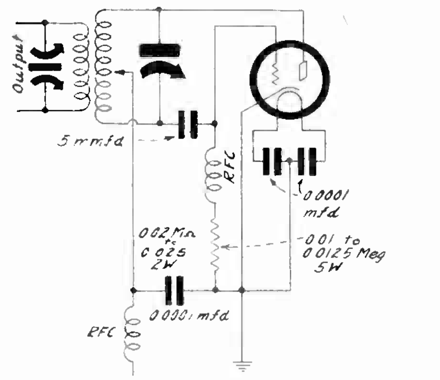
It functions as a special triode. The connection is shown in the diagram above. The resistor in the conventional plate leg should not be very high, as there will be current flowing in it, and too high a potential at this element will reduce the transconductance of the functioning part of the tube. Otherwise the circuit shown, for earphone reception of short waves, is standard. For a 34 output tube the 'phones should be of the high-impedance type.

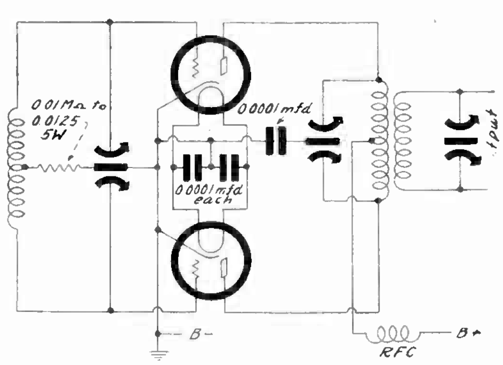
* * *

Acorn Tube Circuits

IN THE CIRCUITS for use of the acorn tube, 955, for high frequencies, what is the type of condenser that has two rotors and a single stator? This is shown repeatedly, but I have no such condenser. The type I possess has two stators and two rotors and while the rotor is common to the frame, the stators are separate. Yet diagrams show the kind of condenser that, so far as I know, does not exist. —W.M.C.

The type of condenser that has one effective stator and two separate rotors can be contrived of two single condensers, with shafts extending also at rear, which is a characteristic of several junior or midget condensers, especially those of the shaped-plate type (midline, etc.). The rotor may be frame-conneced, but the frames would be insulated from a chassis. The tube you refer to is a triode, of the heater type. 6.3 volts, and is used pretty much as any other triode, except that it is imperative to keep the grid input impedance high, and an extra r-f choke is used for this special purpose. The choke is RFC in series with the grid leak in the diagram at lower left. At lower right is a push-pull oscillator. This type of circuit may be somewhat more stable than the single-sided type, as the even-order harmonics are suppressed, and reduction of harmonics is in the direction of stability. In fact, some commentators state that instability is due solely to the presence of harmonics, and cite that a linear curve is an index of stability, whereas curvature of the characteristic denotes the presence of harmonics. The comment on curvature is certainly true. The importance of frequency stability in the region of wavelengths covered, say below 5 meters, is well recognized, but the technique of achieving it has not been fully developed.





At left, an acorn-tube oscillator, with r-f choke in series with the grid leak to hold up the input impedance. At right, a push-ull oscillator.

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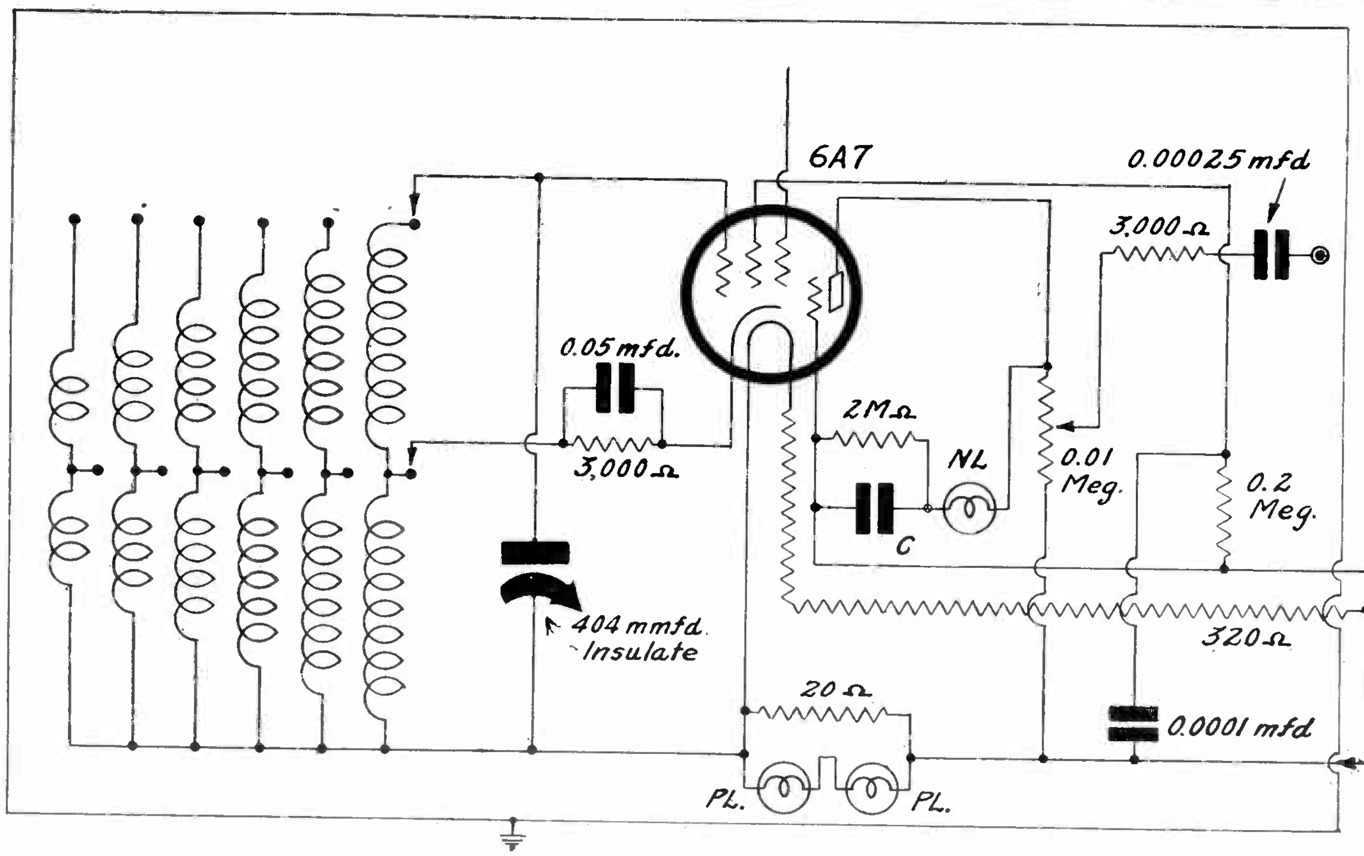


Generator to which decimal multiplication of a low-frequency scale is applied.

High Fidelity at R. F.

REGARDING the three-winding intermediate-frequency coils in high-fidelity receivers, that you discussed all too briefly in your latest issue, can you not give a more detailed account of the operation and purpose?—L.E.D.

