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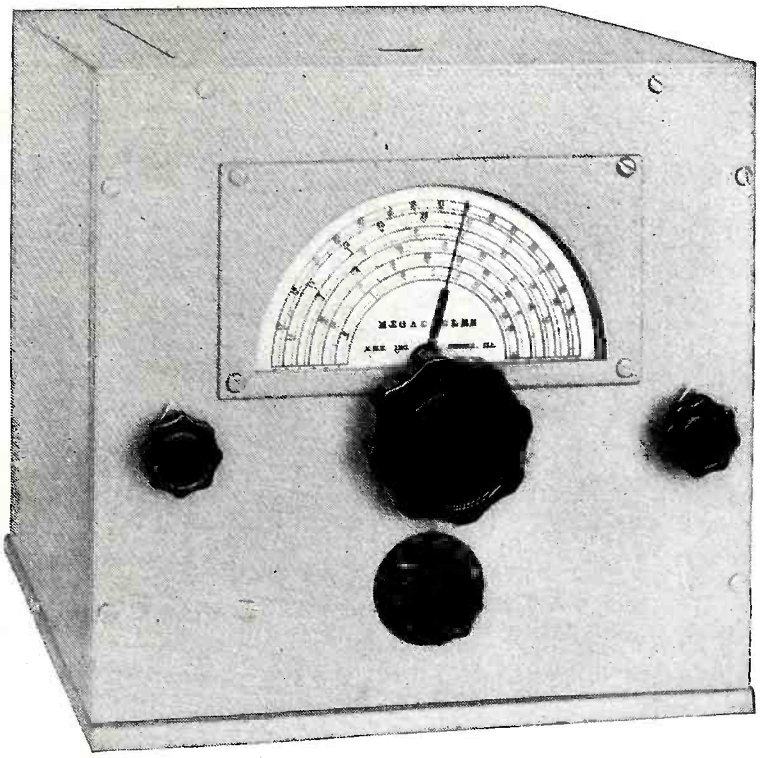

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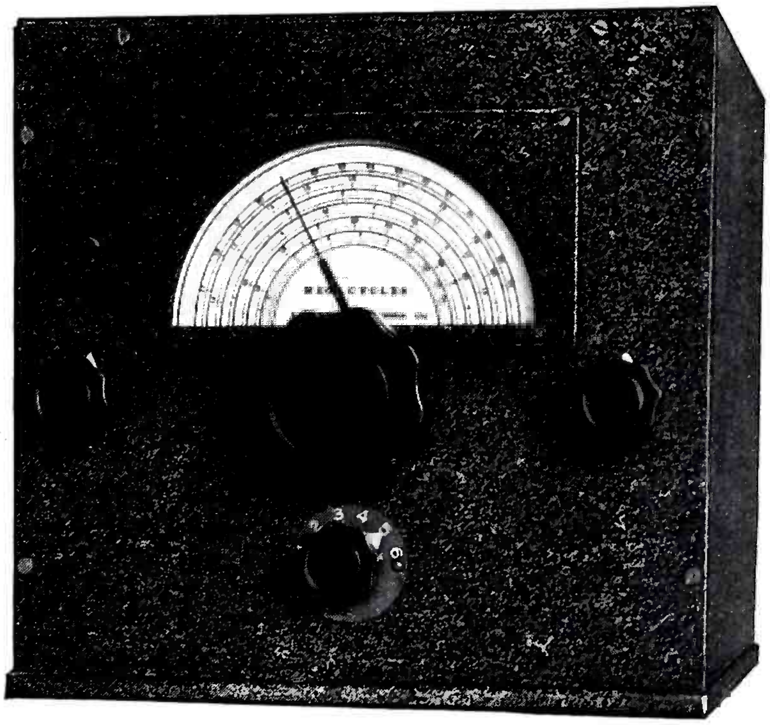

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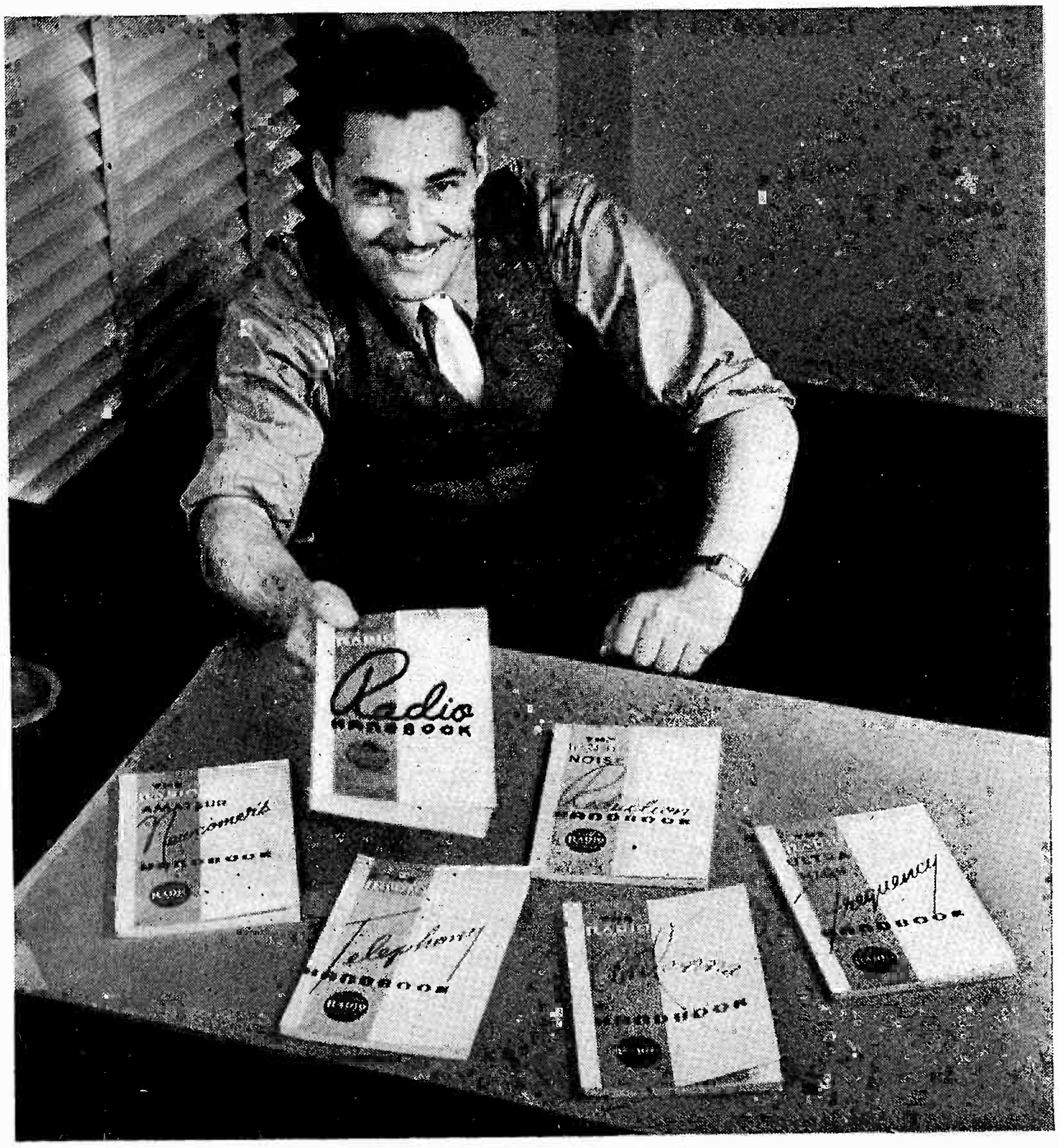

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Since we regard current "chiseling" policies as decidedly unfair, a small payment will be made, usually upon publication, for accepted material of a technical or constructional nature. Freehand, pencilled sketches will suffice. Good photographs add greatly to any article; they can easily be taken by the layman under proper instructions. For further details regarding the taking of photographs and the submission of contributions see "Radio" for January, 1936, or send stamp for a reprint.

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ROTARY "FLAT-TOP BEAM"

Antennas

By

JOHN D. KRAUS,* W8JK

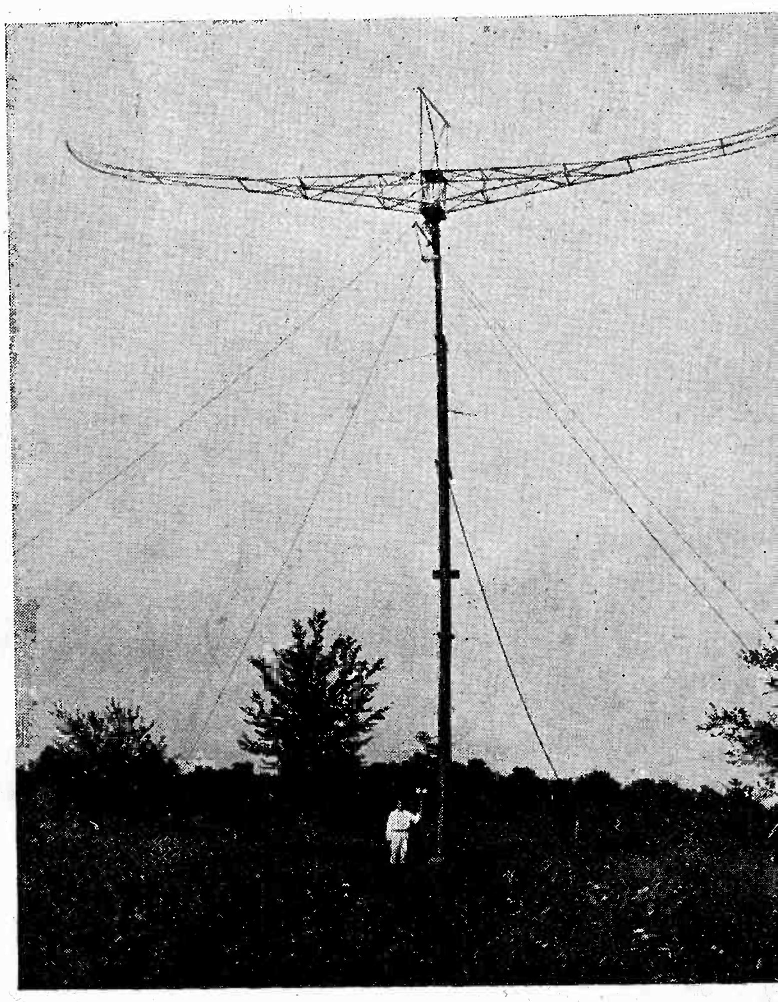

Figure 1. The "60-foot rotary flat-top beam" used on 14 Mc. at W8JK. The rotary structure or gondola is turned by a remotely-controlled reversible electric motor located near the base of the 50-foot supporting pole.

"Beam" coverage in all directions can be accomplished by using a number of fixed beam antennas arranged for different directions. Some type of rotating beam antenna is another possibility. To be of practical size when used on 14 Mc., rotary antennas must be restricted to simple types with limited gain. The controllable directivity feature, however, makes them very useful.

The flat-top beam antennas described in the March and June issues of RADIO[1] give gains which are high for arrays of their size. It seemed that if a 60-foot flat-top beam could be made rotatable, one could have at once both the advantages of a rotary array and fairly high gain. With this in mind, the construction of a 60-foot rotary structure was undertaken. It proved to be a formidable task and many Saturday afternoons and many evenings were put in before the structure was completed.

Figure 1 shows the finished structure or gondola supported on the top of a 50-foot pole. Results with this array were so unexpectedly good that we became curious to know how a 30-foot† rotary flat-top might perform. Being smaller, it would be much easier and more practical to construct. After about a month of operation with the 60-foot flat-top, it was replaced by the 30-foot rotary structure shown in figure 2. Since the smaller rotary is probably of more practical interest, it will be described first.

The 30-Footer

The dimensions for the 30-foot rotary are given in figure 3A. This antenna may be used for both 14 Mc. and 28 Mc. band operation with the same beam pattern having a maximum of radiation in both directions broadside to the antenna. If used on 56 Mc., the pattern has 4 lobes, similar to the pattern of a full-wave antenna. For coverage in all directions on the 14 and 28 Mc. bands, rotation through 180 degrees is necessary and on 56 Mc. through somewhat more than 90 degrees.

---

*Arlington Blvd., Ann Arbor, Michigan.

[1] "A Small But Effective 'Flat-Top' Beam," J. D. Kraus, RADIO, March, 1937, p. 56, and June, 1937, p. 10.

†The terms "60-foot" and "30-foot" flat-top are used in the sense that these are their approximate lengths. A 60-foot flat-top operated on 14 Mc. is a 4 element or 4 half-wave array, and has been referred to as a two-section flat-top. The 30-foot array on 14 Mc. is a 2 element flat-top (single section, center fed) and on 28 Mc. is a 4 element (or 2 section) flat-top beam.

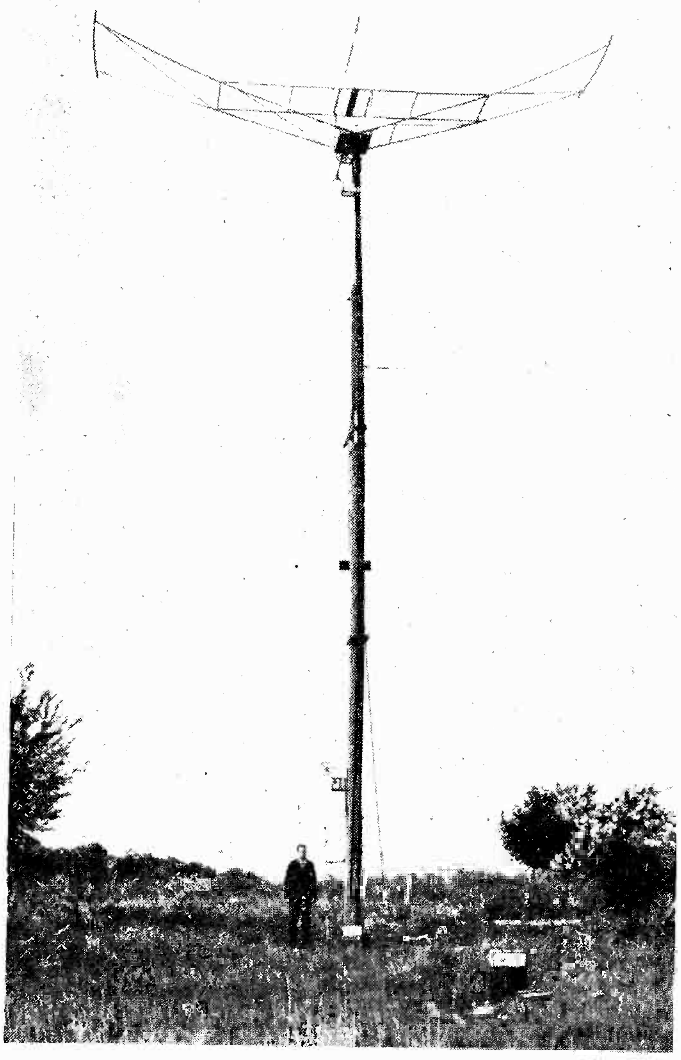

Figure 2. The "30-foot" rotary flat-top at W8JK. This beam operates on both 14 and 28 Mc. with the same bi-directional pattern. The wires of the flat-top are almost 60 feet above ground.

The spacing on the flat-top wires when the antenna is used on 14 Mc. is one-eighth wavelength and on 28 Mc. is one-quarter wavelength. This change will produce very little difference in the operation. The data given by Brown[2], who first showed the advantages of close-spaced antennas, indicates that when the currents in two wires are 180 degrees out of phase, the optimum spacing for maximum gain is about one-eighth wavelength. Over a range of spacing from one-sixteenth to one-quarter wavelength, however, the change in gain is not large, being less than one decibel. Accordingly a flat-top antenna designed for one-eighth wavewavelength spacing on one band is very practical to use on other bands as well. If the spacing becomes too small a fraction of the wavelength, however, it appears that losses due to high currents and high voltages at different parts of the antenna might become important.

A 30-foot flat-top beam designed for fundamental operation on 28 Mc. has a spacing of 4 feet 4 inches. This antenna can be used on 14 Mc. the same as the one of figure 3A, the difference being that the spacing on 14 Mc. is one-sixteenth wavelength instead of one-eighth. With the extra close spacing of one-sixteenth wavelength, the impedance of the flat-top at voltage nodes becomes extremely low and at current nodes extremely high, making the array a bit awkward to feed, so that if one intends to use the rotary on *both* 14 and 28 Mc. the dimensions of figure 3A are recommended.

Some of the characteristics and advantages of the 30-foot flat-top may be listed as follows:

1. As much or more gain in both directions broadside on 14 Mc. as is obtained in the one preferred direction when using a half-wave antenna with a reflector spaced one-quarter wavelength behind.
2. All elements of the antenna are driven. There are no reflector adjustments to make.
3. For a given height above ground, the radiation is at lower, more effective angles than from either a half-wave antenna or a half-wave with reflector. The lower angle radiation gives the effect of even more gain.

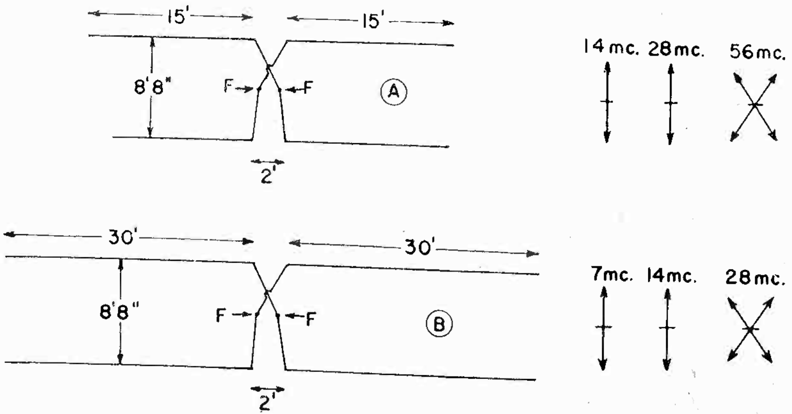

Figure 3. Dimensions of the flat-top beam antennas used in the rotaries. Both antennas are suited for multi-band operation. The type of pattern of each for different bands is indicated at the right. Feeders hook on at F, F.

4. Multi-band operation, with the same type radiation pattern on 14 and 28 Mc.

---

[2] "Directional Antennas," G. H. Brown, *Proc. I.R.E.*, Jan. 1937, p. 95.

5. The dimensions are not critical.

6. The gain over a half-wave antenna is about 4.5 decibels on 14 Mc. and about 6 decibels on 28 Mc.

7. High front-to-side signal strength ratio, over 23 decibels, or a power ratio of over 200 to 1.

8. 180 degree rotation for coverage in all directions on 14 and 28 megacycles.

The dimensions for a 60-foot rotary flat-top are given in figure 3B. This antenna is designed for use on 14 Mc. but might also be used on 7 Mc. with the same bi-directional pattern. 28 and 56 Mc. operation is also possible, the pattern having 4 main lobes on these frequencies. The gain of the antenna on 14 Mc. is about 6.5 decibels (a gain of 4.5 in power).