High fidelity requires relatively low selectivity. It may be assumed that full 10 kc should be passed as a minimum, but even 15 kc would be all right, because experimental stations for high-fidelity transmission, now in the 1,500 to 1,600 kc band, are separated by 20 kc, and assumptively may try higher modulation frequencies than 7.5 kc. For DX work it is advisable to have a closer cutoff even than 10 kc, although this fact is often concealed, because the fact is so well known that over-selectivity injures tone, by attenuating the audio highs. Nevertheless you can't well have both—lots of DX and abundant sidebands as well. So the three-widing coil is coming into use. The primary and secondary may be tuned as usual. The middle coil would be tuned also. As a tuned circuit it is a load on the amplifier, equivalent to a resistance, hence lowers the selectivity. By a resistance control, this third tuned circuit is made ineffective, practically, by introducing a high resistance between it and the coupled pair. Hence by resistance adjustment selectivity may be altered. The dropping off of the highs when the selectivity is increased is very noticeable, and the comparison will teach any untutored ear the difference between high fidelity and low fidelity. In general, sets in the past have been of low fidelity, and the new approach to tone is indeed an improvement worthy of the closest study and fullest approval.

* * *

Number of I-F Stages

SOME SET manufacturers have only one i-f stage in their all-wave receivers. Why is this? I thought two stages were necessary. And is the set more stable with only one stage?—K.W.X.S.

Differences of opinion exist among engineers on such topics, just as differences exist among other persons on other topics. The single i-f stage makes for less noise, just as any lower sensitivity makes for less noise. The program still can be heard, but the quantity of sound is not so great. Yet the noise is perhaps better than proportionately less. Hence the ratio of signal to noise is increased. Nearly all sets that are sensitive, and likely to be noisy when operated at maximum sensitivity, have a sensitivity control, which may be so positioned as to make the very-sensitive set operate for the time at no greater sensitivity than the other. This fact is not generally appreciated by the public. Most receivers have two-stage i-f channels. However, that does not decide the problem. Perhaps the one-stage method is preferable to a public that makes all comparisons with all controls turned "full on." One stage usually is more stable.

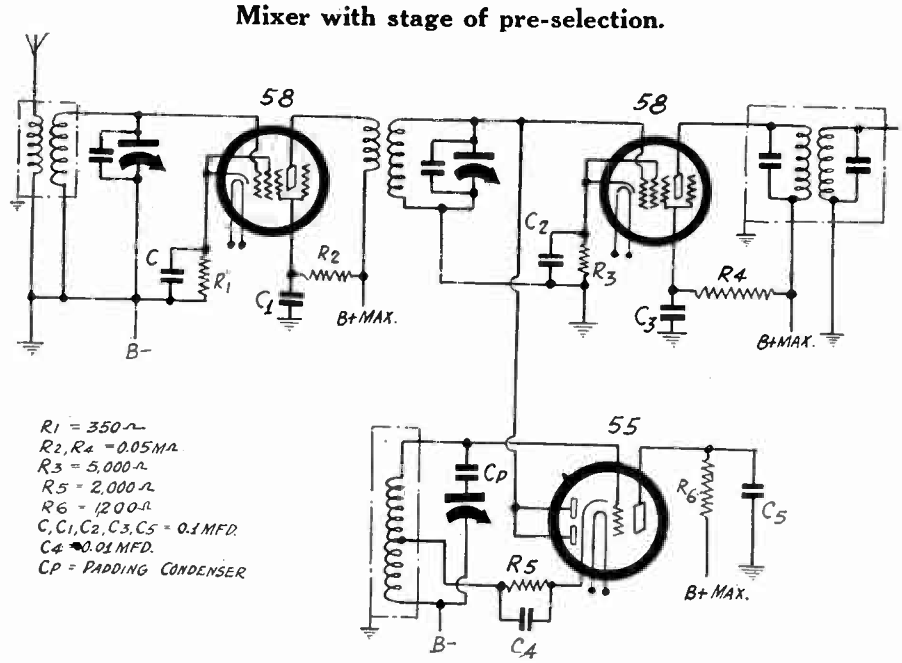
* * *

Decimal Scale

AM I RIGHT in understanding that the decimal system of frequency scale multiplication can be used only when the ratio is constant, band to band? What is the connection for the control grid (No. 4) of the 6A7 and 2A7 for the circuit you discussed? Please show a mixer with preselector.—R.D.

Yes, the frequency ratio must be kept constant, band for band, approximately equal to the square root of 10, certainly not less. The control grid for maximum ratio, lowest input capacity, should be grounded. It is shown as free. The mixer is diagramed below.

Mixer with stage of pre-selection.



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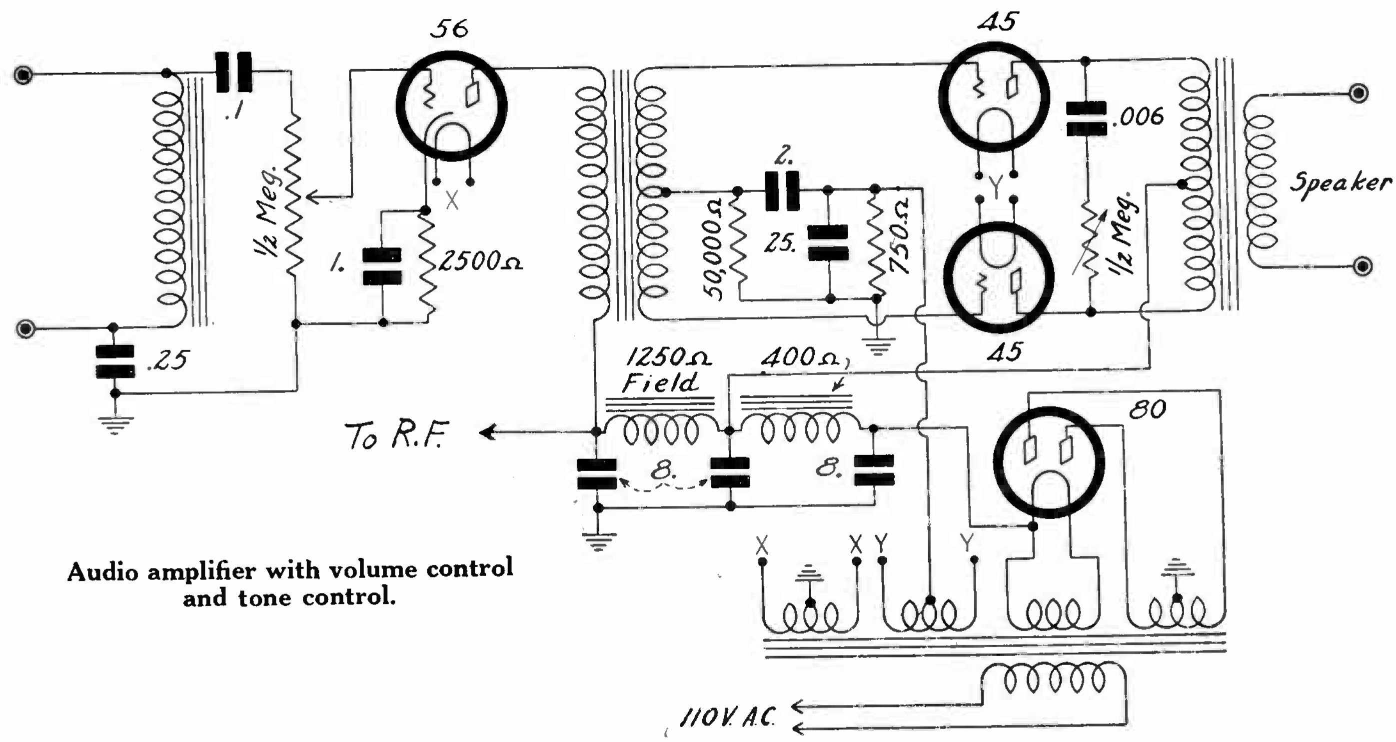

Audio amplifier with volume control and tone control.

Honeycomb Coils

CAN NOT small honeycomb coils be used for radio-frequency stages of tuning, say, in the broadcast band, at least? They are used for intermediate frequencies that almost enter the broadcast band (e.g., 480 kc, compared to the broadcast low of 540 kc).—P. L. O'C.

Yes, they may be used. In general, the solenoid is superior, but if honeycombs are used the circuit can be arranged to compensate at least in part for the increased resistance, due to the necessity of using more wire to attain a given inductance. Some commercial attempts to use honeycombs in the broadcast band did not fare so well because the coils were put in 1-inch diameter shields. Of course the shields should be somewhat larger than that in diameter, and the wire should not be as fine as No. 40 or so. As the frequencies become higher, however, the honeycomb practically disappears from the field of usefulness.

* * *

Bandspread Capacity

WHAT SHOULD BE the capacity of a bandspread condenser, compared to the main tuning condenser? Does a small wheel, actuating an extra pointer on a set, constitute a bandspread?—I. K.

There is no set rule for the relationship. Indeed, the answer would depend on the frequencies. Assuming that four bands are covered with 0.00014 mfd. for short waves, the bandspread parallel condenser should be selected on the basis of the highest band covered, so that on the lowest band of short-wave frequencies the effect of this capacity would be practically nil. One limitation is the capacities obtainable in commercial models. We believe that smaller capacities will be used in the future, something around 25 mmfd. The small wheel-operated vernier pointer is not strictly a bandspread device, as for a given angular displacement of the tuning knob the frequency change is not altered.

* * *

Tuning Meter

IF A TUNING meter is strictly necessary where there is automatic volume control, why do some sets omit such a meter? —K. C.

In general, the tuning meter is necessary with a-v-c circuits, because the response is practically uniform up to 5 kc off resonance, so the exact resonance point can not be attained by ear, unless accidentally. There are some exceptions. One is the instance of the diode-biased triode. Here the only bias on the triode part of the tube is that caused by the rectified component of the signal. When this component is low the bias is so low that the tube practically does not amplify, therefore only at resonance is strong response heard, hence a tuning meter does not become an adamant necessity.

* * *

All-Wave Coupler

IN WHAT MANNER is a universal coupler used with an all-wave antenna, so that it presents the right impedance to all frequencies?—I. W.

We would like to know. It is our opinion that there is no single unmolested coupler that presents the right impedance to all frequencies, since for that result to accrue you would have to create a condition of tuning without any tuning. The all-wave aerial itself is much more effective over certain bands than over others. The coupler has the same discriminatory effect. Although the discriminations might be arranged so as to offset one another, the net effect would be a considerably lowered average input. A manually controlled series antenna condenser, used with an inverted L aerial, is entirely satisfactory. Transposition blocks, twisted pair, and the like may be used, or some other form of transmission line, where noise-reduction is important.

* * *

Inductance Change

DOES THE inductance of a short-wave coil change? If so, why?—T. F.

The inductance changes, especially in the run of commercial coils. This is due to temperature affecting the wire diameter and spacing between turns, and also due to moisture, which changes everything ,and to changes in the properties of the form on which the coil is wound, due to temperature, moisture, etc. Also, many types of forms used are somewhat magnetic in themselves. Special materials, like R-39, have the iron removed to get rid of this effect, and thus have forms that make practical the winding of uniform inductances. In general, the added precaution of threading the form, and winding the wore in the threads, in addition to the use of special form material, is needed for the attainment of equal inductances in manufacture, and inductances that stay put after the coils are wound. Some form of binding also is found necessary in most instances. This is "coil dope," and while it has some deleterious effects, it has some advantages, especially as it tends to produce a moisture-proof winding and keeps the winding intact.

* * *

Volume Control

WHAT IS THE BEST way to use a simple potentiometer to control the volume at the audio level? Also, what is a good tone control?—L.M.

There is no way of using the simple potentiometer to get really high-caliber results in volume control at the audio level. To attain that objective special controls, called pads, are used, and these are expensive. The object is to present a constant impedance. This is pretty nearly achieved, but not quite, by the pads. Perhaps there is no such thing as a real constant-impedance pad or control for this purpose. The potentiometer use shown for audio control is more or less standard for receivers and small power amplifiers, but at low resistance between grid and ground (large attentuation) the low frequencies suffer a lot. The tone contol and values are shown in the power tube output circuit. Notice that in this power amplifier the plate current of the output tubes, the highest current, is not passed through the field winding, but through a separate choke, the d-c resistance of which is 400 ohms. This choke is of course on a separate core.

Micro Waves Pierce "Shadow," Says Marconi

Complete visual obstruction of micro waves does not prevent their advantageous use for short-distance communication, Guglielmo Rarconi said in a talk before the microphone of 2RO, Rome, which was picked up by an NBC station here and sent over a chain. Short-wave broadcasts from 2RO, to be known as "The American Hour," will be on regular schedule soon. The schedule has not yet been definitely fixed.

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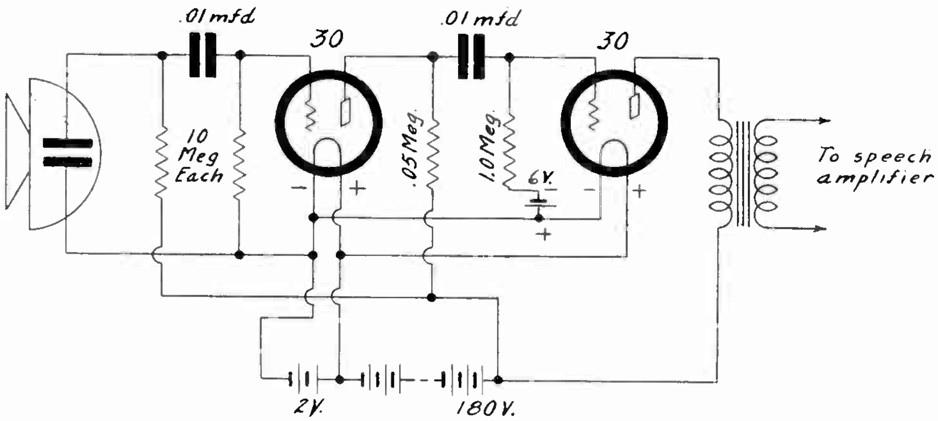
THE AMATEUR ORACLE

Address Questions Concerning Amateur Regulations and Technique to M. K. Kunins (2 Dps), Technical Editor, Radio World, 145 West 45th Street, New York, N. Y.



A pre-amplifier circuit for condenser microphone to present a sufficiently large signal to the speech amplifier.

Sub-Harmonics

CONTROVERSY among our group of hams happened to drift to the subject of sub-harmonics some time ago. I still wonder regarding the existence of these frequencies. Will you discuss this matter?—A.S.D.

The theorists would have us believe that whenever harmonics of an alternating current are discussed, multiples and not sub-multiples of the frequency of this alternating current are involved. This statement is substantiated by Fourier's series—a formula used in the mathematical treatment of this subject. Nevertheless, it is a curious anomoly that practical observations will wreck many grand radio theories. And so, it is not too surprising to find that two independent observers, Strafford and Pederson, have shown experimentally that sub-harmonics can be generated. However, there is much work to be done in this direction before the accepted theory can be suitably revamped.

* * *

Tubes with Black Plates

RECENTLY I'VE NOTICED that the newer tubes are manufactured with black plates. Has this a technical significance or is it just a trademark?—C.F.D.