The dimensions of a flat-top beam antenna are not critical. If the antennas of figure 3 are inconveniently long, they may be shortened by a number of feet with little change in performance. For example, the "60-foot" array as actually constructed was shortened from the dimensions of figure 3B so that each flat-top wire was about 26 feet instead of 30 feet long. The lengths given in figure 3 are the recommended values. If a rotary of even smaller size is desired, one should consider the Smith "Signal Squisher".[3] This antenna is only about 15 feet square on 14 Mc.

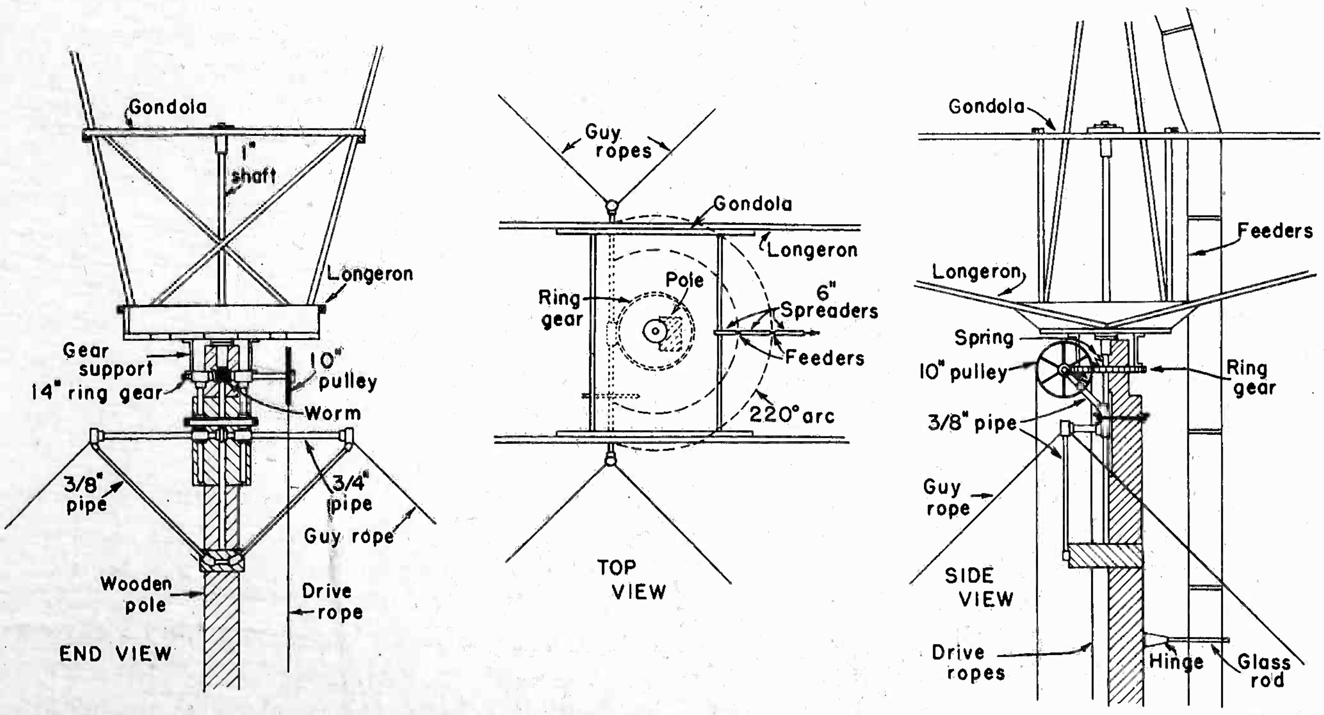

Figure 5. Detail of center portion of gondola structure, showing method of support and drive. The gondola turns on a 1-inch shaft fastened to the pole.

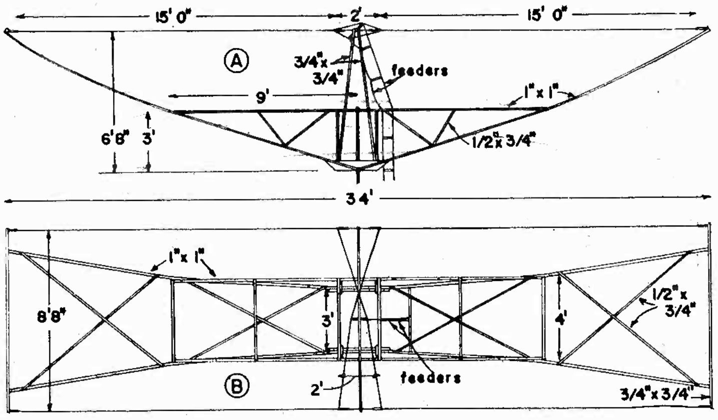

Figure 4. Dimensions for the "30-foot" rotary showing construction of the supporting gondola.

Feed Systems

One compensates for any changes in the dimensions of the flat-top when the antenna is tuned up; i.e., by locating the short on the matching stub or by tuning the Zepp. feeders if the latter are used. Thus, the dimensions of figure 3 will be satisfactory for any frequency in the 14 or 28 Mc. bands, if the antenna is tuned up for the particular frequency used.

The feeding of the 30-foot rotary can be accomplished in a variety of ways. Zepp. feeders are especially practical if one expects to use the rotary on both 14 and 28 Mc. With feeders a multiple of about 35 feet long (measured from

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[3] "A Simple 'Signal Squisher' ", W. W. Smith, RADIO, April, 1937, p. 53; May, p. 16; July, p. 49; November, p. 83.

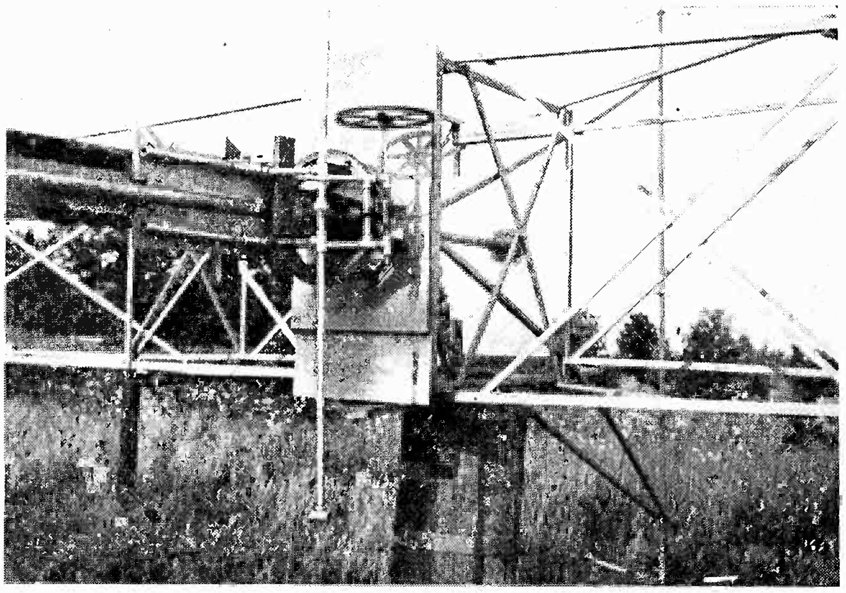


Figure 6. The center of the "60-foot" gondola mounted on the pole, showing the ring gear and worm drive. The outrigger pipes are for guy ropes.

the point where they hook on to the flat-top), one can use series feed at the transmitter on 14 Mc. and parallel feed on 28 Mc.

If a matched impedance line is used, a matching stub is necessary. The stub will be an odd multiple of one-quarter wavelength long. (about 35 feet). After locating the short by shock-exciting the antenna and adjusting the short for maximum current, using a sensitive r.f. meter in series with the short, the transmission line is hooked on two feet or less above the short (for a 600 ohm line) and adjusted for minimum standing waves. A detailed description of this procedure was given in RADIO for June, 1937 (p. 13).

For 28 Mc. operation, it will be necessary to repeat the tuning-up procedure for locating the short and transmission line. On this band the shorting wire will be about 8 feet farther up or farther down the stub. After the short and transmission line positions have been located for both 14 and 28 Mc. operation, the points on the stub may be marked so that the short and line can be shifted quickly when changing bands.

The 30-foot rotary of figure 2, as used on 14 Mc., has a "stub" about 70 feet long, making it convenient to tune up the antenna while standing on the ground after the structure has been raised. In very damp weather, some detuning may be noticed due to wetting of the spreaders. Retuning is accomplished by moving the short and line a few inches along the stub (usually up).

Located part-way down the pole is a hinge with a glass towel bar extension. The feed line is fastened to the bar. The hinge permits the line to swing through 90 degrees at this point while the gondola goes through 180 degrees.

Mechanical Construction

The structure for supporting the flat-top antenna may vary greatly in design. The design to be described is only one of many practical arrangements for making the flat-top rotatable.

Figure 4 shows the design of the rotating structure for the 30-foot flat-top beam antenna. In the side views (figure 4A, and also figures 1 and 2) one may note a resemblance in the structure to the famous water-craft of Venice. For this reason, the structure is called a "gondola". By placing most of the supporting structure considerably below the flat-top, the radiating part of the antenna is well in the clear. Also the radiating portion is about 7 feet above the top of the pole or tower supporting the structure, giving added height to the flat-top.

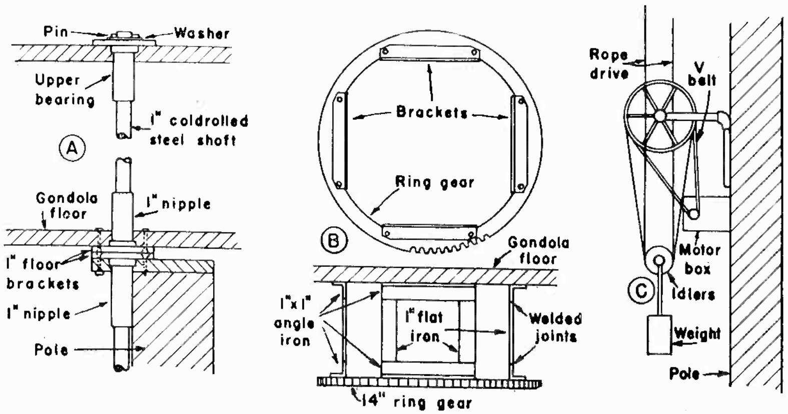


Figure 7. Detail of the gondola support and drive.

The dimensions for the gondola are given in figure 4. It is about 34 feet long by 9 feet wide over-all. The long members or longerons are 18-foot pieces of 1 x 1 inch redwood. The 9 foot spreaders or cross-arms holding the flat-top are ¾ x ¾ inch clear white pine. These two sizes are used for most of the structure. All cross-bracing, however, is of ½ x ¾ inch clear white pine. These dimensions are net.

The method of bringing the feeders down and through the center of the gondola is also shown in figure 4. Six-inch ceramic spreaders are used for insulators both in the flat-top and

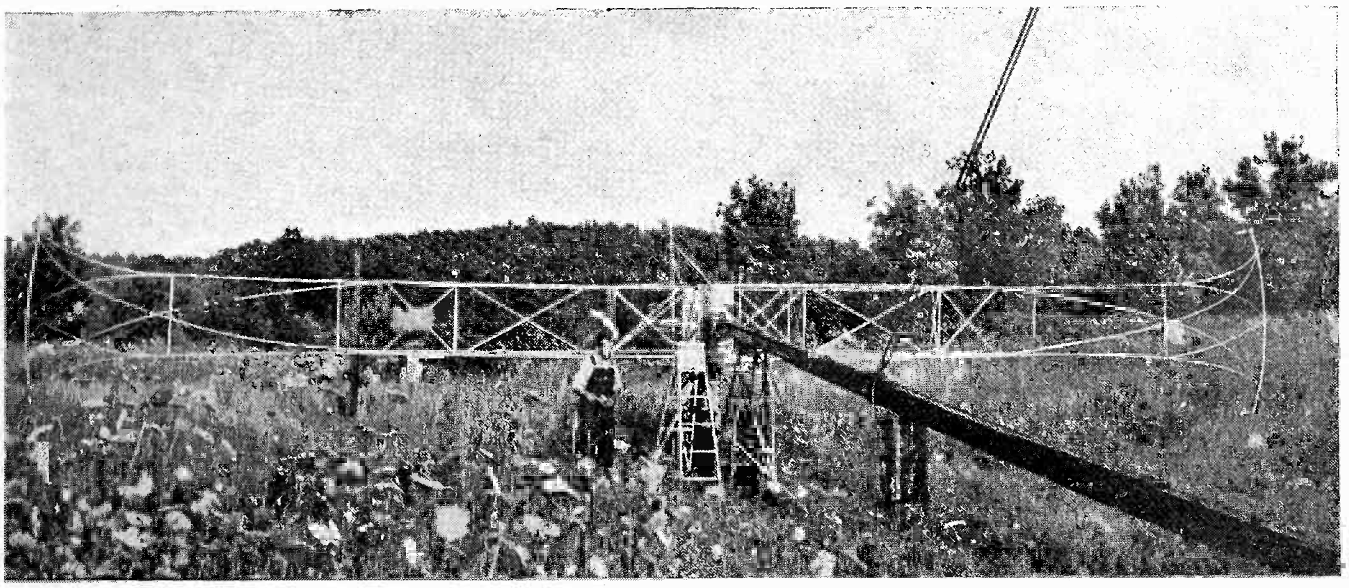


Figure 8. The "60-foot" rotary flat-top mounted on the 50-foot pole and ready to go up.

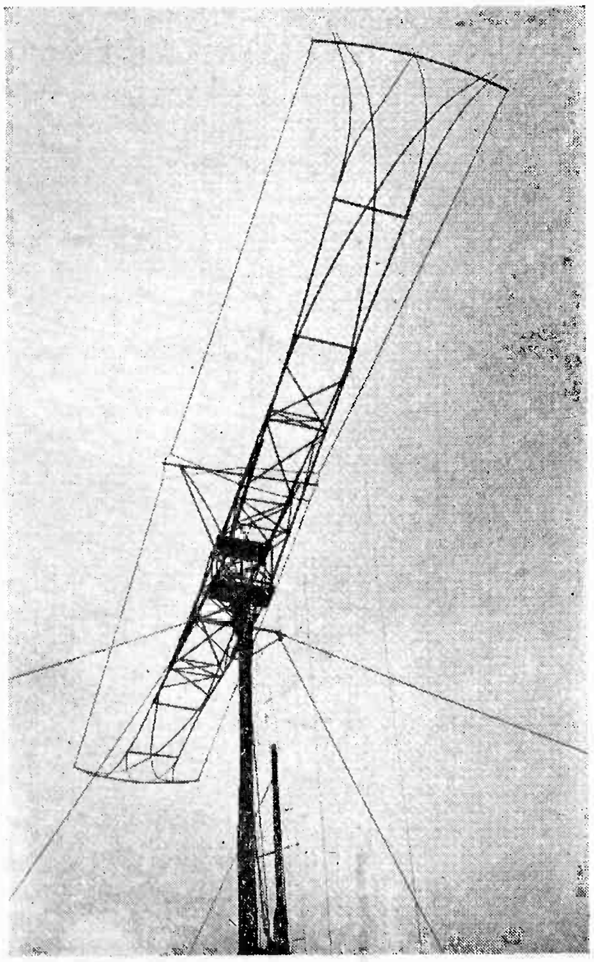


Figure 9. The "60-foot" rotary from below.

feeders. The insulator at the middle of the center 9-foot cross-arm is made of two 6-inch spreaders placed end to end. This long spreader is fastened at an angle of 45 degrees with the horizontal at the center of the cross-arm, and is the only insulator in the cross-over of the flat-top wires. The feeders connect to the flat-top at this spreader also, so that harness at the middle of the antenna is reduced to a minimum.

The Drive System

A more detailed view of the center of the 30-foot gondola and of the drive system is given in figure 5. The drive is rather crude, but it is simple and it works. The photograph of figure 6 shows the center section of the 60-foot gondola which is much similar in construction. Figure 7 gives further details of construction and drive. All joints are made with machine or wood screws. The longerons, extending from the center to either end, are drawn up slightly by tension on the flat-top wires.

Two bearings are located at the center of the gondola. Both are constructed of a short length or nipple of 1-inch pipe (inside diameter 1.05 inches) screwed into a 1-inch floor bracket. Both upper and lower bearings are fastened to the gondola as shown in figure 7A. The bearings turn on a 1-inch cold-rolled steel shaft which is strapped to the pole. The shaft extends down the pole about 5 feet. A floor bracket at the top of the pole and the lower bearing floor bracket of the gondola act as thrust plates to carry the weight of the structure. The gondola turns on the shaft which remains stationary.

The gondola is rotated by a 14-inch ring gear fastened to its floor by a number of brackets as shown in figures 5, 6, and 7. The gear used is a Ford V-8 flywheel ring gear. The gear is driven by a worm on a ½-inch shaft turning in bearings supported by brackets to the pole. The worm's chief function is to hold the gondola in position when the worm shaft is not being turned. The worm used fits the ring gear fairly well and is a Boston steel worm (type GH1076). The shaft is turned by a 10-inch pulley. Both worm and pulley are pinned to the shaft. The bearings holding the worm shaft are made from pipe fittings. Short pieces or nipples of ⅜ inch pipe (inside diameter 0.49 inches) were screwed in ⅜ inch "T" fittings and drilled out to take the ½ inch shaft. A spring (see side view in figure 5) insures a good mesh of worm and gear. The brackets supporting the ring gear were made high enough that the pulley could pass below the floor of the gondola. They are made of 1-inch angle iron and flat stock welded as shown in figure 7B.

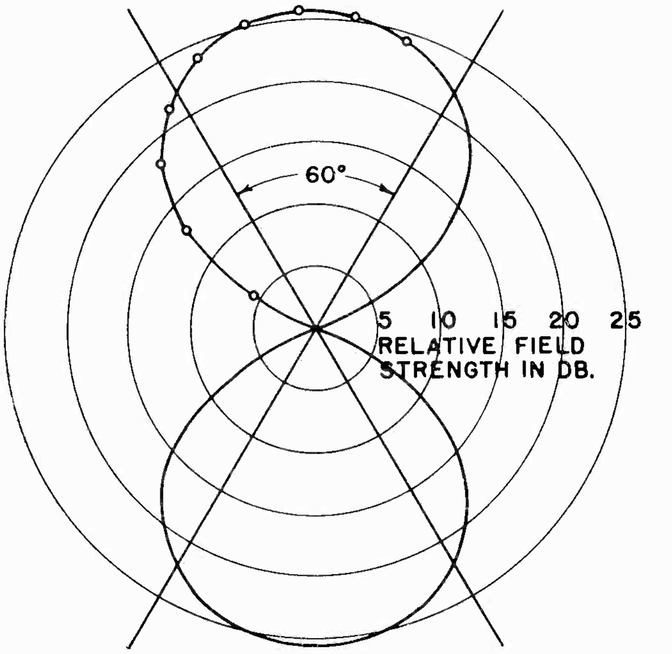


Figure 10. Horizontal field strength pattern of the "60-foot" rotary, showing the broad coverage of the beam broadside to the array and sharp nulls off the ends. The front-to-side power ratio is several hundred to 1. The pattern of the 30-foot array is much similar.