The vacuum tube with the black plates is a technical improvement over past practise whereby plates in a vacuum tube were left in their original metallic shiny state. This improvement involves the minimizing of the phenomenon occurring in tubes known as "secondary emission." This phenomenon was caused by the high-speed electrons from the cathode hitting the plate with such velocity as to dislodge electrons from the plate itself. This would cause a secondary stream of electrons being emitted from the plate which would back the electron stream from the cathode and create distortion of the received signal. Experiments by tube manufacturers have shown that a blackened plate, achieved by carbonizing, minimizes this effect and so improves the results. Though such a development might not make a telegraphy amateur overenthusiastic, it is of great value for the reception of telephony and consequently is a big improvement.

* * *

Head Amplifier

THE CARBON MICROPHONE in my 'phone transmitter had been going bad on me recently, so I purchased a condenser microphone head to replace it. However, substitution of the condenser microphone for the carbon one failed to show any improvement. In fact, no signal was audible. Please advise whether this trouble is caused by a defective microphone or because of faulty circuit design?—T.G.F.

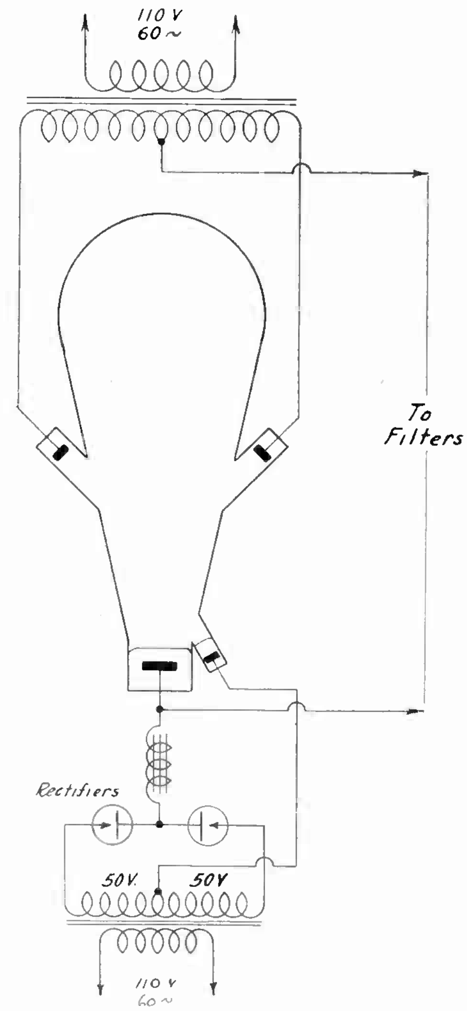
A condenser microphone is not interchangeable with a carbon microphone because of its very high impedence and because of its low sensitivity. Though a condenser microphone does not have to weather vagaries of the carbon microphone, and though it is much better for fidelity, it has the unfortunate disadvantage of requiring much preamplification. Therefore, to substitute it for a carbon mike, it will be necessary for you to add a two-stage resistance-coupled amplifier between your old microphone amplifier and your condenser microphone. This amplifier is diagramed herewith.

* * *

Mercury Arc Rectifier

I HAVE RECENTLY picked up one of the old mercury arc rectifiers and am interested in connecting it up for experimental purposes. Please indicate a diagram that might be used in this connection.—J. Y. K.

The mercury arc rectifier has very largely been displaced from amateur practice because of the great variety of thermionic and mercury vapor rectifier tubes that is more cheaply available on the market. However, the manner of connecting the mercury arc rectifier is diagrammed. It will be seen that two transformers are necessary, the upper one being the high voltage one and the lower one for the keep-alive circuit. This keep-alive circuit has the function of starting the arc and maintaining it. This is accomplished when the tube is tipped slightly by hand or other contrivance so that the mercury pools in the lower electrodes flow into each other and then break to form an arc which vaporizes the mercury and starts the tube operating. It is wise to keep the lower part of the tube in a bath of light oil because of the concentrated heat at the lower electrodes. The rectifier tubes for the keep-alive circuit may be of the Tungar type or as a substitute two electrolytic rectifiers may be made up in two half gallon jars containing a borax solution and aluminum and lead electrodes.



The old-time mercury arc rectifier. The connections are shown for practical operation.

Photostats of Licenses

I'VE HEARD conflicting opinions regarding the legality of photostating amateur licenses and upon which basis a ham station may be operated. Please advise as to the correct status of the regulations on this point.—H. L. G.

Recently the Commission rescinded its former order allowing the use of photostat copies of licenses. Accordingly, should you desire to operate from two points and cannot conveniently take your license to and fro, you should request the Commission to furnish you with a special letter attesting to the existence of your license. This letter will then serve to verify the fact that you are legally operating a transmitter under a valid license. The letter should be displayed in similar fashion to your reguluar license.

* * *

Capacity and Inductance

WHAT IS THE DIFFERENCE between capacity and inductance coupling and what are the special applications of each?—M.L.K.

Two circuits are coupled together capacitatively when they are linked together by means of an electro-static field. This method utilizes condensers as shown. When the linkage between two circuits is obtained by an electro-magnetic field, as by a pair of coils shown, the coupling is inductive. Since the reactance of a condenser is greater for lower frequencies than for the higher ones, it might be used where it is desired to attenuate the lower frequencies. Similarly, since the reactance of an inductance is less for the lower frequencies than for the highs, it might be used to represent the higher frequencies. The special applications of such coupled circuits are seen in low-pass, high-pass and band-pass filters.

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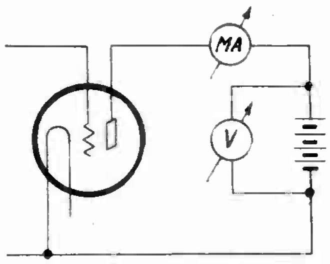
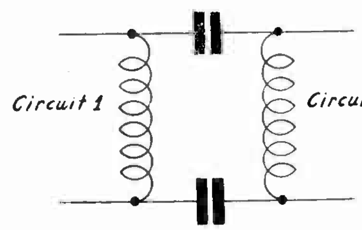
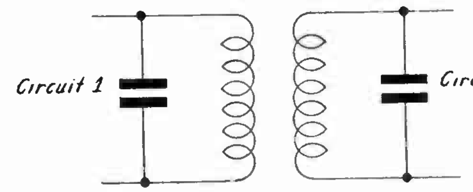


The plate input power to a vacuum tube may be measured by means of a d-c milliammeter and a voltmeter connected in the plate circuit.



The energy in circuit 1 is transferred to circuit 2 because of the capacity of the two condensers.



The energy in circuit 1 is transferred to circuit 2 because of the inductive coupling of the two coils.

(*Continued from preceding page*)

Plate Input Power

HOW IS PLATE INPUT power to a vacuum tube measured?—A.S.

Plate input power measurements require the use of a d-c milliammeter and d-c voltmeter, connected as shown. Multiplication of the two readings and dividing by 1000 will give the power input in watts.

* * *

Antenna Ammeter Measurement

WHAT DOES an antenna ammeter indicate?—A.L.S.

An antenna ammeter measures current in the feeder at the meter's position in the circuit and does not measure efficiency, radiation or energy directly, as supposed by some amateurs.

* * *

Resistances in Parallel

I DO NOT UNDERSTAND the method used in determining the value of a pair of resistances connected in parallel. Will you please show the general theory involved?—O.U.G.

Connecting two resistances in parallel reduces the net resistance and also increases the current carrying capacity of the circuit. When two equal resistances are connected in this fashion, the net resistance is half of either resistance singly; and, the current carrying capacity is double that of either resistance alone. In general, the formula that is applicable is: Total resistance =

$$\frac{1}{\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}+\frac{1}{R_4}+\text{etc.}}$$

where R_1, R_2, R_3, etc. are the resistance values of each individual resistor used in the parallel combination of which the net resistance is desired.