A heavy sash-cord drive rope passes over the worm shaft pulley and runs down alongside the pole to a motor drive and idler system near the base of the pole. Figure 7C shows the detail of this part of the drive. Two small pulleys or idlers turn independently on a shaft loaded by an adjustable weight to keep the rope tight. The drive rope from the worm shaft pulley at the top of the pole passes down and around one idler pulley, up over another 10 inch pulley, back down and around the other idler, and up again to the worm shaft pulley.

The 10 inch pulley near the base of the pole is pinned to a ½-inch shaft, which is driven by a similar pulley having a V-belt drive from a small motor. A small box on the pole holds the motor. It is a 110-volt a.c. or d.c. one-sixth h.p. motor with a built-in 14 to 1 gear reduction. A four wire underground line using two pairs of lead-covered cable, runs from the motor to the station. One pair of wires connects to the motor armature (brushes) and the other to the field. At the station the two pairs connect in series with the 110 volt line. By reversing the armature pair with respect to the field pair (or vice versa) using a double-pole-double-throw switch, the motor can be run in either direction.

The drive motor operates under normal load at such speed that the gondola turns quite leisurely, about the speed of the second hand of a clock. So far no indicator mechanism has been installed to tell in which direction the gondola is, it being necessary to watch it from the window of the station. A number of 3 volt flashlight bulbs are used at current maximum points in the flat-top, forming a new "constellation" in the sky, so that the gondola's position can be observed at night. Due to the large currents which flow in the flat-top, the bulbs need to be shunted across considerably less wire than would be the case on a single half-wave antenna operating with the same power.

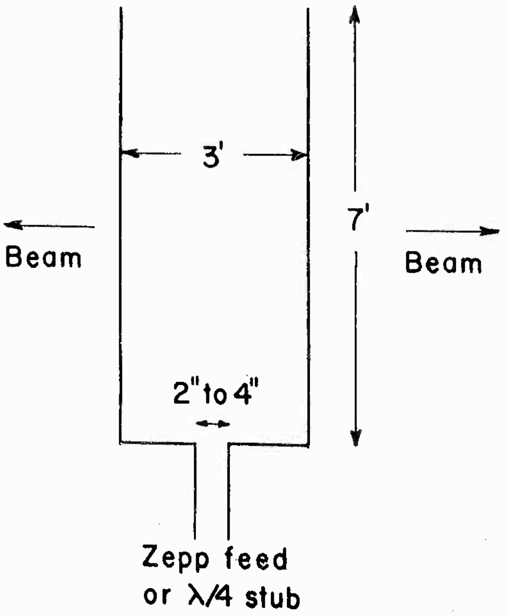


Figure 11. Close spacing beam ("vertical flat-top") for 56 Mc.

Figure 8 shows the method of supporting the gondola prior to raising. The gondola in this photograph is the 60-footer. The pole in the foreground is pivoted close to the base of a rigid 35-foot "telephone" pole. Block and tackle,

[*Continued on Page 78*]

GROUND SYSTEMS

For Efficiency

By ELMER H. CONKLIN,* W9FM

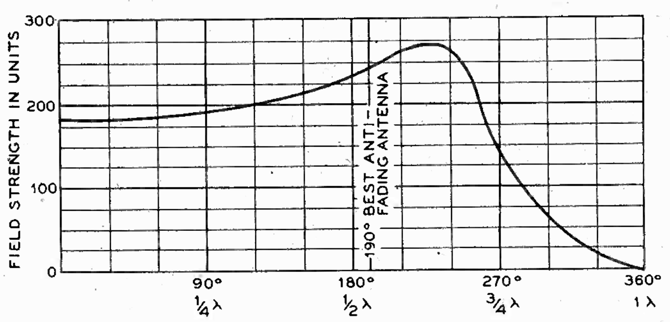
Some rather interesting and helpful results have been uncovered by Messrs. Lewis, Brown and Epstein of RCA Communications in regard to the importance of a good ground system for low frequency transmission. The results of their experiments that will pertain to amateurs on 2 Mc. and 4 Mc. work have been set down by E. H. Conklin in the accompanying short article.

● Broadcast stations during recent years have changed from the old T antennas to the new vertical-mast radiators. Higher power installations have been using an antenna slightly longer than a half-wavelength mainly for its "anti-fading" property—the high-angle radiation causing the sky-wave being smaller in relation to the low-angle "ground-wave" radiation. Low power stations have found the cost of this anti-fading antenna prohibitive and unwarranted because signal deficiency or interference from other stations will limit the service area before the "fading wall" is reached. These stations have used quarter-wavelength antennas, but R.C.A. engineers have found[1] that even ⅛ wavelength antennas are practical if a suitable ground system is employed.

Antennas on the order of ⅛ wavelength—33 feet for 80 meters and 66 feet for 160 meters—would make possible push-button beams of the three element type suggested by Dawley[2] or the four element type used at W9PZ and pictured on page 43 of the RADIO *Antenna Handbook*. The experimental data[1] also provides us with considerable information about ground systems for better radiating efficiency.

The accompanying diagram shows the intensity of radiation in the horizontal plane for various antenna heights. The best antifading antenna is 190 electrical degrees long, or slightly longer than one-half wavelength (180°). This length of antenna will give the strongest horizontal radiation, relative to high-angle radiation which is reflected back to earth at a relatively near point. The strongest horizontal radiation disregarding the sky wave is shown to occur with a vertical antenna 230° long, or about ⅝ wavelength. It is seen that the usual quarter-wavelength vertical antenna (90°) is well down from the nose of the curve and is not much better than considerably shorter antennas.

The diagram shown is based on constant radiated power and does not give consideration to changes in loss which may occur. With a short antenna the earth currents rise to a high value near the base of the antenna, causing considerable loss if the ground system is poor. In a test of this condition, the power losses were measured[1] for two antenna heights used at a frequency of 3000 kilocycles — midway between our 2 Mc. and 4 Mc. bands. With 15 radial wires buried six inches and 0.4 wavelength long (135 feet), an 88° antenna—just under a quarter wavelength—showed a loss of 447 watts out of an antenna input power of 1000 watts. A 22° antenna—one-sixteenth wavelength long—showed 745 watts loss out of the kilowatt!



Tests were then conducted to determine the losses with various lengths and numbers of

[*Continued on Page 82*]

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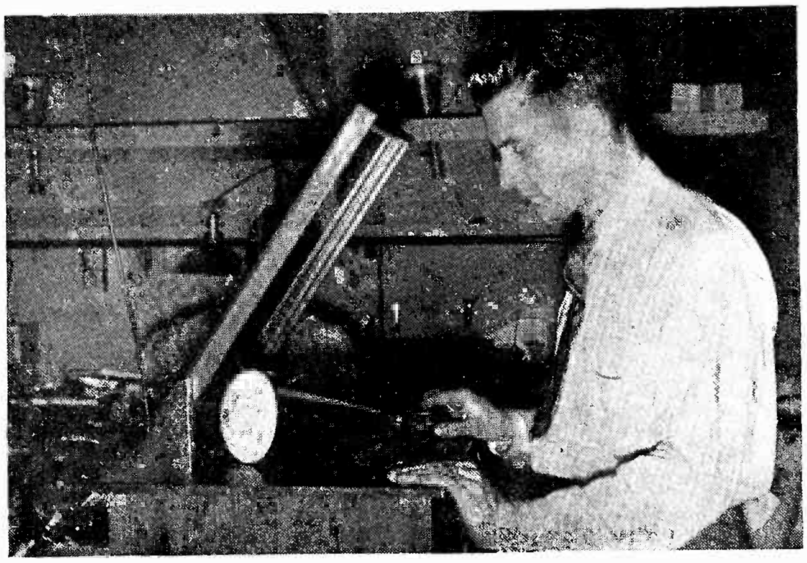
[1] G. H. Brown, R. F. Lewis, and J. Epstein, "Ground Systems as a Factor in Antenna Efficiency," *Proc. I.R.E.*, June, 1937.

[2] Ray L. Dawley, "Push Button Antenna Directivity," RADIO, June, 1937.

*Associate Editor, RADIO.

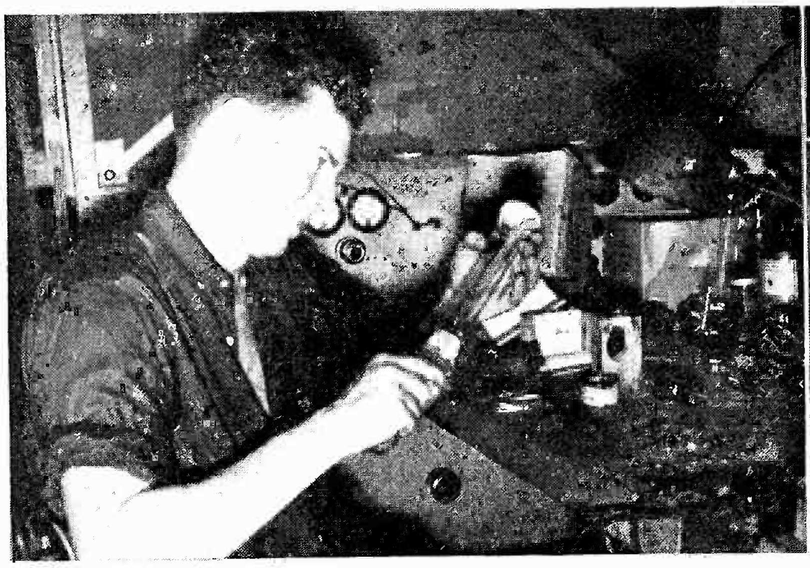


To detect any strains that may exist in the glass envelope, glass blanks as well as finished tubes are placed on the screen of the polariscope. The reflecting mirror then indicates in varigated hues any defects that may be present.

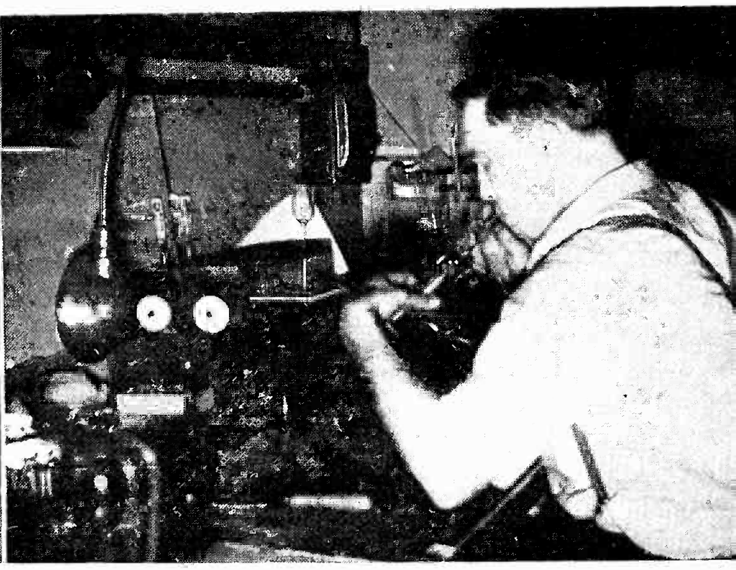
Cathode-Ray OSCILLOSCOPES *in the making*

RADIO takes its readers on a pictorial tour through a laboratory where these indispensable electronic devices are manufactured.

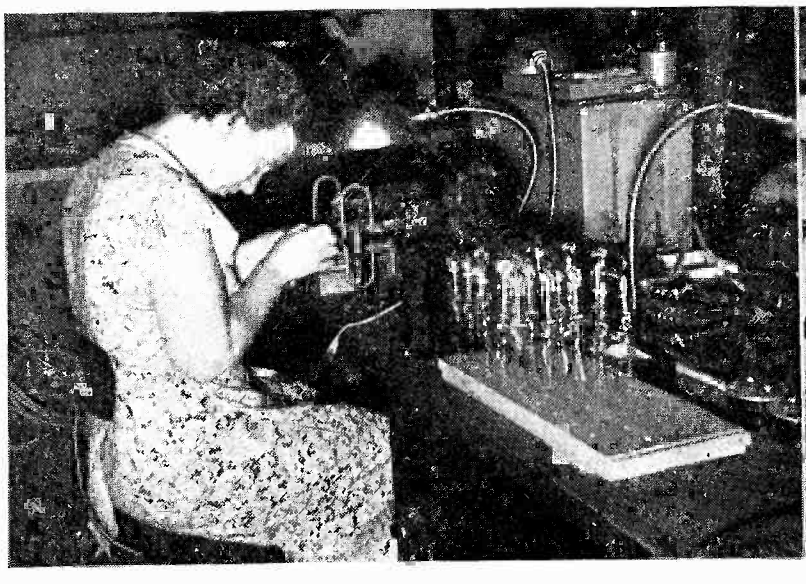
(Photos courtesy Allen B. Du Mont Laboratories, Inc.)



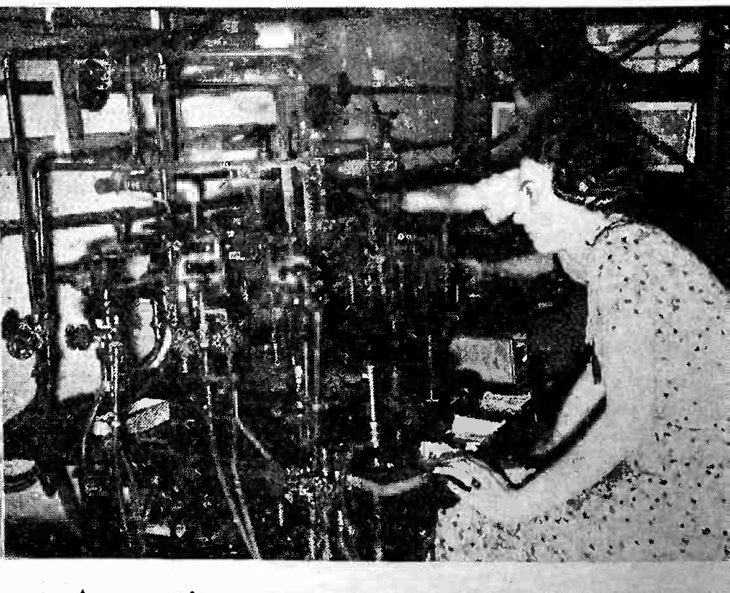
Trimming the fluorescent screen of a 2-inch cathode-ray tube. The skilled workman removes the surplus chemical coating around the sides, for a neat perfect-circle screen.



One of the dozens of glass blowing operations in the making of cathode-ray tubes. The glass-worker is here shown blowing into the exhaust tube to form the exhaust port.

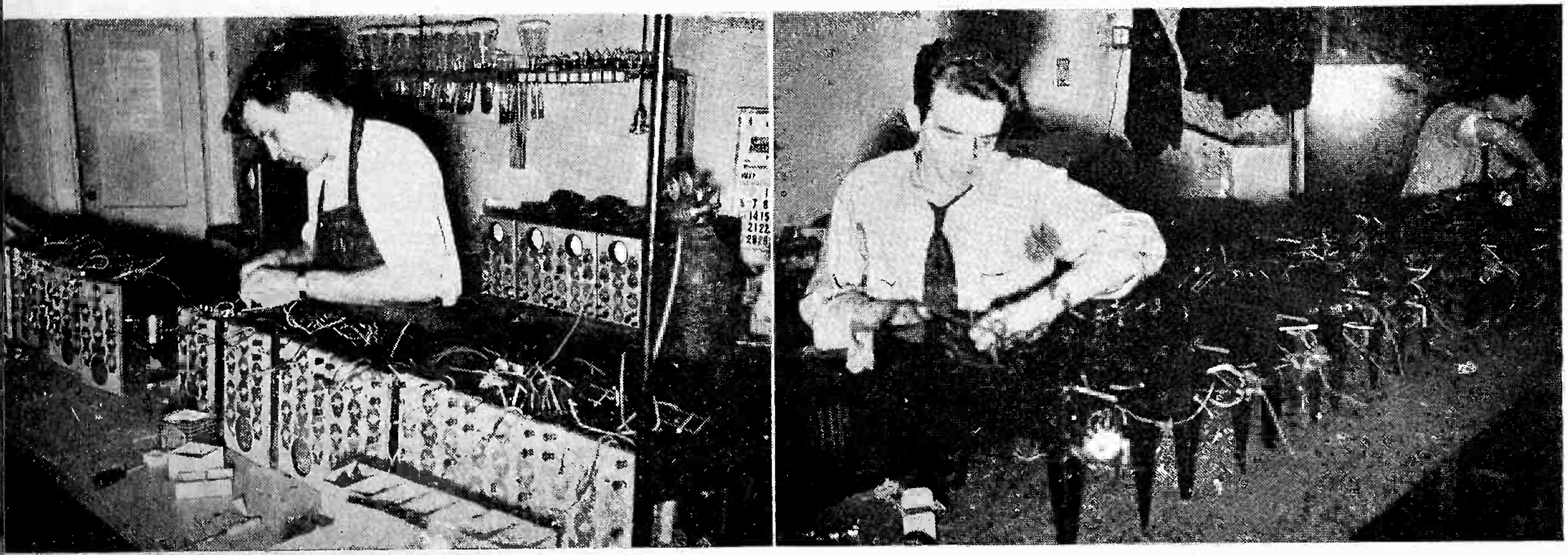


Intricate and tedious stem mounting for cathode-ray tubes. On the stem or glass-and-metal support, the various elements must be assembled and spot-welded in place.

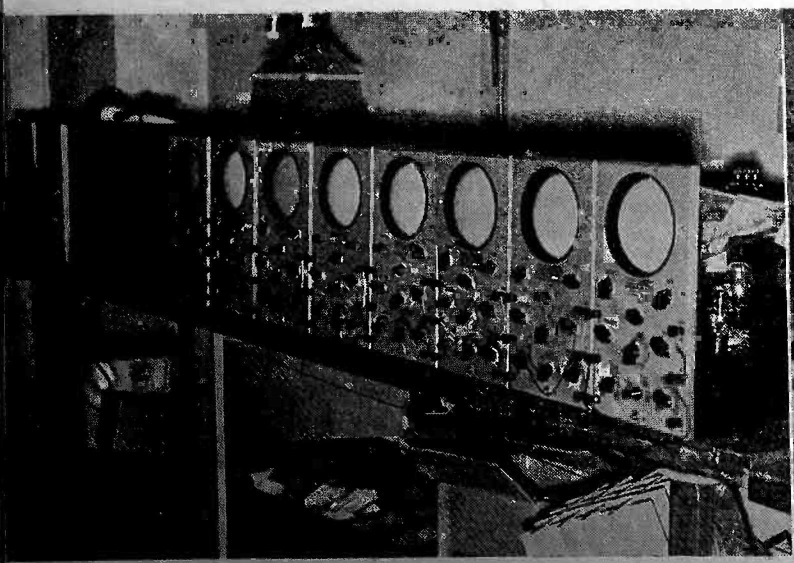


Automatic stem-making machine which forms th intricate support of metal and glass for the elements of the cathode-ray tube—the electron gu and the controlling and deflecting electrodes.

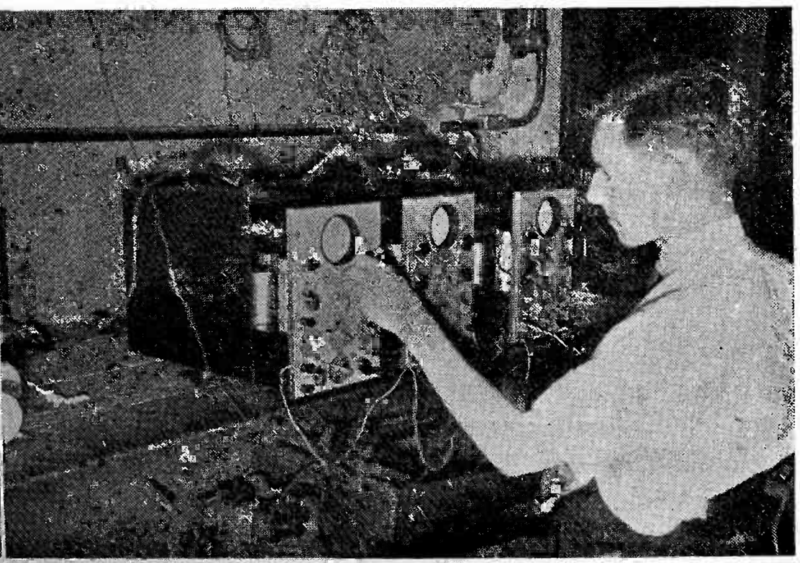
Bombarding the cathode-ray tubes during exhaust. The heavy coils carry high-frequency current. The high-frequency magnetic field causes the metal parts within each tube to glow at incandescent temperature, as the bombarding coils are held in close proximity. This heat effect causes the metal parts to give up their occluded moisture and gases for a more thorough exhausting of the tube.



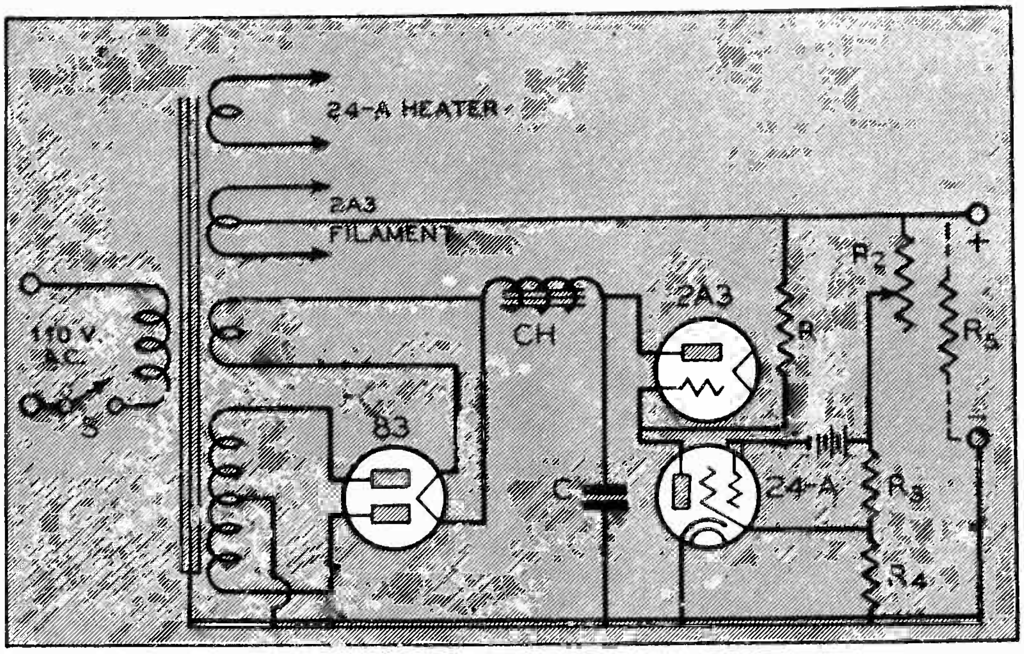
Oscilloscopes on the assembly line. Skilled mechanics and electricians assemble and wire these instruments step by step from bare chassis to finished job.



Completed oscilloscopes undergoing a thorough test prior to packing and shipping. These instruments are operated for hours to make certain that they will function properly in actual use.



Final tests on 3-inch oscilloscopes. Each instrument is thoroughly tested and adjusted under actual operating conditions before placement in its cabinet.



C—16 μfd., 450 volt elect.
R—2 megohms, 1 watt
R_2—100,000 ohm variable resistor.
R_3—50,000 ohms, 1 watt
R_4—25,000 ohms, 1 watt
R_5—Stabilizing resistor, 10,000 to 40,000 ohms
CH—20 hy. 100 ma. filter choke

An Improved System of VOLTAGE STABILIZATION

For a long period of time there has been need for a really stable power supply; one that is stable with respect to variations in load, line voltage, and ageing of components. In addition, such a power supply should be fairly flexible. It should be capable of use as a plate supply where a reasonable current drain may be encountered and as a potential supply where the current drain may be very low or even negligible. Also, the output voltage of the unit should be adjustable over a reasonable variation without affecting the stability.

In recent years there have been published a great many partial solutions to the problem. Each one of these solutions has been ineffectual under some conditions of operation. Either the system was dependent upon constant line voltage for its stability or it was dependent upon constant current flow or some other condition that is undesirable in practice. Some systems using gaseous discharge tubes (874's, neon tubes, etc.,) were satisfactory enough from the standpoint of stability but were definitely limited from the flexibility angle. The voltage is determined by the drop across the regulator tubes so it must be some integral multiple of (most commonly) 90 volts.

A system recently introduced by the Bell Telephone Laboratories* seems to embody all the features to be desired of such a power supply. The electrical layout of the system can conveniently be divided into three sections: the high voltage supply, the variable-drop resistance element, and the d.c. amplifier that supplies the control voltage. The primary source of stabilization (in other words, what the stabilization puts its "feet" on) is a small B battery which serves only as a source of constant potential. In other words there is no actual d.c. drain from this battery; the life of the battery in service would be the same as the so-called "shelf life."

The system is very accurately stabilized; reasonable changes in load, line voltage, or tube characteristics will change the output voltage less than one per cent. In fact, with ordinary variations in the parameters concerned, the output voltage change will remain well within one per cent.

A multitude of uses for the arrangement immediately present themselves: power supplies for frequency standards, beat-frequency oscillators, multi-vibrators, self-excited and crystal controlled oscillators where stability is of prime importance, in fact for any type of an instrument where variations in supply voltage would have a detrimental effect.

Looking at the power supply from the output terminals, it acts, up to its maximum current capabilities, almost as if the voltage were being obtained from a freshly-charged high-voltage storage battery. In other words, the unit supplies very well-filtered direct current and it, in turn, acts as if it had a very low internal resistance. While a good power supply of from 300 to 500 volts may show an effective internal resistance of 500 to 2000 ohms,

[*Continued on Page 84*]

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*Bell Laboratories *Record*, May, 1937.

AUDIO TRANSFORMER Characteristics

By E. F. KIERNAN,* W6EOO

Over a period of several months while doing development work on audio amplifiers, the writer had occasion to investigate the characteristics of various transformer components. Methods of altering some of them, principally the frequency response, were revealed. This discussion will be limited to methods of modifying the frequency response of finished units rather than to the original design procedure.

Although the design of an audio transformer fixes its frequency response to a considerable extent, it is possible to modify the response by a judicious selection and arrangement of the adjacent circuit elements.

In figure 1, the solid curve represents the frequency response of an "ideal" transformer, "ideal" signifying either a theoretical design or an actual sample measured under such conditions as to give a false indication of its performance. The dotted extensions represent exaggerated departures from the "ideal" as are often encountered in practice.

High-Frequency Response

Considering the high-frequency response, a pronounced peak, such as that indicated, is due to resonance between the leakage inductance and the distributed capacity of the windings. This condition may become aggravated when the unit is used in conjunction with a tube having low plate resistance. It is essential, therefore, that the response-curve data be taken under actual working conditions. Uniform response at the higher frequencies is essentially a matter of design, however, and the resonant peak may be flattened out by shunting a resistor of from 250,000 to 100,000 ohms across the secondary. Figure 2 shows this. The response becomes more nearly uniform at the expense of a slight amount of gain.

A factor having a very pronounced effect on the high frequency response of an audio transformer is the polarity of the secondary winding. In figure 6 the dotted curve shows the effect of reversing the connections to the secondary of a certain transformer. This transformer had its primary wound next to the core with the start connected to the plate of the preceding tube. The finish of the secondary (wound over the primary) should connect to the grid of the following tube. This assists in keeping the by-passing effect of the capacity between the two windings as low as possible.

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*631 No. Santa Anita Ave., Burbank, Calif.

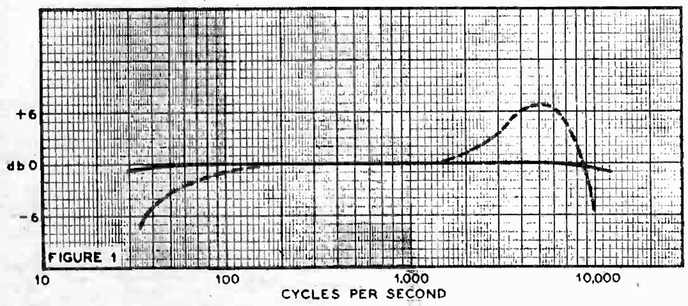
FIGURE 1

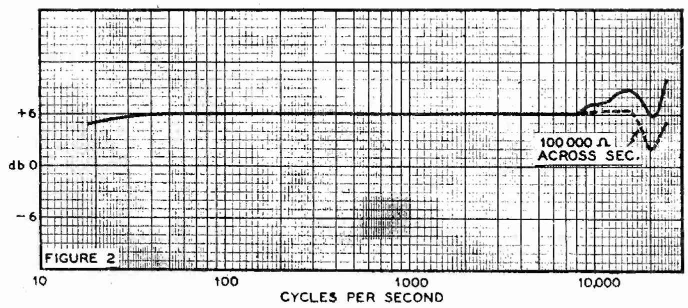
FIGURE 2

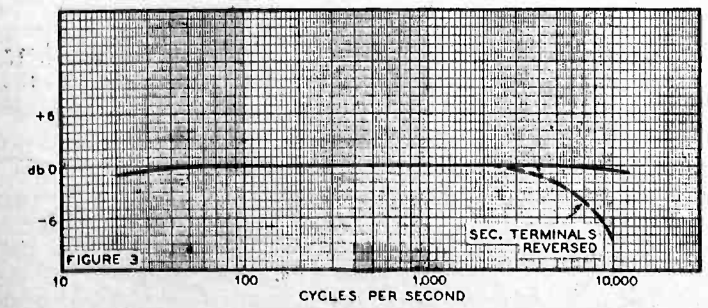
FIGURE 3

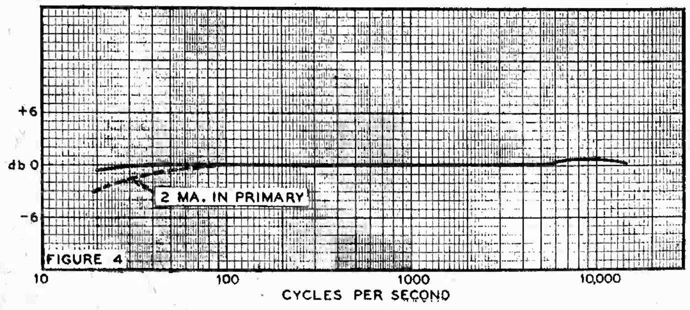
FIGURE 4

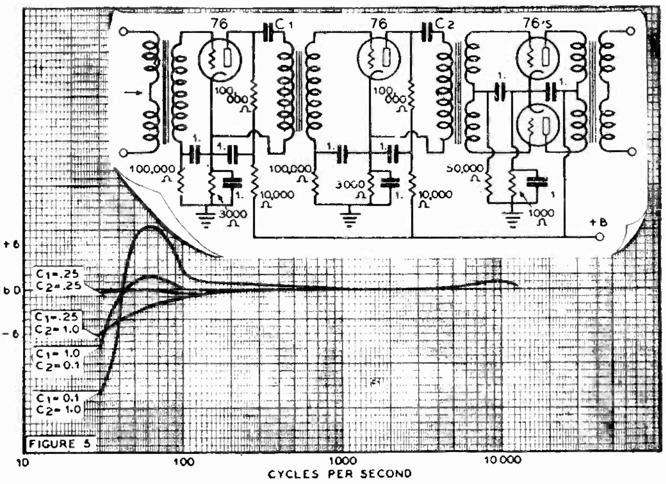

FIGURE 5

The better grades of transformers manufactured by reliable concerns are generally flat within one or two db up to at least 10,000 cycles. It is essential that the individual units have as small a deviation as possible, preferably less than one db, as the deviation is generally accumulative; a two stage amplifier having an input, interstage, and an output transformer each down one db at a given frequency, would have an accumulated drop of three db.

It might be well to add a word of caution regarding the interpretation of gain or loss ratios in terms of the decibel. The writer had occasion to track down a matter of five watts missing from an expected total of thirty from the output of a certain amplifier. The "insertion loss", (a factor seldom mentioned by the manufacturer) of the output transformer amounted to approximately .95 db. This represents a voltage loss of but 10%, but in terms of power, 20%, which could hardly be called negligible in any case.

The "Lows"

The low-frequency response is primarily determined by the primary inductance of the transformer. To secure high values of primary inductance, various high permeability alloys may be used in the core. These core materials enable the manufacturer to build compact units with remarkably flat response over the audio spectrum. When using such units, certain precautions must be observed in order to obtain the desired results. The magnetic properties of the core material undergo marked changes when subjected to mechanical shock or excessive values of flux density. They are not suitable for applications exposed to heavy vibration, jars, etc. Definite limits must be observed in the amount of flux generated in the core material by the d.c. flowing to the tube. This factor limits applications to those involving small values of d.c. or to push-pull units with balanced currents in the split primary. Parallel feed to the tube plate through either an inductance or a resistor is often used to eliminate the effects of the d.c. in the primary. In figure 4 is shown the response with and without d.c. in the primary of a typical interstage unit.

In conjunction with the parallel feed it is often possible to utilize resonance in the primary to obtain a flat or a rising low frequency response. The desired result is secured by using a blocking condenser of the proper capacity in series with the primary. Figure 5 shows a three-stage amplifier and the variations in response afforded by changing the blocking condenser values.

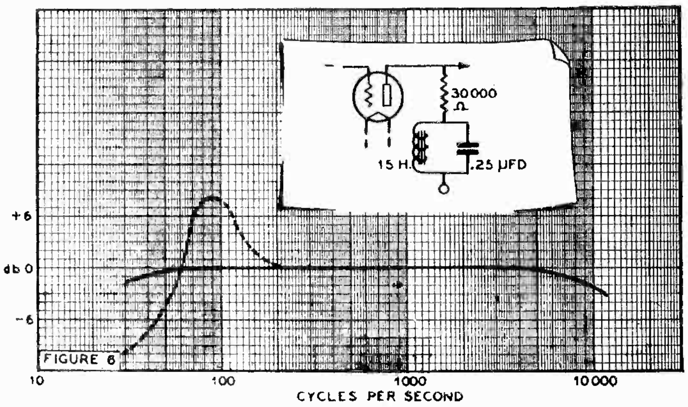

FIGURE 6

Similar effects may be obtained by inserting resonant circuits in the parallel feed to the tube plate. Such arrangements are applicable to resistance coupled amplifiers as well. In figure 6 the dotted line gives the rise in bass response due to the resonant circuit shown. Various other combinations have been used from time to time to provide variations in response for specific applications.

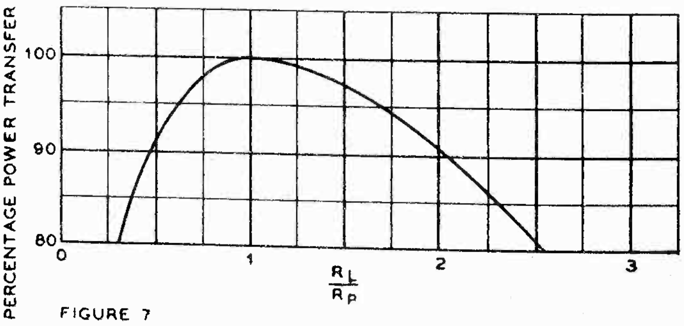

FIGURE 7

The selection and application of transformers depends upon the particular installation under consideration; however, there are cer-

[*Continued on Page 83*]

Surveying an ANTENNA LOCATION

***By* C. B. STAFFORD,* W9KWP**

At the present time, a great amount of magazine space is devoted to the design of V and rhombic antennas. Angles and distances are being tossed around promiscuously, and yet few of us have paid much attention to the methods of measuring these angles and distances. It is difficult to select a spot for such an antenna, as it is scarcely worthwhile to hire a surveyor to determine whether it will fit. It is somewhat of a nuisance to erect all but the last leg of a rhombic and find that the distance and the wire don't coincide. Even if we were all surveyors, surveying is a slow and exact science, which ham radio is not. There must be simpler methods some place.

It is at this point that the Army comes to the rescue. The best place to find a general is behind the lines. But the fighting is directed by the general. And how does he know how to direct it if he doesn't know where the enemy is? It's all very simple. A certain part of the Army is selected to make maps. These maps are taken back to the general. The general points his pudgy finger at Hill 235 and says, "Take that point immediately!" The general's location behind the lines is then very convenient. If Hill 235 is too hard to take, the boys just make up another map and let it go at that.

But it takes real genius to make up a convincing map at a minute's notice. These maps, of course, aren't always accurate. But with the help of trigonometry (that is, the mathematics of triangles), military methods of determining the physical characteristics of a plot of ground are sufficiently simple and accurate to be useful to ham radio. So let's see what it's all about.

In any surveying operation, two standards are necessary. The first is a standard of distance, and the second is a standard of angular displacement. The foot, yard, meter, rod, and mile are a few of the standard units of distance. Angles are normally measured in degrees.

Measuring Distance

The common way to measure distance accurately is by means of a steel tape. The degree of accuracy thus obtained, however, is usually far in excess of the requirements of a preliminary antenna location survey. A cloth tape is the usual method, but it is susceptible to stretching and shrinking to a much more serious degree than is a steel tape. Composition tapes of wire and cloth are relatively cheap and probably more nearly approach the desired accuracy than any of the other types. But pacing is probably good enough for most of us. In some cases, such as the distance between the tops of two trees, it is not possible to measure by applying the standard directly, and more advanced methods must be used.