High-Frequency Circuits

PLEASE SHOW a Hartley circuit for the acorn tube for work on 56 mgc, also a two-tube balanced oscillator for the same purpose, with concentric-tube feeders, and a balanced tuned-plate oscillator. —R.F.

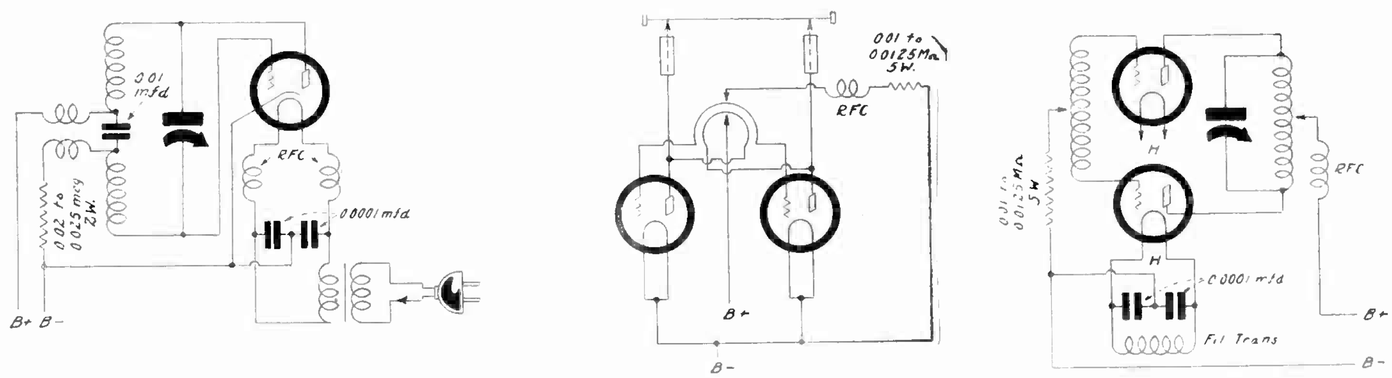
The acorn tube in a special Hartley circuit is shown at left below. The two other circuits you refer to have filament-type tubes. In the central diagram battery operation is assumed, no modulation. In the right-hand one, the line hum will constitute the moldulation, hence this circuit can be used as a generator for ready measurements.

* * *

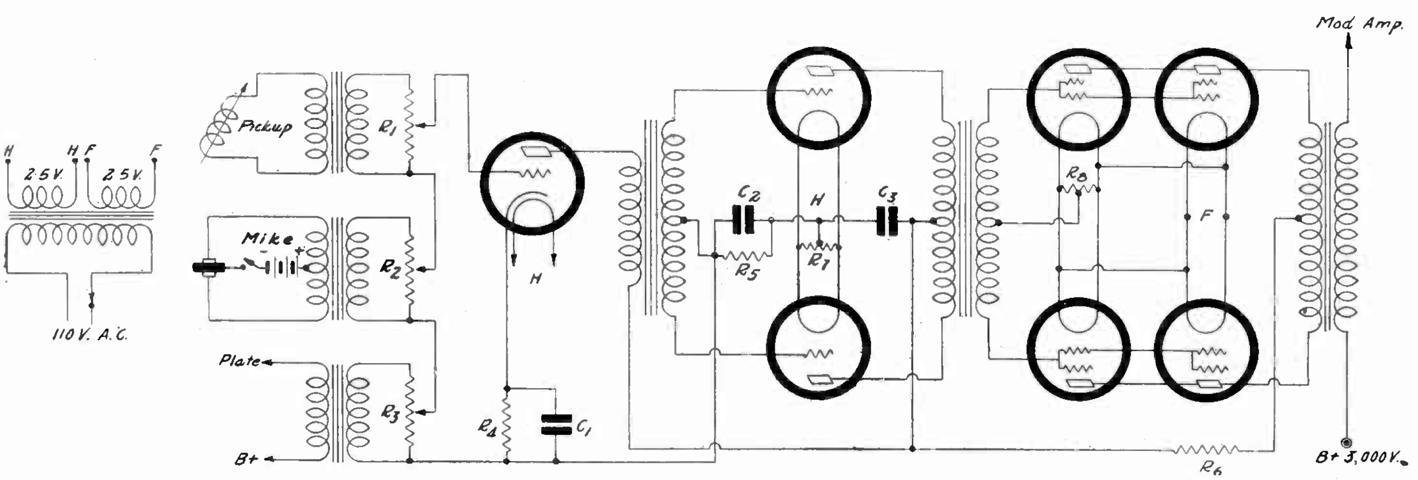
Speech Amplifier

KINDLY SHOW speech amplifier with microphone, phonograph-pickup and radio pickup input.—P.O.

This diagram is printed below.



High-frequency circuits



A speech amplifier

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Station Sparks

By Alice Remsen

RAY HEATHERTON GETS IT

A GOOD BIT OF NEWS comes our way, Ray Heatherton has a new commercial program, with Harry Reser and his orchestra, every Sunday at 4:30 p.m. over an NBC-WEAF network, sponsored by Wrigley's Spearmint Toothpaste; series to start on December 9th. . . . Radio's first three-hour dance program providing three uninterrupted hours of dance music for listeners from coast to coast each Saturday night—will be inaugurated over a nationwide NBC network under the sponsorship of the National Biscuit Company on December 1st. Three orchestras playing in the Radio City studios will send out three hours of rhythm under the title of "Let's Dance" . . . Sherlock Holmes returns on November 11th over an NBC-WJZ network and each Sunday thereafter at 4:00 p.m. Edith Meiser, who adapted all of the previous radio versions of the Doyle stories, will prepare the adventures for this new fourth series. . . . Eddie Peabody and Gus Van, will be Nellie Revell's subjects for interviews on Fridays, November 16th and 23rd respectively, at 5:30 p.m. . . .

LANNY COMES BACK

Lanny Ross is back in the NBC Radio City studios, continuing his broadcasting and preparing to give ambitious young artists in the East a radio hearing on the Wednesday evening broadcasts featuring Ross and his Log Cabin Orchestra. All this follows the close of his latest camera engagement in Hollywood. The series went on the air while Ross was working in pictures on the West Coast and brought to the microphone a number of promising young singers who had never had a chance before the nationwide radio audience. . . . Ross himself had the same hard road to travel to fame as the newcomers that are getting a "break" in Ross's Log Cabin show. A few short years ago, an obscure college boy with an untried voice and unrealized ambitions, he got a radio hearing and began the career that has gained him recognition from coast to coast.

Consequently, with his own experience fresh in his mind, he enjoys the opportunity of presenting the youthful talent from New York City and the surrounding district in the programs from Radio City.

EXPANSION OF THE NBC

General expansion of the activities of NBC Artists Service was announced by Richard C. Patterson Jr., recently. Mr. Patterson is executive vice-president of the National Broadcasting Company. The expansion is the result of recommendations made after an extensive survey. One major change in the set-up of the department, which is under the direction of George Engles, vice-president, will result in the separation of the activities of Talent Supply and Management, and of Talent Sales into two main divisions of Artists Service. D. S. Tuthill is appointed sales manager to direct talent sales. . . . Ireene and Walter Wicker are not superstitious, but Ireene has an extra "e" in her name because of numerology. And Walter has just discovered that all his NBC shows are mysteriously bound up with the initials "T.C."—they are "Today's Children," "Little Church Around the Corner" and "Song of the City." The first two were written in collaboration with Irna Phillips, and the last one he wrote alone. . . . Jane Ellison's Magic Recipes, which have been broadcast over a WABC-Columbia network on Wednesdays at 11:45 a.m., may now be heard on an afternoon spot over the same network. Each Thursday at 3:00 p.m. Miss Ellison is sponsored by the manufacturers of Borden's Eagle Brand Condensed Milk.