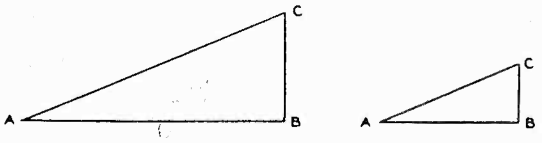

FIGURE 1

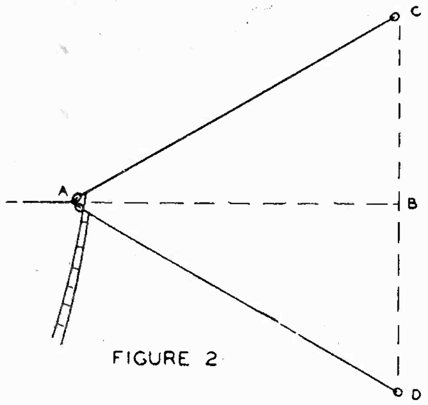

FIGURE 2

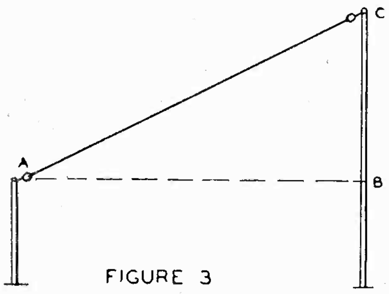

FIGURE 3

Fortunately for us, the length of the average

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*241 South Grant, West Lafayette, Ind.

man's pace is approximately the same as that of two of our standards of length, the meter and the yard. This makes it possible to approximate distances as being nearly equal to the number of paces. It might be well here to differentiate between the "pace" and the "stride". The pace is one step and is used in civilian surveying. The "stride" is two consecutive steps and is used chiefly in military survey work. The latter has the advantage of a lower total number for a given distance, while the former may be used more conveniently for the meter or yard approximation.

Measuring Your Pace

There is no easy way to predict the length of your pace. The only alternative is to measure it. The way to do this is to mark off some convenient distance several hundred feet long, or use a football field. Pace off this distance and record the number of paces. Repeat this process of pacing and recording until you have three consecutive values for the distance which agree to within 2 or 3 per cent of each other. This will usually occur on the third or fourth trip. In this way, you eliminate three of the variables involved. The four variables are ground conditions, wind resistance, fatigue of the person doing the pacing, and slope or grade. Try to pick ground which is level and in about the same condition as that which you intend to survey. Choose a calm day if possible. Walk back and forth over the course, rather than just taking values in one direction. In this way, you counteract most of the variables. After pacing off a standard distance, the distance divided by the number of paces will naturally give you the length of your average pace. This figure might well be entered in your log book. Thus, to determine an unknown distance, step it off twice in opposite directions, average the results, and multiply by the length of your standard pace. If the ground is level and there is no wind, you may get just as good results by pacing the distance only once.

Measurement of "Unpaceable Distances"

The main objection to the measurement of lengths by pacing is that the method can only be used in the direct measure of approximately horizontal distances. This is just an involved way of saying that not even our super-experts can accurately pace up the side of a 90-foot mast. Gravity appears to be one of the few laws not repealed in the last decade or so. Therefore, we must employ other means for measuring vertical distances. There are two general methods: direct measure—by dropping a tape from the top and measuring the tape, or using a tape already measured; and indirect measure, or triangulation (don't let this word scare you). The Pythagoreans used this method at such an early date (about 540 B.C.) that not even Swiss yodeling had been invented for communication; George Washington used it, and we all know he wasn't very smart, or he could have lied out of that cherry tree incident. So it shouldn't be any great difficulty to men who push Q-signals and electrons all over the globe.

All that you will have to know about triangles for this type of surveying can be put in a few words. Most have had this in plane geometry or advanced arithmetic.

Fundamental Trigonometry

If two triangles have the same shape, though not the same size, they are said to be "similar," and the respective sides of one are proportional to those of the other. Figure 1 shows two such triangles, ABC and abc. If the angles of one are the same as the angles of the other—which happens in similar triangles—then the ratio of the sides BC to AC is the same as the ratio of sides bc to ac. If we choose a right triangle with the 90 degree angle at B, then we can readily calculate tables to give us quickly the ratio of one side to another for each possible angle at A. The angle at C is always 90°-A. The ratio is expressed as a decimal. The terms *sine, cosine,* etc., found in trigonometric tables are merely tables to tell which sides are used to form the ratio. If side AC is opposite the 90° angle, B, and we wish these ratios for a given angle at A, the *sine* of the angle is the side opposite A, BC, divided by the hypotenuse, AC. The *cosine* is the side adjacent A, AB, divided by the hypotenuse, AC. The *tangent* is the opposite side divided by the adjacent side, or BC/AB. These ratios are given in columns 2, 3 and 4 of Table I, for the angles in column 1. Inasmuch as any triangle can be divided into a couple of right triangles, these ratios become very useful.

Let's try the table on a V antenna two wavelengths on a side and an angle of 70 degrees between the legs. On 14 Mc. the sides would be about 130 feet long. In figure 2 we have pictured the antenna, adding two dotted lines AB and CD dividing the V into two right triangles ABC and ABD. In one of these triangles the angle at A is one-half of the 70° between the legs, or 35°. Therefore we can obtain the length BC by multiplying 130 feet—the side AC—by the *sine* of 35 degrees. Here is the algebra:

$$\frac{BC}{AC} = \text{sine} < CAB$$

$$BC = AC \text{ x sine} < CAB$$

$$BC = 130 \text{ x } 0.536$$

$$BC = 69.68 \text{ feet.}$$

Multiplying BC by 2 we obtain the distance CD, and can therefore erect the V beam simply by cutting the two 130 foot wires and spacing the ends 139.34 feet apart, without any necessity to measure angles. Don't forget, however, to add the insulator and halyard length at the far end to the leg length before making the calculations if you want to know how far apart to put the poles.

If you want to know how long your lot must be, which is represented by the line AB, then multiply the leg length by the *cosine* of 35 degrees, which is 0.8192, and you have the answer. Here is the algebra:

$$\frac{AB}{AC} = \text{cosine} < CAB$$

$$AB = AC \text{ x cosine} < CAB$$

$$AB = 130 \text{ x } 0.8192$$

$$AB = 106.5 \text{ feet}$$

The same method can be applied to tilted wires on masts of unequal height, as shown in figure 3, by considering only the part of the taller mast above the height of the shorter mast. Knowing AB and BC, BC/AB gives the *tangent* of the angle at A, and thus from the table the actual angle can be obtained. Then the side AC can be determined as with the V antenna.

SIMPLIFIED TRIGONOMETRIC TABLES
Angles of every 3 degrees

Angle in Degrees	Sine Side opposite / Hypotenuse	Cosine Side adjacent / Hypotenuse	Tangent Side opposite / Side adjacent
0	0.0000	1.0000	0.0000
3	.0523	.9986	.0524
6	.1045	.9945	.1051
9	.1564	.9877	.1584
12	.2079	.9782	.2126
15	.2588	.9659	.2679
18	.3090	.9511	.3249
21	.3584	.9336	.3839
24	.4067	.9136	.4452
27	.4540	.8910	.5095
30	.5000	.8660	.5774
33	.5446	.8387	.6494
36	.5878	.8090	.7265
39	.6293	.7772	.8098
42	.6691	.7431	.9004
45	.7071	.7071	1.0000
48	.7431	.6691	1.1106
51	.7772	.6293	1.2349
54	8090	.5736	1.4281
57	.8387	.5446	1.5399
60	.8660	.5000	1.7321
63	.8910	.4540	1.9626
66	.9136	.4067	2.2460
69	.9336	.3584	2.6051
72	.9511	.3090	3.0777
75	.9659	.2588	3.7321
78	.9782	.2079	4.7046
81	.9877	.1564	6.3138
84	.9945	.1045	9.5144
87	.9986	.0523	19.0813
90	1.0000	.0000	

Table I

To measure the height of a vertical object on reasonably level ground, a stick, some arithmetic and the sun come in handy. If the side BC in the large triangle in figure 1 represents a mast of unknown height, and if the shadow of the top at the moment falls at A, then of the triangle ABC the side AB can be measured along the ground. Using a stick of convenient length, bc, measure its height bc (when standing up straight) and the length of its shadow, ab. By proportion, $\frac{BC}{AB} = \frac{bc}{ab}$,

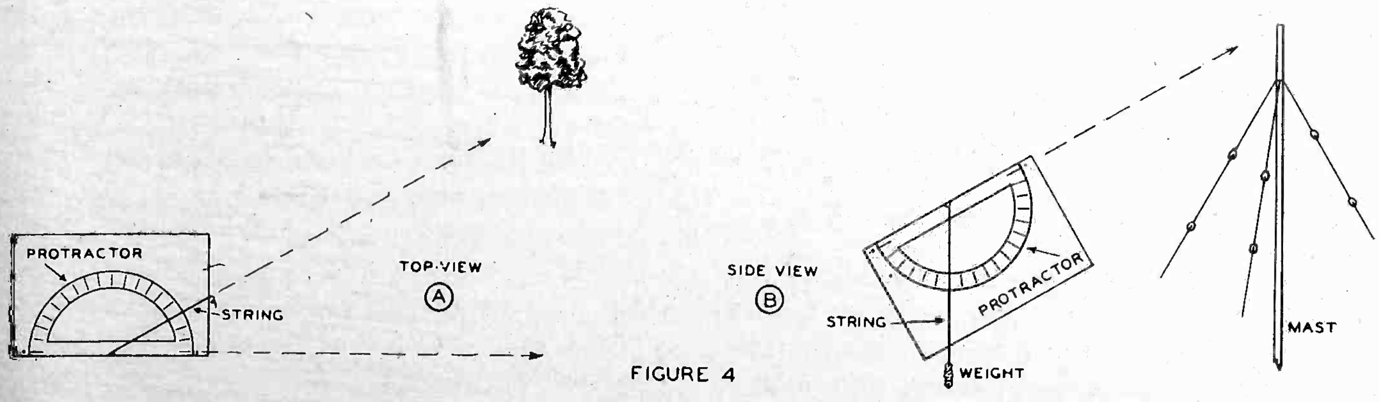


FIGURE 4

and $BC = \frac{bc \times AB}{ab}$. If the mast's shadow is 40 feet, the stick's shadow 4 feet and its height 5 feet, then the mast is 50 feet tall, as follows:

$$BC = \frac{bc \times AB}{ab} = \frac{5 \times 40}{4} = 50.$$

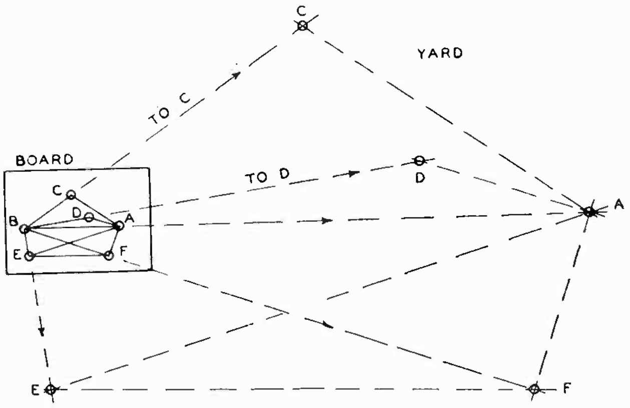


FIGURE 5

Measurement of Angles

The measurement of angles in preliminary location surveys is best accomplished with the use of a surveyor's transit. But like astronomical telescopes, their cost is prohibitive to the amateur, and they are not easily borrowed. But if angles must be measured, the cheap drawing protractor can be used. For making a lot of measurements, a protractor can be fastened to a board with thumb tacks, so that one edge of the protractor is along the edge of the board. A weighted string can be arranged to be stretched at any angle. Place the board on a tripod or a box and sight along the above mentioned edge in the direction of one leg of the angle to be measured. Now when you sight along the string for the other leg, the string crosses the protractor at the proper angle. This is portrayed in figure 4. In measuring vertical angles, just let the string and weight fall like a plumb line, tilt the sighting edge of the board to the desired elevation and read the protractor where the string crosses it.

"Mapping-out" Your Lot

If you want to make a scale drawing of your available space, put a sheet of paper on a drawing board and set the board on a tripod or box. Mark a point on the paper where you wish to start the drawing, and take the board to the spot indicated in the yard, which we shall call "A." Place the board in a position so that north on the paper will be about the same as true north, and sight along a ruler laid on the paper toward several important objects in the yard, drawing a line on the paper after the rule is properly laid on the paper. Then move to one of the other objects, which we shall call "B". Set up the board so that the rule, when along the previously drawn line AB, will be in line with the first point A when you sight along it. Point B can be marked on the line AB, preferably at a distance having some scale relation to the measured distance between points A and B. Now without turning the board, sight on the other objects of importance and draw lines from B toward them which, by intersecting lines from point A, will locate all positions on the map. You won't even have to go to the other objects unless you want to check the accuracy of the angles on the paper

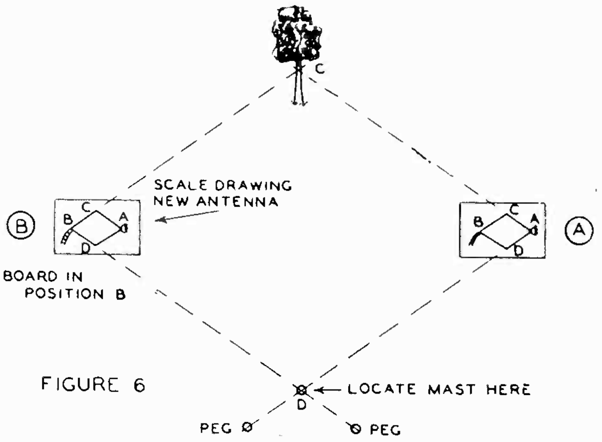


FIGURE 6

or can't see all points from both A and
You now have a scale map. The procedur
just described is illustrated in figure 5.

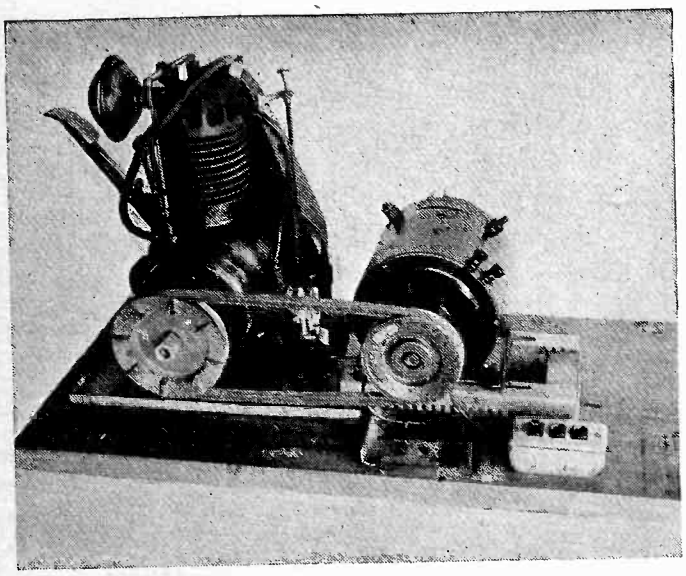
If one of the points you want to locate
the place to erect a new mast, just reverse th
process by drawing the mast on the paper in i
proper position and locate the spot by sigh
ing along the drawing at pegs placed in th
ground for the purpose of marking the inte
secting lines. This is illustrated in figure 6.

The methods outlined here are not free fro
error, but they are simple enough to hand
and be of practical value to all of us. And u
til wavelength shrinkers are developed, it w
be a sane policy to know whether your elabora
or simple array will fit before trying to co
struct it.

Portable A. C. POWER SUPPLIES

By GEO. M. GRENING*
W6HAU

●



Complete 500-watt self-excited power plant. The motor is an antique that was bought for a "song" and overhauled to put it in shape. The pulley on the motor is from a Model B Ford generator.

The recent disastrous floods in the middle west have awakened the entire amateur fraternity to the necessity of having available reliable, portable radio equipment. While excellent apparatus may be constructed using either B batteries or a storage battery, the power output is always pretty well limited. A reasonably high power output necessitates the use of some type of a.c. supply, which, surprisingly enough, may be easily constructed by the amateur himself from an old automobile generator.

Two different types of a.c. generators may be constructed, either a self-excited type or a separately-excited one, the first generating its own current to excite its field and the latter requiring a separate source of excitation. The self-excited type is preferable when the driving power is to be obtained from a stationary engine, while the separately-excited generator is more adaptable to being driven from the fan belt of a car since the necessary field excitation is readily available from the car battery.

The most popular type is the self-excited generator, which, together with its engine, may be put in operation at any desired location, particularly where a car cannot be driven. An additional factor is the greater economy in the running expense.

An excellent booklet published by S. W. Duncan, 408 S. Hoyne Ave., Chicago, Ill., entitled "Autopower" is the basis for the construction of the generators described. A few changes have been made which appear to make the generators more suitable for radio work. The special slip ring and other material may be obtained from the same address at a reasonable price. For further information and the conversion of other types of generators, you are referred to this booklet.

Dodge-4 Generator Used

By far the most suitable generator for radio work is the old four-cylinder-Dodge combination starter-generator. The usual junk yard price on these is $3.00. They were made in two types. The earlier type, known as the Model G, may be identified by the fact that the end plates are held in place with four hexagonal nuts. The later, or GA type, has its end plates fastened with small bolts.

The GA model has a better grease retaining ring than the G but has the disadvantage that it may require work on the brush holders as described later. The Model G has a plate in the end which can be conveniently used for a ground brush collector ring. On some of the early Model G's, however, the armature slots have no lip to hold wedges in place, the wires being held in by bands around the armature slots. Avoid this type if it is encountered.

The generator may be burned out as long as the bearings and commutator are in good condition since only the frame is to be used.

The Tearing-down Process

Completely disassemble the unit, removing armature, brushes, field coils and poles. Clean everything thoroughly in gasoline. The only possible difficulty in this respect lies in removing the eight bolts which hold the field poles in position since they have been prick-punched to prevent their loosening. The task can be accomplished, however, by placing a drift punch in the bolt slot and striking smartly with a hammer to jar the bolts loose. If the heads are

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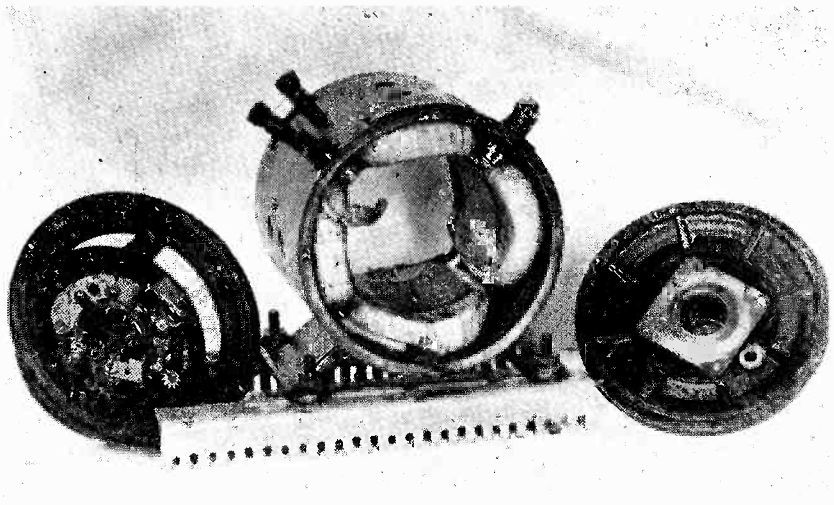
*Police Dept., Santa Barbara, Calif.



Completed frame with new field coils in place. Right end plate shows ground brush plate and "hot" a.c. brush holder. D.c. brush holders shown on the left end plate. Model GA with model G ground plate installed.

damaged by this operation, replace with new ones.

Cut the wires joining the field coils together and remove them.

All wire must be removed from the armature, which may be accomplished by cutting through the wire with a hacksaw, close to the end of the slots and directly behind the commutator risers, after which the wedges may be driven out of the armature slots and the wire peeled out. There is a wooden spool mounted on the shaft between the rear of the commutator and the slots. Be careful that this is not damaged by the hacksaw, since it is to be left in place.

Using a hacksaw blade with the teeth ground off to form a knife edge, thoroughly clean all the old insulating paper from the slots.

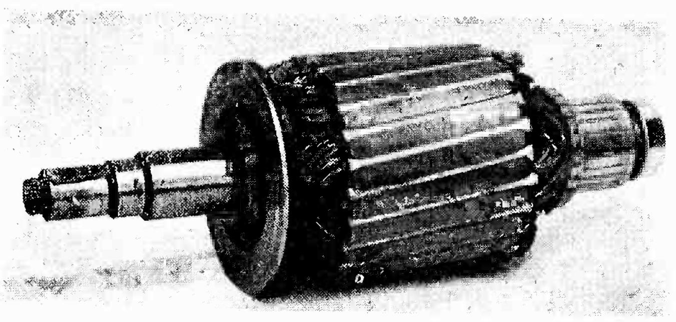
At the completion of these operations, you will have several pounds of copper which may be sold to a junk yard to help defray the generator cost.

New field coils and a new armature are now to be wound. The first operation in winding the field coils is to construct a form similar to that illustrated. This form may be rotated in a hand drill whose handle has been clamped in a vice. It can be taken apart to remove the winding after completion. To facilitate this removal, four nails are located at the inside corners of the winding which may be pulled out and the finished coil removed. The outside dimensions of the spacing between these nails is 3⅜" by 1⅛". The winding slot is 13/16" wide. Dimensions of the end plates are 3¾" by 6¼".

A length of friction tape is laid into each long side of the form so that it may be wrapped around the wire to hold it together after completion of the winding and during the time between its removal from the form and the taping.

Winding the Field Coils

Saw a slot in one side of the form in which to place the start of the wire. Tightly wind on 180 turns of number 15 plain enameled wire for each of the four coils in the self-excited type and 200 turns per coil of no. 17 s.c.e. in the separately-excited job. Wind the first few layers evenly and jumble the balance as evenly as possible. Carefully remove the coil from the form and wrap with either ¼" or ½" cotton tape, lapping this tape well. When the number 15 plain enameled wire is used, tape with either two layers of cotton tape or one of cotton and one of empire cloth or linen tape as it is called.



The complete self-excited armature. The ground brush can just be seen on the inside of the collector ring; this bears against the ground brush-plate shown in the figure above.

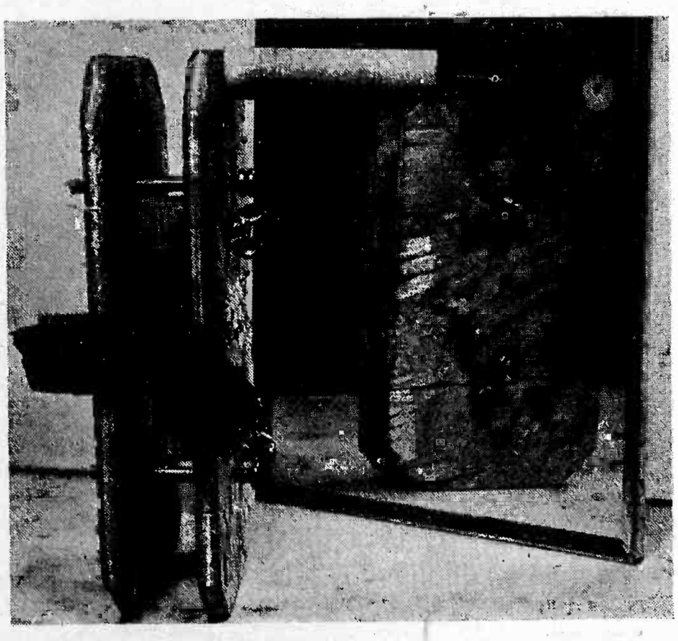
It is advisable to secure some sleeving to cover the leads from the coils for better insulation. Run this sleeving along the ends so it will be held in place by the tape. Wind all coils in the same direction.

Form the completed coils by bending carefully, to fit the curve of the frame. The final forming may be done by bolting the coil into the frame by means of the pole-piece. Be careful in this operation that the insulation is not damaged. Dip the completed coil in baking varnish and bake dry or put four coats of white shellac on the entire coil to impregnate the windings.

Assemble the coils in the frame, having the leads from each coil in the same relative position.

Field Coil Connections

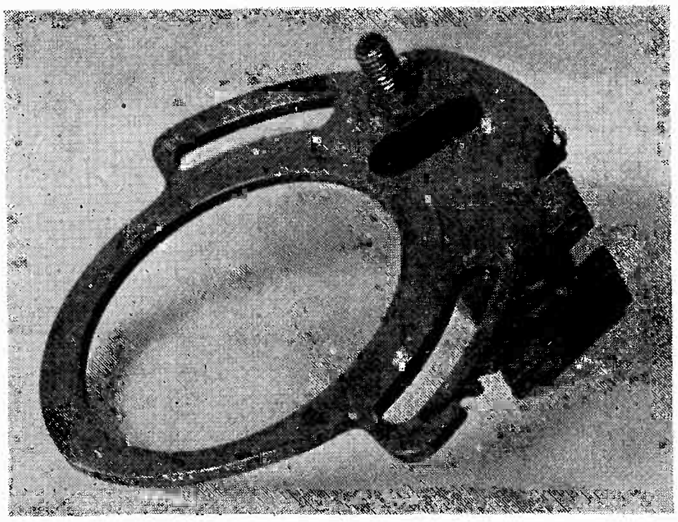
If the generator is to be self-excited or separately-excited from a 6-volt auto generator, connect the field coils in series, the outer wire of one connecting to the other wire of the next and the inner to the inner of its adjacent one, so the current flow through each coil will be in an opposite direction from the next one. When excited from a battery, connect in two banks of series-parallel. If the connections are properly made, running a compass around the frame, with a battery connected to the fields, should show alternate north and south poles. If it does not, reverse the connections on the wrong field coil. This is very important.



The winding form for the field coils. Spacing between the sawed-off nails, 3⅜″ and 1⅛″ (outside). Winding slot, 13/16″ wide. End plates, 3¾″ by 6¼″. The tape used to bind coil before removal is shown in place.

When separately-excited, connect one end of the field coils to the frame and bring the other through one of the original insulated terminals. One of these terminals may be grounded, so inspect and remove the ground if necessary. The exciting current will connect between this terminal and the frame.

If self-excited, connect one end of the field coils to the movable brush and the other to the fixed brush which is closest in a clockwise direction, looking at the brush assembly from the outside of the frame. Remove the third brush entirely. No polarity need be observed for the excitation.



Brush-holder plate from model GA showing method of slotting to allow an adjustment of the holder.

The field current of the generator, separately-excited, is about 5½ amperes and, with the following described construction, about 3 amperes on the self-excited outfit.

If directly excited with a 6-volt generator, adjust the third brush on that generator so the a.c. generator delivers 110 volts into the rated load when it is driven at 2000 to 2300 rpm.

Armature Winding

Since the self-excited type is the more popular, the winding of the armature will be given more in detail, followed by the procedure for the separately excited one.

Before winding the armature, it is advisable to turn the commutator down if grooved and undercut the mica between segments. While turning it down, it is as well to have the risers smoothed up. Test between segments for shorts. With a single hacksaw blade saw a slot in each riser deep enough to take two pieces of number 20 wire.

Number each slot of the armature in some convenient manner, starting at any point. There are 25 slots.

The commutator segments must now be numbered in the following manner. Place a hacksaw blade over slot four so that it is parallel to the shaft. Sight down on the commutator, and the segment which is in line with it will be segment number 7. Counting counterclockwise around the commutator, mark segment number 1.

Cut 25 strips of .010″ insulating paper into 1¾″ by 3-13/16″ pieces and lay one in each slot to insulate the windings from the slots. The ends of these strips should project out of the slots slightly.

The D.C. Winding

Using number 20 s.c.e. wire, start the d.c. winding by soldering one end of it into segment number 1 after sleeving long enough to reach from this segment to the armature slot has been slipped over the wire.

Pressing the wire down against the wooden spool on the shaft, bring it over to armature slot number 1, laying it in this slot, thence around the back and through slot number 7 to the front again. Continue winding into slots 1 and 7 until there are three turns in these slots. On coming out of slot 7 on the end of the third turn, cut the wire long enough to be soldered into segment 13. Place sleeving over the end, the same as at the start of the winding and solder to segment 13.

Starting at segment 2, solder the wire to this point and wind the same three turns into slots 2 and 8, coming out to segment 14. Use the sleeving as described above, on all these d.c. windings.

Continue the same procedure all the way around the armature, advancing one segment and one slot for each three turn winding. When segment 13 is reached, it will be found that the end of the first coil will have been soldered in this segment. Simply sweat this second wire into the same segment and continue.

While this entire procedure looks very complicated on paper, with the work in front of you and following these directions it is immediately apparent how to proceed and no trouble should be experienced.

At the conclusion of the winding, you will have 25 separate coils each consisting of three turns, the start of one coil and the finish of another soldered into the same slot, while in each armature slot there will be six lengths of wire.

Before placing the a.c. winding on the armature, use a piece of ⅛″ fibre or bakelite whose sharp edges have been rounded slightly and tamp the d.c. coils down in the slots. Cut a narrow slip of insulating paper slightly wider than the slot and lay on top of this d.c. winding, bending the edges so they can be forced down between the wire and sides of the slot, insulating this winding from the a.c. one which is to be laid on top of it. Do this to each slot. With fishcord, wrap a number of turns around the end of this d.c. winding, between the commutator and armature slots, to hold the ends down against the centrifugal force which will be present.

The A.C. Winding

The a.c. winding is made of number 16 s.c.e. With two hacksaw blades together, saw a slot in the shaft on the opposite end from the commutator and solder one end of the wire in this slot. From this point, carefully wind 21 turns in slots 1 and 3, pressing the wires down lightly but firmly into the slots as you progress. Upon coming out of slot 3 with the 21st turn, bring it over to slot 25 and wind 24 turns in this and slot 4. Continue to slot 24 and 5 and wind 12 turns in these slots.

Upon completion of this procedure, you will have one coil, consisting of three windings. Lay the wire from slot to slot, fairly close to the ends of the slots, to permit room for the slip ring to be mounted on the shaft.

Again tamping the wire down into the slots, fold the edges of the .010″ insulating paper over, so they lap over the top of the wire in each slot and force a wedge made of either heavy fibre or the regular wooden wedges used by armature winders into each slot except the two with but 12 turns each. These wedges should be of a thickness sufficient to hold the wire down firmly.

At the end of the 12th turn in slot 5, go to 9, and in this and slot 7 wind 21 turns in the *opposite* direction from the windings just completed. Jump to 10 and 6 and wind 24 turns, thence to 11 and 5 and place 12 turns in these slots, all in the same direction.

This will make 24 turns in slot 5, 12 of which are in one direction and 12 in the opposite. Again press the wires down, lap the insulating paper and drive wedges in.

From slot 11, reverse the direction of winding and go to slots 15 and 13, placing 21 turns in these slots. Continue to 16 and 12 with 24 turns and thence to 17 and 11 with 12 turns. Wedge this coil in place. Reverse the winding coming out of slot 17 and put 21 turns in 21 and 19, then 24 turns in 22 and 18 and 12 turns in 23 and 17.

Upon completion, you will have four coils, each consisting of three smaller coils, the wire being continuous from start to finish. Each coil will be wound in an opposite direction from its adjacent one. Slots 23 and 24 will have 12 turns each, while slots 2, 8, 14 and 20 will be empty as far as the a.c. winding is concerned. Fill slots 23 and 24 and those with no wire in them full of wedges. Make the final wedge in slots 2, 8, 14 and 20 long enough to project over the coil center and help hold it in place.

The Collector Ring

Unless you have machine shop equipment, it is preferable to buy the special slip ring and brush holder as mentioned previously. The combination sells for $3.25 and includes a ground brush to prevent the bearings acting as a conductor for the a.c. The illustration of the armature, however, shows the design of the collector ring clearly. Mount this slip ring on the shaft at the opposite end from the commutator, shimming if necessary, and tighten the set screws securely.

Solder the end of the a.c. winding to one of the bolt heads which hold the brass ring onto the bakelite disk.

Saturate the armature with bakelite varnish and bake well. An alternative is to saturate it with five coats of white shellac to help hold the wire in place and impregnate the windings against moisture and grease.

Assemble the armature in the frame, packing the ball bearings with grease. Replace the end plates and insert the a.c. brush.

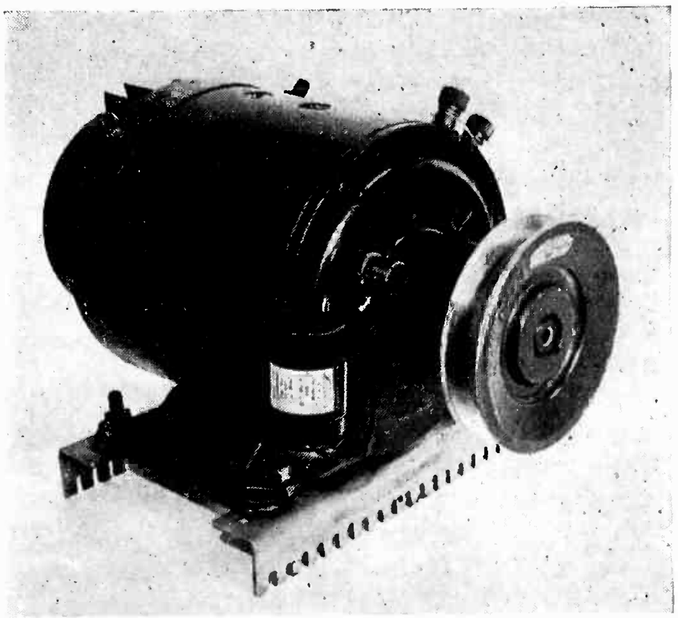
A Few Precautions

There is not much insulation on any of the wire, permitting more turns in the given space. Use great care so that this insulation is not damaged in any way during the winding process. As an additional help in getting the required number of turns in the slots, don't bend the wire where it lies in the slots. Place each piece straight and force down to the bottom.

Take your time and use care on the whole job. Armature winding is a trade in itself and unless you are an expert, do not hurry. If any difficulty is encountered, go to a motor rewinding shop and ask them to show you how the wire is placed in the slots and how the wedges are inserted.

Checking the Unit

Upon completion, take the generator to an automobile electrical shop and ask them to place it in their generator tester which is equipped with an electric driving motor, universal chuck and tachometer. Move the regulating brush as close to the other brush as possible.



Complete self-excited generator. Note a.c. brush holder and the filter condenser to which it is attached. The two insulated terminals on the top connect to the 6-volt field and are brought out for battery charging.

To build up the residual magnetism which may have been lost in the construction process, connect the positive end of a storage battery to the stationary brush and run the generator up to 1,000 rpm. Momentarily touch the negative terminal of the battery to the movable brush and it will start generating. If not, reverse the battery leads and try again. If it still does not function, look for the trouble elsewhere. During this process, the generator should be run in a clockwise direction, facing the commutator end.

Put a 500 watt load, which may conveniently be a lamp bank, on the generator and run the speed up to 2100 or 2200 rpm. Adjust the voltage to 110 by means of the movable brush. The frequency will be around 70 to 80 cycles, a great advantage in radio work, since the higher the frequency, the better the filtering in the power pack of the transmitter and receiver.

Changes for a Separately-Excited Field

To wind the armature for a separately-excited field, use number 15 s.c.e. wire, leave the d.c. winding out and use the same number of turns and procedure as given for the self-excited type.

Solder a heavy wire around the commutator risers, soldering each segment to this wire. End the a.c. winding on this band so the frame will be one connection and the entire commutator the other. No slip ring is necessary on this type since the commutator is being used in its place.

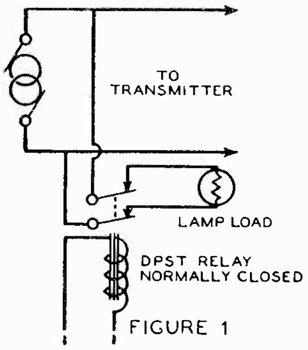


FIGURE 1

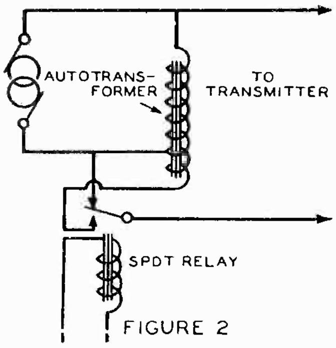


FIGURE 2

erator and motor can now be mounted on a board with slots cut in the board to permit moving the generator for correct belt tension. An alternative is to construct a mounting for both engine and generator from angle iron.

A further improvement may be provided by mounting the generator on an adjustable "motor rail" similar to that illustrated. This has the advantage that belt tension is quickly adjusted and the generator may be removed from the baseboard for ease of transportation.

Adjust belt tension until the output voltage is stable. A light bulb should burn without flicker.

Mount a double convenience outlet box on the base to make connections to the load. A 5 or 6 ampere fuse should also be incorporated.

One major precaution. *Never* fill the gas tank with the engine running. The danger of explosion and fire is too great.

Automobile Drive

If a separately-excited generator is to be used, driven by a car engine, a four-inch pulley on the generator, bearing against the fan belt, will permit the full output to be obtained with an engine speed of 800 to 1,000 rpm., equivalent to a road speed of 25 to 30 m.p.h., at which speed the engine will be delivering sufficient horsepower and running smoothly.

While the actual mounting must be worked out by the individual, means should be provided to disconnect the generator from the engine when not in use. A 250-volt a.c. voltmeter should be installed adjacent to the hand throttle. Adjust to proper voltage by adjusting speed of the engine. Incorporate a switch to disconnect the car battery from the field coils.

When the generator is connected, never "gun" the engine. Increase and decrease speed gradually.

Voltage Regulation

Returning to voltage regulation, it is possible to replace the engine governor with a more sensitive electro-mechanical one. This may be constructed on the solenoid principle by using a soft iron core $\frac{3}{8}''$ to $\frac{1}{4}''$ in diameter and placing two windings on the coil in opposite directions. The first winding is made of fine wire and is connected across the 110. It should have a resistance between 200 and 400 ohms. The second, wound on top, is of heavy wire and is in series with the load. With no load, the magnetism holds the plunger in and closes the throttle. As the load increases, the current through the series winding increases and bucks the shunt coil, a spring then pulling out the plunger which opens the throttle. No exact description can be given of the coil, it being necessary to work it out for each type engine.

An automatic method of keeping the voltage constant (figure 1), particularly when a phone transmitter is used, is to adjust the voltage to 110 with the transmitter on. A relay is then incorporated, which will cut in a lamp bank, of a wattage equal to the difference between the drain with the plate power on and off.