ROXY'S 12TH ANNIVERSARY

Roxy, pioneer showman of the air will observe his 12th anniversary on the air in his broadcast of Saturday, November 17th, at 8:00 p.m. over a nationwide Columbia network. Don't miss it! . . .

REAL MINISTER OFFICIATES

A real clergyman officiated at a make-believe wedding at Radio City when Cap'n Henry, skipper of the famous Show Boat of the air waves, "married" his old sweetheart, Nancy Stokes, before a misty-eyed audience that crowded NBC's largest studio to capacity for the "ceremony." The clergyman, who took a conspicuous part in the broadcast over NBC networks was the Rev. Dr. George H. Mack, President of Missouri Valley College at Carshall, Mo. . . . The Maxwell House Showboat, on its mythical cruise stopped at Jefferson City, Mo., only a short distance from Marshall, to celebrate Captain Henry's nuptials. When the sponsors learned that Dr. Mack was visiting New York and had asked to be in the studio for the broadcast, they invited him to be guest of honor and, as an ordained minister, to perform the ceremony, adding a touch of realism to the radio drama. It was his debut before the microphone. . . . The wedding, arranged by script writers to allow Cap'n Henry to take a leave of absence fro mthe cast, had all the features of a real church ceremony, with the singing of "Oh Promise Me" and the playing of Mendelssohn's Wedding March. . . . The "wedding" introduced to the radio audience Captain Henry's brother, George Henry, played by Frank McIntyre, a veteran of 30 years on the American stage. . . .

STUDIO NOTES

Wendall Hall, the "Red Headed Music Maker," made more than $50,000 from sales of his song "It Ain't Gonna Rain No More," but this was a decade or so ago. . . . While Himan Brown, author and director of the NBC dramatic program, "Peggy's Doctor," was in the studio directing a broadcast recently a new member of the family began broadcasting in an uptown hospital. Mrs. Brown and the eight-and-one-half-pound boy are doing well. . . . Jacques Renard has dropped a hundred pounds from his weight —and does it make a difference? Well, rather! . . . Frank Simon, conductor of the Armco Band, heard from WLW over NBC, recalls the days when he was assistant bandmaster with Phillip Sousa and the band always struck up "El Capitan" march whenever the lights went out, if they stayed out, "Stars and Stripes Forever" always came next. . . . A few years ago, when Frederic March was just trying to crash the films, Thomas Meighan, noted star of the silent screen, gave him a helping hand. The two became fast friends. Recently auditions were being held for an actor to impersonate March in the "Forty-Five Minutes in Hollywood" radio version of his latest film, "We Live Again." The fellow who got the job was James Meighan, radio actor and nephew of Thomas Meighan. . . . The Tree of Hope, which gave so many of Harlem's famous entertainers encouragement, is still doing that over the ABS network. Bill Robinson, the colored dancer, saved a large piece of the tree when it was cut down recently and presented it to the management of the 125th St. Apollo Theatre, and each colored aspirant touches it before going on in the Harlem Amateur Night on Wednesday over the WMCA-ABS network at 12:00 midnight. . . .

"YOUR ANNOUNCER IS:"

ELLIS ANDREWS—One of NBC's youngest announcers, Andrews came to radio from Wesleyan College, where he specialized in languages and dramatics. His hobby is racing sail boats and he has a yen to sail around the world. Joined NBC last June.

GEORGE ANSBRO:—One of the few native New Yorkers on NBC's announcing staff. Only 21 years old, he is the baby of the organization. He started as an NBC page, with but one ambition, to become an announcer.

ALWYN E. W. BACH:—American Academy of Arts and Letters diction award winner in 1929, Bach also is one of NBC's authorities on bridge. Tried his hand at law, printing and music before finding a career in radio.

WILLIAM BAILEY:—Wanted to be a dramatic actor but tried radio announcing and changed his mind. Native of Philadelphia and a graduate of the University of Pennsylvania. Five feet, ten inches tall and single. Joined NBC a month ago.

FORD BOND:—Started his career as a singer at 13; tried his hand as a newspaper reporter and mare his radio debut as an announcer over WHAS in Louisville. Since joining NBC in 1930 he has broadcast many outstanding sports events.

NELSON CASE:—NBC's tall, blonde, deep-voiced announcer hails from San Francisco. Started as theatre usher, then became a newspaper reporter and made first radio appearance as singer. Graduate of William and Mary College.

A Thought for the Week

NO RADIO DICTION PRIZES for radio announcers and actors this year! That's not the happiest statement that has come from the American Academy of Arts and Letters but it fits the facts. The award committee of the Academy does not offer any apologies in deciding on the no-award policy for 1934. The members indicate, however, that a canvas shows that no announcer of the year has won any particular acclaim—due, in part, we understand, to the fact that there is a more general excellence now among microphone specialists than there was during any previous year.

Mr. David Ross et al can not be blamed for feeling they are fortunate in having won their laurels during the period when radio speakers were less gifted generally than they are now and when judges of the great American indoor game of microphoning were more enthusiastic and less bored than they seem to be at present.

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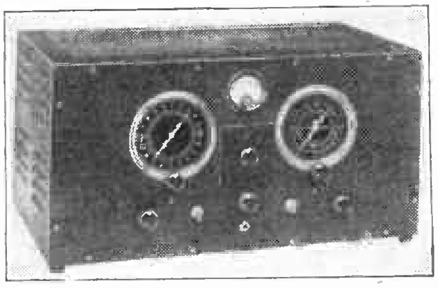
Peak Precision in POSTAL'S All-Wave Model 35

USED BY CAPT. HORACE L. HALL



Every Desirable Refinement Is Included in the POSTAL All-Wave Model 35 Receiver

EXTREME pains were taken to put peak precision into the POSTAL Model 35 All-Wave Receiver, and make its performance incomparable with that of mass-production receivers. The POSTAL 35 is custom-built and has fifty important features. It uses the shielded drawer-type coils developed by POSTAL, has a stage of tuned pre-selection to squelch noise and image interference, a separate 56 local oscillator, a beat-frequency oscillator, direct-reading frequency-calibrated large airplane dial; separate tiny three-gang bandspread condensers with separate airplane dial; automatic volume control; two dual manual volume-tone controls; tuning meter, and an exquisite eye appeal, externally and internally, with painstaking cabled wiring of chassis. This a-c operated all-wave receiver is one of the finest obtainable, meant for the discriminating and the appreciative set-owner.

Write at once for free descriptive pamphlet, No. RW-150, and special prices to Radio World readers.

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World-Famous SHORT-WAVE PRODUCTS

"COSMAN TWO"

Battery operated S. W. receiver. Novel rack permits placing of five coils in proper band order—no groping for coils. Efficient design permits tuning from 15 to 200 meters. The regular broadcast band can be tuned with a broadcast coil (200 to 550 meters) at additional cost of 39c. Uses a 232 and 233 tube.

Kit of parts..................$5.95
Wired and tested .... 1.50 extra
Set of RCA licensed tubes..... 1.40

"DUO WONDER"

2-in-1 short wave receiver. Features the new type "19" tube. Supplied with coils to cover the entire wave band, without any gaps whatsoever, from 15 to 200 meters. A fifth coil, covering the broadcast band (200-550 meters) supplied for 39c additional.