This simple method of keeping the load constant at all times is not, however, applicable to a c.w. transmitter, owing to the small time interval between minimum and maximum load. For such a transmitter, the best device to use is an auto transformer. When incorporated, the proper step-up tap is selected to give 110 volts with the full load of the transmitter on the generator. A s.p.d.t. relay is then installed to connect the transmitter to the line (figure 2) when the key is up, and to the auto transformer when the key is down, giving 110 volts in both positions. Other electrical arrangements, using an auto transformer to obtain good regulation, readily suggest themselves.

A convenient method of connecting the relay in the transmitter circuit, to secure full automatic operation, is in the plate return or cathode circuit of the tube or tubes being keyed.

The general conclusion should not be drawn, however, that all installations require voltage regulators. It is only when the current drain on the plant, with all apparatus on, approaches the maximum capacity, that such regulating devices are necessary. On transmitters having an input up to 50 or 75 watts on the final stage, it is almost always possible to operate without any extra regulation. The generator may be set to deliver 125 volts with key up and even though it may drop to 105 volts with key depressed, no noticeable trouble will be ex-

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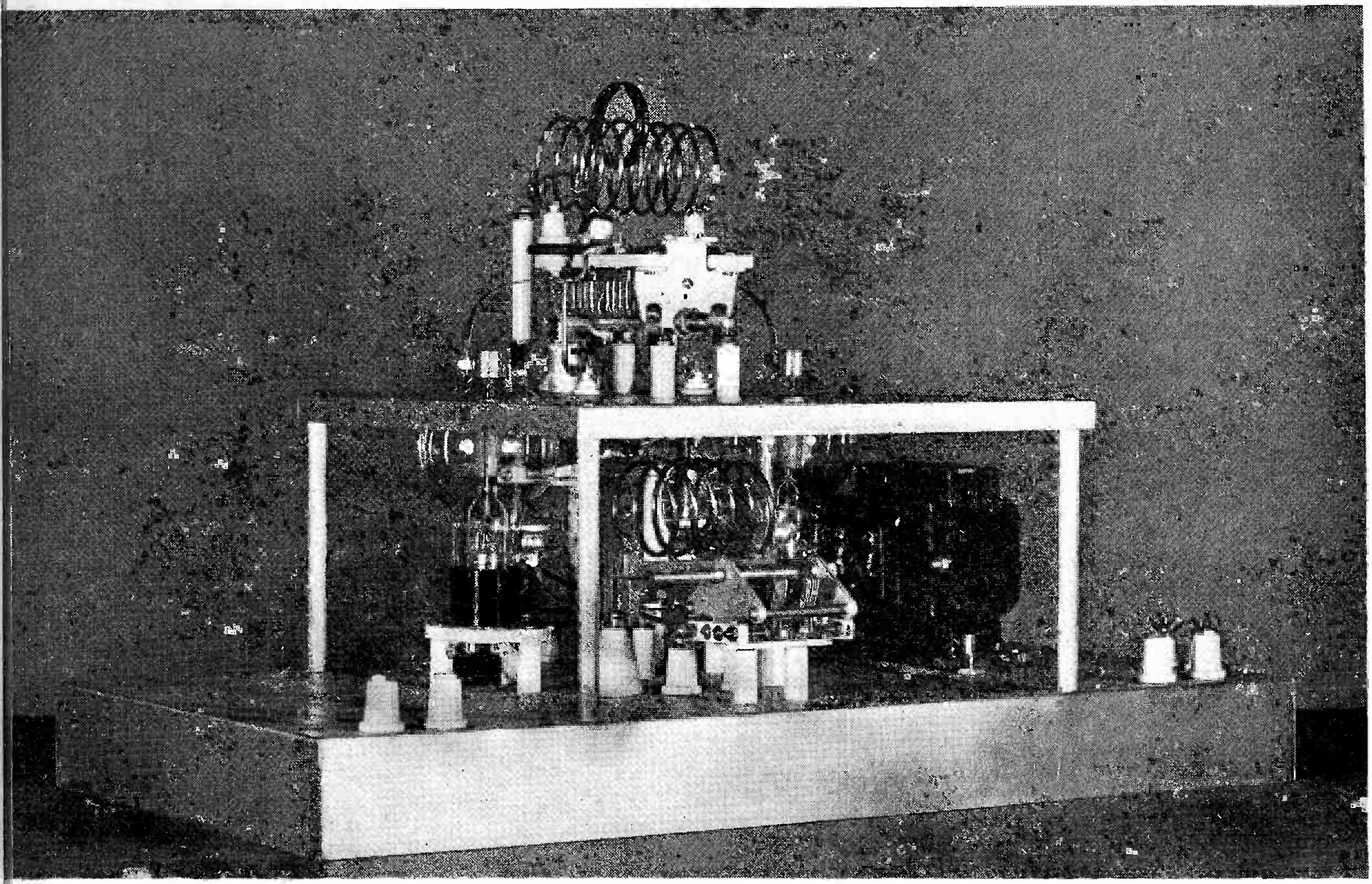
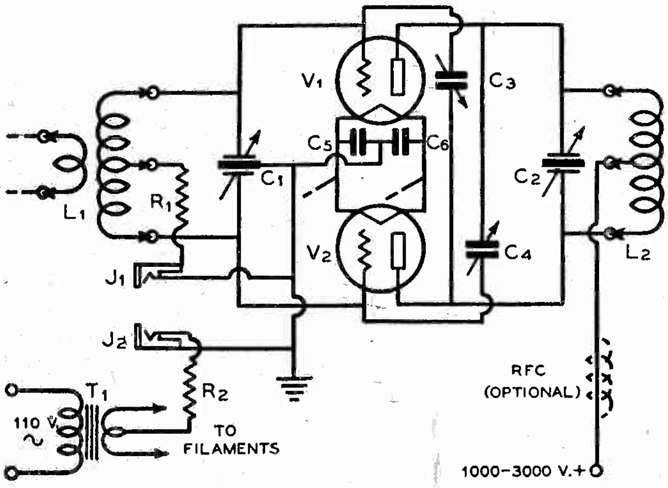


" . . . and a pair of 808's with a quarter kilowatt input."



Schematic of the Amplifier

C_1—50 μμfd. per section split stator
C_2—35 μμfd. per section, 2000 volts
C_3, C_4—"800-type" neutralizing condensers
C_5, C_6—.002 to .006 μfd. mica by-passes
V_1, V_2—808's. Similar tubes could be used
R_1—500-ohm, 20- to 30-watt grid leak
R_2—50 ohms, 10 watts (can be omitted)
RFC—2½mh., 500 ma. r.f. choke
T_1—7.5 volt, 8 amp, filament transformer (primary rheostat not shown)
Coils—See text for description

As used by C. A. COLVIN,* W9VHR

Perhaps it may seem a little redundant, our showing another high-frequency push-pull amplifier after having had one in the two previous issues, but we believe that the constructional excellence of the one shown herewith merits its presentation. The unit is well laid-out, leads are short and direct, and the grid and plate circuits are completely shielded from each other. The photographs and diagram are self-explanatory making a long constructional description unnecessary. To quote from Mr. Colvin's letter:

"The filament transformer mounts on the chassis and voltage is controlled by a rheostat in its primary. This rheostat is mounted under the chassis and its shaft can be seen protruding just in front of the filament transformer. A flexible drive brings the control to the front panel.

"The grid tuning condenser also is controlled

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* c/o Omaha and Council Bluffs St. Ry. Co., Omaha, Neb.

from the front panel by a flexible drive; its control is mounted in a symmetrical relation to the one that operates the rheostat. It will be noted, by looking at the main front view, that this allows the grid circuit to be laid out very symmetrically.

"Satin-finished aluminum forms the chassis and the separate mounting base for the plate circuit. To preserve the finish after the sandblasting, the chasses were sprayed with clear lacquer. It will be noted that the plate circuit is an entirely separate unit and can be easily removed. Also, simply by lengthening the vertical supports that hold up this smaller chassis, any of the larger medium-power r.f. tubes with the plate cap on top may be substituted.

"All r.f. circuits are wired with no. 8 soft-drawn copper wire. Coils are wound of the same material (those for 28 Mc. are shown in the photographs). The antenna link is made variable by a simple method which the photographs clearly indicate. Inasmuch as W9VHR is only operated on 10 meters, plug-in coils were not considered necessary. For the sake of simplicity, however, the grid coil is mounted upon a plug-in base.

"The feed-through insulators along the front of the chassis take care of the grid and plate meters which are mounted on the front panel of the amplifier and are always connected in the circuit. The voltmeter plugs into an open-

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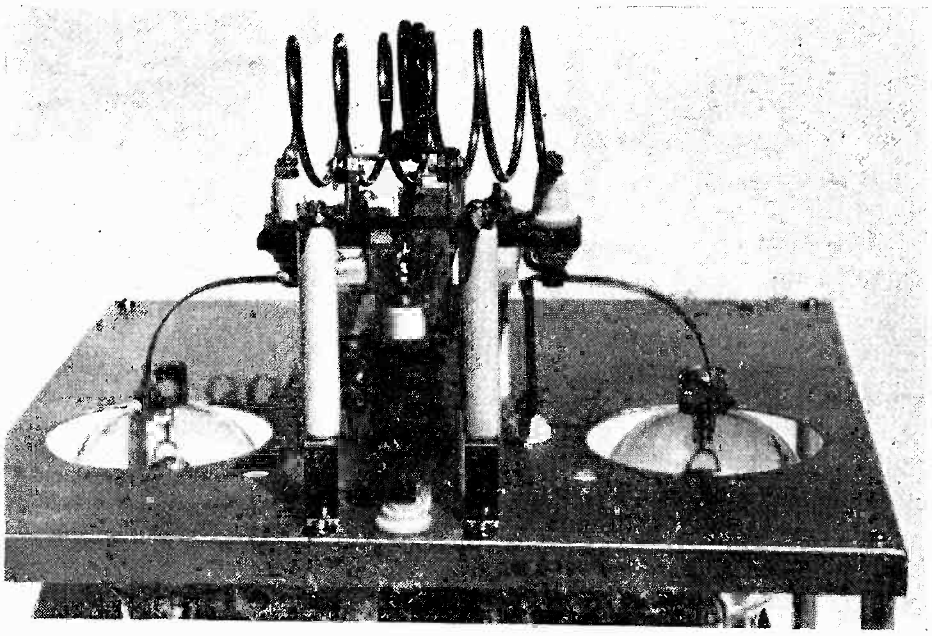
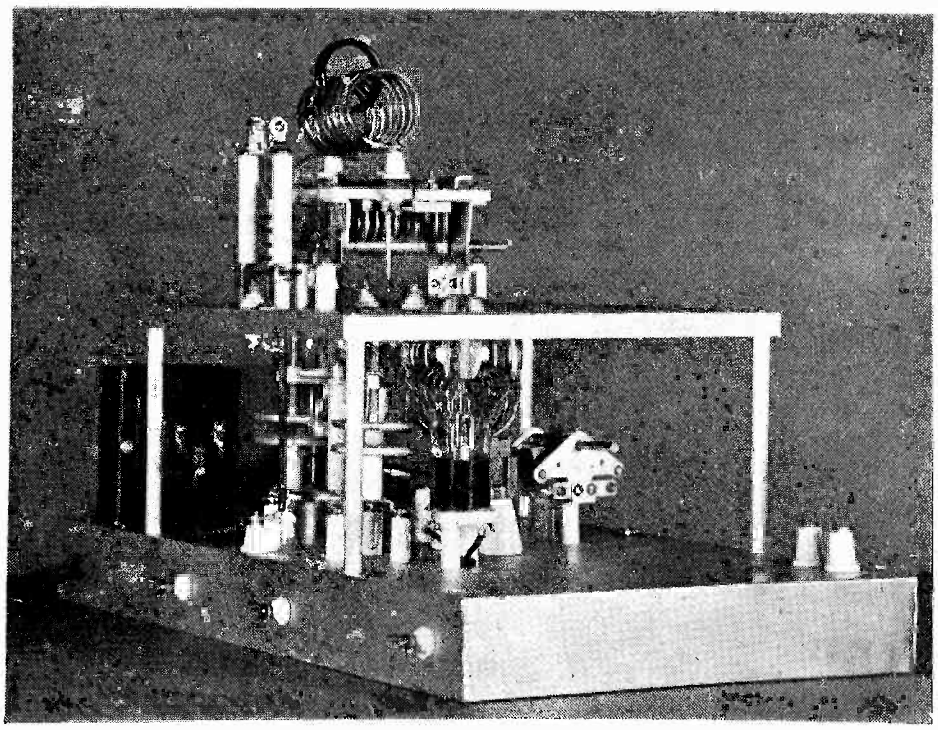


Top view of the plate-circuit shelf showing the tank circuit, antenna-coupling link, and flexible-strip plate-cap connectors.



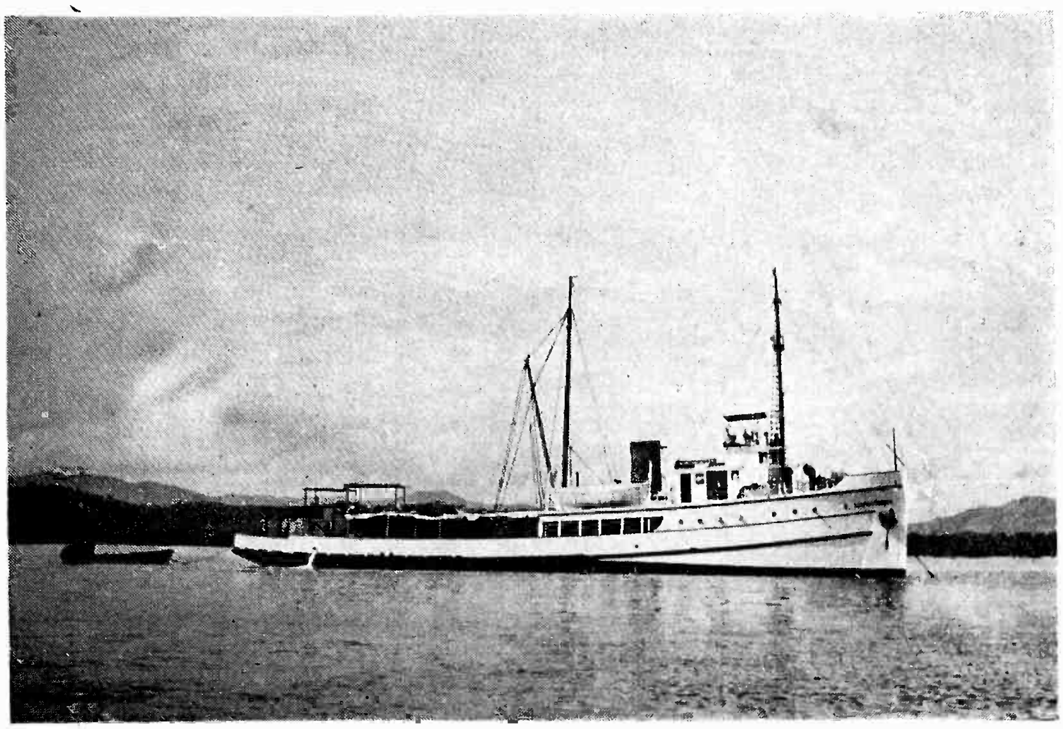
Three-quarter side view of the complete amplifier showing the general layout of the stage. The neutralizing condensers, filament transformer, and grid circuit can be seen in their proper relation to one another.

"SPARKS" with the Tuna Clippers

By

A. F. PENNIWELL,*

W6EZK-KGRL



Wherein the writer, a "ham" who has gone to sea at his chosen vocation, tells of one of the lesser-known branches of professional radio operating.

Probably the term "Tuna Clipper" is unfamiliar to the greater number of readers so I will explain that they are boats equipped to travel far in quest of this necessary ingredient for cans labelled "Tuna." The "Northwestern" (above), on which I am at present employed as radio operator-fisherman, is perhaps representative of the 60-odd radio equipped vessels of the tuna clipper fleet. She is 127 feet in overall length and is deisel engine powered, equipped with complete refrigeration and is otherwise fitted for cruises up to periods of better than two months at sea.

A crew of about sixteen men is generally carried. Four of them, namely the Skipper, Chief Engineer, Chummer and Cook do not actually handle fishing tackle as they have plenty of other duties that keep them busy during the spells of fishing. On most boats, Sparks is expected to fish when the fish are running, doing his radio job at other times.

All fishing is done with a nine or ten foot pole and a four or five foot line terminating in an imitation squid, which is a steel fish hook with feathers and skin tied around the hook. Only when fishing is very slow is live bait used on the hooks. When a school of tuna, dashing around furiously feeding on the bait thrown overboard, starts hitting the hooks there is action plenty. The hooked fish is swung over the fisherman's head, the line is slackened and the barbless hook clears the fish's mouth and the fish drops into the bin behind the fishing racks. The hook is immediately swung down into the water again, ready for the next one. One man can handle up to about a 35-pound tuna alone, but if he has been fishing 30 to 35 pounders all day he knows he has done some work. When they run 15 to 20 pounds one can fish them all day without becoming too tired. Tuna that weigh between 35 and 60 pounds require two men to handle them, each man having a pole and line with the two lines joined at a single hook. Larger fish, 60 to 150 pounds, require a similar rig with 3 poles and 3 lines. This is the hardest kind of fishing and requires perfect synchronization of the three men.

When the bins and deck are full, or when the fish are apt to be damaged by the hot sun, fishing must stop and all hands turn to in getting the fish into the hold and iced down. They are packed into the refrigerated hold in alternate layers of fish and crushed ice. On a heavy fishing day, involving 60 or 70 tons of tuna, this is anything but a picnic.

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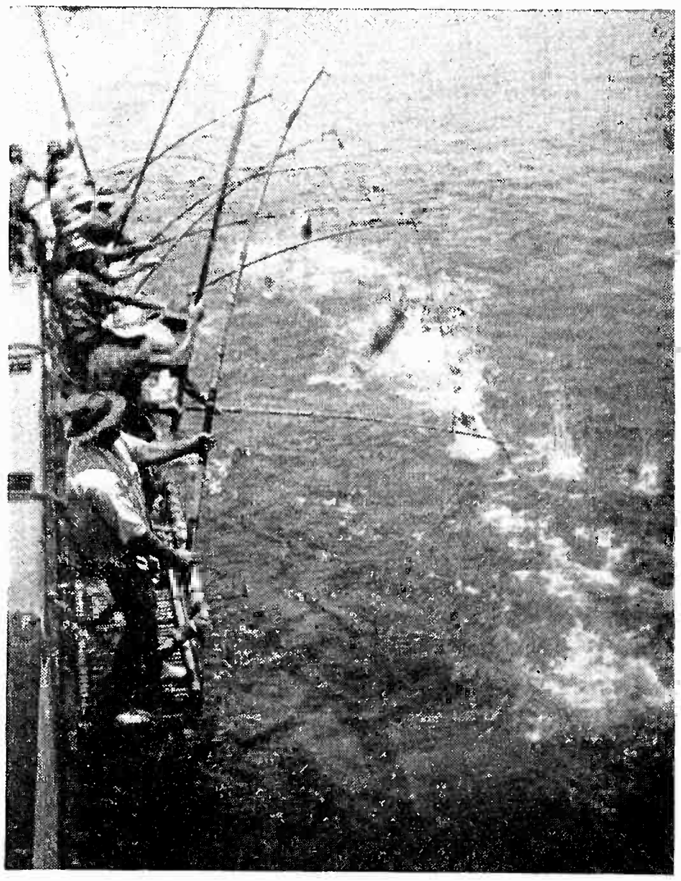


Fast and furious fishing in a school of one-polers. The writer is the second man from the near end of the fishing rack.