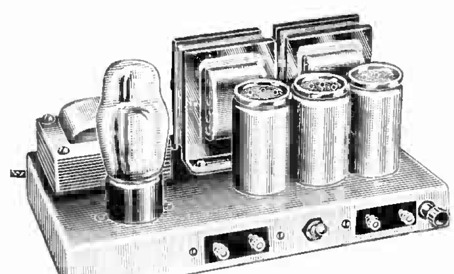
Kit of parts $4.95
Wired and tested............. 1.00 extra
RCA licensed '19 tube......... .60

DICTATOR of the AIR
Battery Short Wave RECEIVER

Made famous by its consistent reception. Will tune stations from every corner of the globe—from 15 to 200 meters with Powertone plug-in coils. Two sets of coils are used with the Dictator of the Air for clearer and more decisive reception. Uses 1—234 and 2—230 tubes.

Kit of parts $9.95
Wired and tested............. 2.00 extra
RCA licensed tubes........... 3.10

Short Wave POWER PACK



Supplies clear, hum-free power, regardless of circuit sensitivity. Especially designed for use with Dictator of the Air battery receivers. Delivers 180 volts with taps at 135, 90 and 45. Supplies 2½ volts at 10 amps. Uses 280 rectifier tube.

Wired and tested with tube.........$5.95

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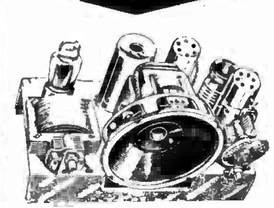

Four-Tube A-C Short-Wave Receiver with Built-In Speaker

Will tune in short-wave stations from all parts of the world with ease. Uses four plug-in coils to cover the entire short-wave band from 15 to 200 meters. The built-in power supply is entirely free from hum or disturbing line noises. Uses an ultra-sensitive dynamic speaker which aids in tuning in the weaker signals.

Cat. 4TK. Kit of Parts, less cabinet, less tubes.................**$17.50**
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Cat. 4TCB. Cabinet only...**$1.50** extra
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U. S. GOVERNMENT SHORT-WAVE STATION LIST

2,400 short-wave stations listed by frequency, wavelength, with call, location, and power. Some time-tables included. All the short-wave phone transmitters on earth (except amateurs)!
Distance map for world application printed right in the book!

THE CONTENTS:

Station Identification: List of the most popular short-wave program stations of the world that use characteristic "air signatures."

Foreign Alphabetic Pronunciation: How the letters of the alphabet and numbers 1 to 50 are pronounced in English, French, Spanish, German and Portuguese.

Short-Wave Broadcasting and Police Radio Stations by Countries: The calls, location and frequencies are given for the whole world. It repeats data found in the main grouping of the 2,400 stations by frequencies.

Distances to Foreign Cities: A textual and map-illustrated explanation of how to determine how far any one city on earth is from some other city.

Short-Wave Radiophone Stations by Frequencies: This is the comprehensive, never-before-available list of the 2,400 or more stations, including all the program stations on earth that send on short waves, using phone (speech and music) but not including amateurs. A treat unparalleled in radio history—the most accurate list of its kind man has ever produced!

Time Zone Chart: This insert (stitched right in the book) is a black and white reproduction of a colored chart issued by the Hydrographic Office, Navy Department.

Send $1.00 for 8-weeks subscription for RADIO WORLD *and ask for "World Short-Wave Radiophone Transmitters" sent post-paid as premium.*

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New Signal Generator *Free*
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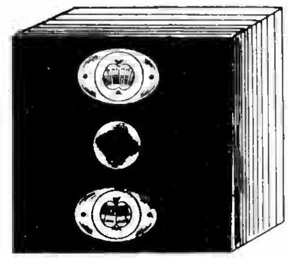

The Signal Generator, PRE-6, has practically straight - frequency - line tuning. It works on 90-125 volts, a.c. or d.c., and is modulated on a.c.

The Signal Generator offered as a premium with a one-year subscription is a serviceable instrument, of durable and accurate construction, and enables the peaking of intermediate frequencies, as well as broadcast frequencies. Moreover, short-wave frequencies can be determined. Determinations in frequencies in kilocycles and wavelengths in meters are made by use of this splendid instrument.

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The scale reads directly in frequencies of the fundamental (109 to 200 kc, with bars 1 kc apart), and wavelengths of the fundamental (2,700 to 1,500 meters, with bars 10 meters apart). Besides the intermediate frequencies on the fundamental scale, others are on the scale on the next tier from top, including the following imprinted twice: 400, 450, 465 and 480 kc. The reason for these imprints appearing twice is that an automatic check-up on whether the channel measured is tuned exactly to the right i.f. is obtained, when using harmonics, for there is a response in the receiver channel when the generator is turned to one and then another of these two points. Hence no harmonic confusion is possible. Also, 250 and 260 kc are imprinted once on the second tier, for no confusion can result, as second harmonics are used.

GUARANTEED ACCURACY IS 1%

THE upper tier, at the edge, is 109-200 kc, the lower corresponding tier at the edge is for wavelengths. One inside tier has the registrations for the popular intermediate frequencies not on the fundamental. The other inside scale reads 0-180, so that any odd frequency one is interested in may be recorded elsewhere in respect to a calibration in degrees of a semi-circle. The 335 dial scale is used.

The guaranteed accuracy is 1 per cent. This is checked twice in a precision laboratory. The accuracy is not changed when a tube is inserted. The wired, calibrated, tested Signal Generator is supplied less tube. All you have to do is to insert a 30 tube and start making precision measurements.

Send $6.00 for one-year subscription, and ask for PRE-6. Present subscribers may renew on this basis. Shipping weight, 3 lbs. Enclose postage if prepaid shipment is desired. It's cheaper.

Foundation Unit for this Signal Generator can be obtained by sending $3 for six-months subscription (26 issues, one each week). The Foundation Unit consists of frequency-calibrated scale, two escutcheons, knob, coil, tuning condenser, and wiring diagram. Order PRE-3. Shipping weight, 1 lb.

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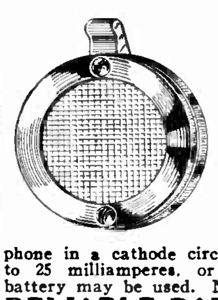

A single-button carbon-granule lapel microphone, impedance 200 ohms, requiring 4.5-volt excitation, of good frequency characteristics, and both handy and inconspicuous. Outside diameter, 1¾ inches. The case is chromium-plated brass. The excitation may be provided by introducing the microphone in a cathode circuit carrying around 20 to 25 milliamperes, or a 4.5-volt C biasing battery may be used. Net price, $1.75.

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SHORT-WAVE AND PUBLIC ADDRESS MANUAL
FREE

192 pages, 400 illustrations, costing $4,000 to produce. And yet a copy of this manual will be sent to you free if you send $1.00 for an 8-weeks subscription for RADIO WORLD. Existing subscribers may extend their subscriptions under this offer.

Bound in cardinal red leatherette, this manual includes articles on the construction of short-wave receivers from one to nine tubes, inclusive, and all values between, supers and t-r-f, with the clearest imaginable illustrations, both photographic and draughting. Besides the usual plain circuit diagram there is a pictorial diagram for each circuit. And all the photographs are brilliantly alluring and informative. Portable short-wave sets, design and winding of coils for short waves and broadcasts (intimately illustrated), list of short-wave stations with meters and kilocycles and hours on the air; trouble-shooting, and forty other topics, all done well.

The public address section contains data on different systems, how to use them, and offers opportunities to turn public address work to profit. Besides, there are articles on testing and servicing not encompassed by the title of the manual—signal generators, broadcast home and portable sets, analyzers, formulas, capacity data. Everything plainly told, simple language, from microphones to speakers.

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1935 Model ALL-WAVE DIAMOND OF THE AIR!

8 TUBES! 5 BANDS! A. V. C.!

TABLE MODEL

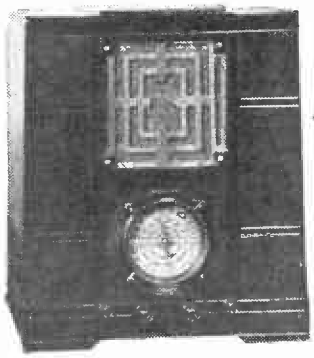
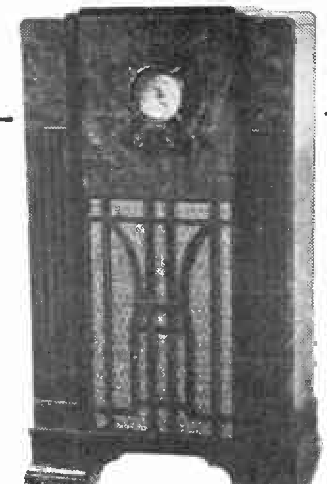


Table Model All-Wave Diamond, using the same 8-tube chassis and tubes as the console model. Wired, complete, with eight tubes. Shipping weight 28 lbs. Order Cat. 1008-T.

CONSOLE MODEL



The All-Wave Diamond, 150 kc. to 22 mgc. (2,000 to 13 meters), in its distinctive modernistic console cabinet of genuine burl walnut, curly maple front, artistically carved overlays. Extra large baffle and powerful heavy-duty 8-inch dynamic speaker. Wired, equipped with following RCA tubes: one 6A7, two 6D6, one 75, one 76, two 42's, and one 80. Cat. 1008-CON. Weight, complete, 37½ lbs. For 50-60 cycles, 110 volts. Shipping weight, 51½ lbs. Net price, F.O.B. Sandusky, O.—$45.57

WHENEVER a person wants to buy a particularly fine receiver he usually feels he has to pay a particularly high price for it. Ask almost any one what kind of a set he would want and the answer would be: "An all-wave a-c set, of course." He might prefer a console model or a table model, but he would want band selection by switching. The only drawback, perhaps, is that, times not being so prosperous, he hasn't the price of such a fine instrument. But we point to something new and startling in radio merchandising—the production of a de luxe, superb all-wave set, 150 kc. to 22 mgc. (2,000 meters to 13 meters), at the inconceivably low prices of $45.57 net for the console, and $32.05 for the de luxe table model. These two cabinets are illustrated herewith, and the same superheterodyne chassis is used in both.

These prices are absolutely net, and represent complete wired receivers, equipped with RCA tubes throughout, and securely packed.

The low prices would not mean a thing unless these receivers were of first quality and excellence, unless they had great sensitivity and selectivity, so that foreign short-wave stations and domestic broadcasts could be tuned in with enjoyable volume and steadiness, and unless the tone was marvelous. These new DIAMOND OF THE AIR All-Wave Receivers, in the two models illustrated, are quality products of the highest attainment, enthusiastically indorsed by leading radio engineers, who blink with amazement when told the selling price, in view of the outstanding performance.

As a check on whether care has been taken to make this receiver outstanding, note that the low-frequency band is included. Now, an all-wave set may mean almost anything, but when you are told that the low-frequency extreme is 150 kc., and that the highest frequency tuned in is 22 mgc. (13 meters, mind you!) then you can realize that painstaking craftsmen spent long hours getting the instruments right, so that they would cover frequencies that sweep from one end to the other of program and other bands.

And there is sufficient overlapping between bands, as you turn the gentle band-selector switch, to prevent missout. And moreover, the programs come in with steadiness and clarity, for there is a highly-effective automatic volume control, to correct for fading and to prevent blasting when tuning from station to station.

Exceptional care has been taken in prevention of image interference, and the wisest experts who have given this receiver critical attention admit that the pre-selection is abundant.

Another interesting technical point: This set runs cool. The 6-volt series tubes are used—wise choice indeed—because the elements of these tubes are stronger than those of the 2-volt series, and the power consumption in the heater is considerably less. And yet there was no skimping. The primary power consumption is 80 watts.

Nor does the dial have mere arbitrary numbers on it, 0-100 for instance, as found on what we term "unfinished" sets. This receiver has the very latest illuminated airplane dial, with frequency calibration for each of the five bands, so is direct reading in frequencies, and besides has a double pointer so the benefit of wide spreadout on the scale is derived from both semi-circles. Close vernier tuning is provided.

There is a manual volume control, a tone control and provision for phonograph or earphone connection.

And the speaker? A heavy-duty 8-inch diameter-cone dynamic speaker that is a fitting climax to an expert design and assembly.

$45.57

TO get away from the conventional and ugly cabinets in which table model receivers have been housed in the recent and remote past we have just obtained an entirely new design, 14½ inches wide, 16 inches wide, 9½ inches front to back, to house our 1008 chassis, the finest all-wave 8-tube superheterodyne receiver made. The performance is exactly the same, as between the console model and the table model.

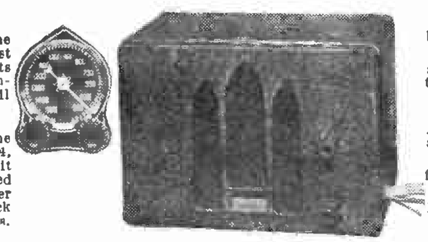
The selection of one model or the other will depend considerably on whether you have some mantel or end table or the like on which you'd prefer to place a physically smaller cabinet (but the same-sized set), or whether you have the room for the large console, 21 inches wide, 36½ inches high, 12 inches front to back. We have gone to great pains to obtain two models that do not differ in performance, and that yield the maximum that radio has to offer to-day, so that space and artistic requirements can be met to the fullest, along with maximum performance.

The table model is Cat. 1008-T, shipping weight, 28 lbs., wired, in cabinet, complete with eight RCA tubes; net price (shipped from Sandusky, Ohio)— **$32.75**

The wired chassis, with speaker and tubes (no cabinet) can be purchased by any who care to use a cabinet they have. See price at right.

The 8-tube, high-gain, all-wave (150 kc. to 22 mgc.) Diamond of the Air wired chassis, 50-60 cycles, 110 volts; with the powerful dynamic speaker and the eight RCA tubes, may be purchased (no cabinet). Order Cat. 1008-CH. Net price, $29.25

6-TUBE DIAMOND AUTO SET, $23.95



OUR previous model Auto Set was so good that the model was not changed in three years. Now at last it has been improved upon, certain mechanical refinements introduced, and tubes of somewhat higher efficiency included. Some of these tubes were not manufactured until recently. Also the set now has a.v.c.

Our 1009 Auto Radio is a six-tube superheterodyne set, using one 6A7, one 41, one 75, two 78's and one 84, and tunes from 540 kc. to 1,600 kc. It is a one-unit receiver, ruggedly built for long life, and is equipped with a dynamic speaker. It has an illuminated vernier airplane type control. The manual volume control and lock are one combination. The power consumption is 4 amperes.

No B batteries required. There is a B-eliminator built in.

This is one of those fascinating auto sets that has single-hole mounting provision, and therefore is a cinch to install. There are only two connections to make: (1), to the ammeter; (2), to the aerial.

The remote tuner is, of course, supplied with the set. And the spark plug suppressors and commutator condenser are supplied, also.

The size is 8¾ inches wide, 6 inches high, 6¾ inches front to back. Shipping weight is 18 lbs.

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