Lower California to the Galapagos Islands

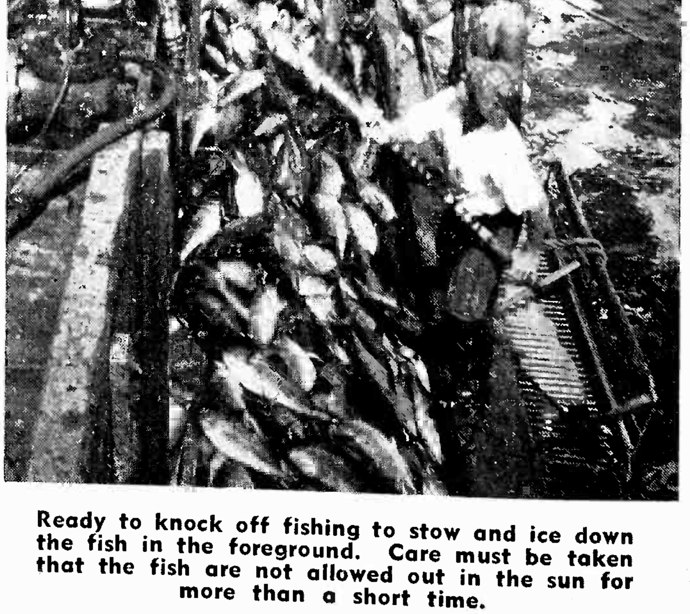
The lengths of the trips vary greatly, depending on the season of the year and the success in finding good fishing conditions. The shorter the trips the more that can be made and the higher the pay check. The majority of the crews are paid on the profit sharing basis, no fish, no pay, and vice versa. During the months between May and October the fish are generally to be found on the banks off Lower California (Mexico) and it is during this period that the shorter trips are made. During the other months the boats generally run either to the Galapagos Islands, on the equator about 700 miles off Ecuador and 2500 miles south of San Diego, or to Central American waters off Guatamala, El Salvador, Nicaragua, Costa Rica and Panama. The headquarters of most of the boats going into the latter waters is generally Punta Arenas, Costa Rica, where bait is usually abundant and supplies can be secured. Oftimes however, it is necessary to go to Balboa, Canal Zone, for fuel. This is the Pacific Coast entrance to the Panama Canal and there are many points of interest to be visited.

The Radio Equipment

Enough of fishing for the present and to the radio equipment. The transmitters used are reminiscent of the pre-crystal control days, when you used to hear that 60 to 120 cycle drone of the self-excited rigs with a.c. power supply. However, most of the tuna clippers use 500 cycle power supplies with the resultant higher pitched notes.

The rig on the "Northwestern" is self-excited for ease in changing frequencies and consists of a pair of HK354's in a TNT circuit with the modification of a very small variable condenser across the grid coil for some variation of grid excitation. It is run normally at about 750 to 800 watts input. Holding the key down for several minutes colors the plates only a slight pink, so a goodly proportion of the watts are going some place.

Plate supply is furnished by a motor generator putting out 130 volts of 500 cycle a.c. which is stepped up to 2500 volts and rectified with a pair of 866's. These rectifiers are lit with a regular 60-cycle filament transformer, with no ill effects on the transformer. Due to the not-so-good line regulation, a compensated keying system is necessary to keep the filament voltage up. This is in the form of another contact on the keying relay which shorts out part of the generator field resistance resulting in higher a.c. output while the key is down. Incidentally,



Ready to knock off fishing to stow and ice down the fish in the foreground. Care must be taken that the fish are not allowed out in the sun for more than a short time.

no amount of filtering has removed all the generator hash from the receiver, so it is necessary to shut off the "jenny" while receiving. When starting up again the filaments of the 866's are heated only a few seconds before punching the key, to avoid keeping the other fellow waiting too long. In spite of this rough treatment, a pair of good 866's will last from 8 to 12 months.

Antennas

The antenna is the old standby, an off-center-fed Hertz. As the space for antenna erection is rather limited, there being only 40 feet between the two masts, the flat-top is continued down for about 18 feet at about a 120 degree angle, paralleling and only a few feet away from an iron stay. Similar antenna-space trouble is encountered on most of the other clippers.

The other wavelengths used, 48, 24, and 27 meters, have no harmonic relationship to 36 meters for which the antenna was cut so the antenna is necessarily a compromise to these. However, "believe it or not" the single wire-fed Hertz seems to work fairly well on 24 and 27 meters using it as an end-fed Hertz clipped directly on the tank coil. Of course the efficiency is low but as long as the Pacific Coast land stations can be worked from Panama, no kick is forthcoming. High efficiency is hard to secure due to cramped quarters and the other factors above mentioned.

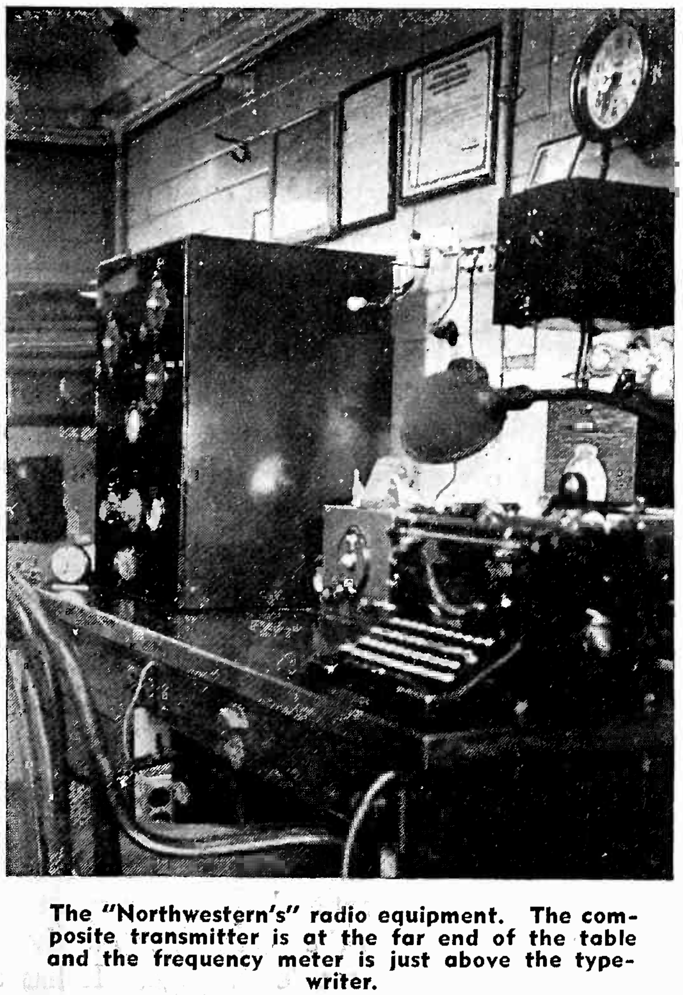
Reception, and Lack of Reception

The receiver used on the Northwestern is one of the well-known SW3's equipped for 6-volt operation. On the 36-meter band the ham 40-meter coils are used to spread things around a bit. As the shack is right above the engine room with its ice-machine motors, d.c. generators, electric pumps, blowers, fans, grinders, drills, etc., most of which are running all the time and each contributing its part in the general electrical racket, you can imagine what a job it is to insure any kind of decent reception. Scattered throughout the ship there are a large number of electric fans and above deck there are also the photo-electric automatic steering device with its electric motor and four relay circuits, and the electrical fathometer with its two rotary converters and synchronous motor.

The nearest thing to a remedy for the QRN is constant cleaning of the various commutators and adjustment of the brush-tensions, and the use of a good noise-avoiding receiving antenna. This antenna is a flat-top strung in the clear as much as possible and fed to the shack with a commercial 70-ohm cable with matching transformers at each end. A couple of phasing coils in the line with bucking fields give a further reduction in noise.

Added to all the above-mentioned local racket, there is also the infamous static of the tropical regions. When the ship goes through one of these electrical storms, reception of any kind is often impossible. During the first static storm that I encountered, the noise was tremendous and so much like that caused by a faulty d.c. motor or generator that I proceeded to accuse the engineer of having something haywire in the engine room. He tested with me for a half hour, shutting off everything in turn including the main generating units without results, until I happened to touch the antenna lead with a neon bulb and it lit up brillantly. I called the engineer, showed him and made various excuses for my ignorance. He said nothing much but walked off, shaking his head and no doubt muttering something about another "sparks" that had made one trip too many.

If you think the 40-meter ham band is the only crowded spot, take a listen some early evening on the mobile-marine 36-meter band be-



The "Northwestern's" radio equipment. The composite transmitter is at the far end of the table and the frequency meter is just above the typewriter.

The "Belle Isle" Disappearance

In the four years that I have been in the fishing fleet, there has been only one boat that has disappeared completely, the "Belle Isle." She sailed from San Pedro, carrying a new radio operator and 13 other men. She was seen trying for bait off San Diego and after leaving there was never heard from again. It was a month before any uneasiness was felt due to her quietness, for often when the Skipper thinks he has lined up some good fishing spot, he will not allow the radio operator to go on the air, fearing some slip that will give away their location and bring other fishing boats to chisel in. The opinion is that she was top-heavy and caught in a heavy beam sea, turned turtle and sank with all on board.

Emergency Radio Calls

There are numerous interesting happenings that occur in this kind of radio operating, and a few of the incidents in the past few years among the tuna fleet may be of interest. While on the clipper "Navigator" a member of the crew was taken seriously sick of on intestinal ailment and for the next few days nearly fifty medical messages were handled with the Marine Hospital in New York, via the RCA station at Chatham, Mass. Nothing seemed to help and so it became a case of getting him to a doctor as soon as possible, although the nearest port was about six days run for us. However, WCC at Chatham, Mass., found out that the Yacht "Orion" was at the Galapagos Islands near us with a doctor aboard, but with no short-wave apparatus. So that night WCC managed to raise the "Orion" on 2000 meters, and then relayed messages back and forth between the two of us, although we were only about 80 miles apart. The next morning as we came alongside the "Orion" their doctor came aboard and worked with the man. The doctor worked all day, but was unable to do much with him, so he advised us to get the man to a hospital just as soon as possible. In the meantime I had managed to load up some SW-3 b.c. coils, and the operator on the "Orion" had hooked up a small s.w. receiver, so we were able to work each other.

The next night the "Orion" hooked up with a British liner heading toward Panama from Australia and told them of our predicament, so they agreed to take the sick man into Balboa. As they had already passed the islands, they turned about and steamed back 12 hours in our direction while we proceeded at full speed toward them. We were due to meet at about midnight but because of rough seas and heavy rain, we were unable to find them until about 1 a.m. The operator on the steamer, having no regular s.w. equipment, had dragged out a small discarded receiver and worked it over so that we were able to communicate for about 3 hours before we found each other. Even at that early hour the rails were lined with passengers and crew to watch us make the transfer. Two days later the man was in the hospital in Panama where he recovered.

Just about a year ago the clipper "San Lucas" sank off Cape San Lucas, the southern tip of Lower California. Although she had sent out her SOS at about 10 p.m. the night before, we didn't find out about it until the next morning. The call had been picked up by NOJ, a Coast Guard station and also by KPH. We on the "Fisherman" were just returning from a long cruise and were about 300 miles from the scene of the sinking, and of course turned to head for the position given, as did several other fishing vessels and some steamers. A Coast Guard cutter rushed down from San Diego but no trace of any wreckage could be found. The next day we received a flash from the cutter that the crew of the sunken ship had reach San Jose del Cabo, Mexico, about 120 miles from where they sank, in their small motor launch and skiff. Two days later we picked them up there and took them to San Pedro. It seems that a seam had opened up in the bottom of the ship and the pumps available were unable to keep the water from rising in the engine room. As soon as the water reached the main generator, no radio apparatus was usable as, in the case of most of these boats, there was no auxiliary power available.

International Incident

Because they claimed that our permits for bait and fishing in Mexican waters were no good, fifteen tuna clippers were picked up and held in Magdalena Bay by Mexican patrol boats. We didn't know what it was all about as we had obtained the permits from Mexican officials in San Diego. After being held in the bay for two days, all fifteen clippers were herded out of the bay by three patrol boats, heading us south for an unknown destination. We were warned to silence all radio apparatus and that any boat using its transmitter would have its radio

[*Continued on Page 85*]

The Amateur's FREQUENCY METER

By JOHN L. REINARTZ,* W1QP

In this article Mr. Reinartz describes a very much simplified method for making accurate frequency measurements. The equipment that is used is quite simple in design and involves no constructional problems; it is the method of using this equipment that is new and that allows the making of such accurate measurements.

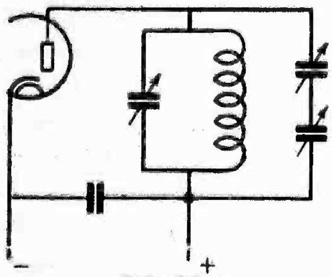


FIGURE 1

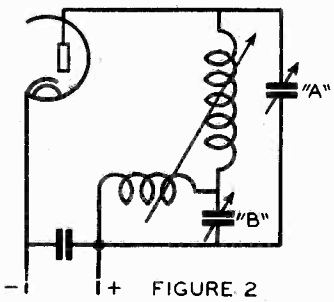


FIGURE 2

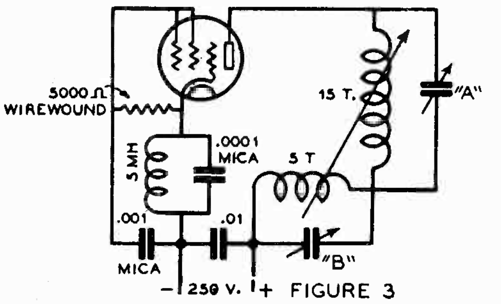


FIGURE 3

● Whenever we build a frequency meter, it is always with the desire to have it cover all of the amateur frequency bands as well as the in-between spectrum, should that be found desirable. When such a frequency meter covers the wide ranges mentioned, it becomes obvious that the primary range of the instrument will have to be from 1500 to 3000 kilocycles, so that harmonics thereof will cover any of the higher frequencies. The 1500 kilocycles that the dial then covers is much too great to allow accurate reading even with a vernier, as a single division of a conventional dial would be 15 kilocycles and a single division of the vernier would still be 1.5 kilocycles, and therefore much too coarse a reading for even amateur use.

Having a desire to build a frequency meter that would allow readings down to plus or minus 50 cycles, and yet have the complete range mentioned above, I set about to determine how such an instrument should be wired and yet keep the device within the means and building capability of any of us amateurs. The problem was to cover 1500 kilocycles with a main dial and to cover but 100 kilocycles with an auxiliary dial; then to have the vernier come into action on the 100 kilocycle dial and allow readings down to 100 cycles, or tenth reading of the 100 kilocycle dial, as each division of the 100 kilocycle dial would be 1 kilocycle.

The next problem that presented itself was always to keep the 100 kilocycle dial representing 100 kilocycles, no matter where the main dial had been set. To explain: let it be supposed that the range to be covered for a given test is from 1700 to 1800 kilocycles. The main dial is then set for 1700 kilocycles with the second dial so set that any rotation of it will be toward 1800 kilocycles. We desire that the second dial will cover that 100 kilocycles and no more nor less. Were we to shunt the main dial with the second dial, there would be no assurance that the second dial would always be the right proportion of the main dial, and it actually will not be. Since the dials cover condensers, the same reasoning holds true. For different frequency settings of the main condenser, the second condenser would not always represent just 100 kilocycles. Our second problem then, was to provide means for adjusting the ratio of the second condenser to that of the main condenser so that the second condenser would always represent 100 kilocycles for the 0 to 100 range dial.

Methods of Covering the 100 Kc.

Two methods of obtaining a 100-kilocycle

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*Manchester, Conn.

range on the second condenser present themselves. The first method is to have, in addition to the main condenser, two others in series with each other and shunted across the main condenser. One of these two condensers allows a ratio change of the other condenser so that it presents the 100 kilocycle range. See figure 1. The second method is to place an inductance in series with the main inductance and provide means for changing its value with respect to the main inductance. The main condenser is shunted across both inductances and the second condenser is shunted across the second inductance. If we vary the value of the second inductance, the combination of capacity and inductance always allows a range of just 100 kilocycles. See figure 2. Either method may be used, but the writer chose the variable inductance method, because then there is no need to obtain a straight-line-frequency condenser.

The oscillator came in for attention next. It was desired that the oscillator should cover from 1500 to 3000 kilocycles, oscillate easily, take very little plate current and, of course, be very stable.

The crystal-oscillator circuit devised by the writer several years ago met the specifications very well and was used. The circuit of the oscillator is shown in figure 3. It will be noted that there is no grid tuned circuit. The cathode circuit which is not tuned, in combination with the tuned plate circuit, provides an oscillator that takes only between 1 and 2 milliamperes plate current. It oscillates freely over the whole tunable range and is of such stability that the drift, even when using eliminator power supply in place of batteries, is as low as 100 cycles in several hours, after the first 15 minute warming-up period. Because there is no tuned grid circuit, the tuning is done in the plate circuit, and no complications enter into our scheme for dividing up the plate tuning system. A type 42 tube or preferably a 6F6 tube can be used in the circuit for a.c. operation, while for d.c. operation the type 34 tube will function very well.

The Variable Inductor

Assume that the circuit has been assembled and that preliminary tests have been run to make sure that the frequency range of the main tuning system takes in the range that is desired, either from 1500 to 3000 kilocycles, or from 2000 to 4000 kilocycles for those who do not care for the 175 meter band and its frequencies.

It now becomes necessary to see that the small tuning inductance is adjusted so that when it is rotated, the secondary dial will cover 100 kilocycles. (The small tuning inductance can best be made in the form of a rotatable coil within a larger coil on the same plan as the old-fashioned variable tuners or ticklers that were once used in broadcast sets. The main coil can be approximately 15 turns of no. 18 d.c.c. wire and the form between 2½ and 3 inches in diameter. The tickler coil can be 5 turns of the same size wire on a form that will readily rotate within the larger form, the whole being so mounted that the smaller coil form becomes controllable from the front of the panel.) When we turn the small coil one direction, the inductance is reduced and the tuning range is also reduced. As a result the secondary condenser, B, will not cover 100 kilocycles when rotated from 0 to 100, while if the rotatable coil is turned the other direction, the B condenser will cover more than 100 kilocycles.

To determine when 100 kilocycles are being covered by the bandspread dial, B, recourse must be made to some kind of a 100-kilocycle standard oscillator. This oscillator can best be crystal controlled; one of the small 100-1000 kc. "Piezo-Electric Calibrators" as made by RCA would be ideal. However, since some of us will be unable to afford such a unit, a homemade 100-kc. oscillator can be constructed. It can either be crystal-controlled or self-excited; numerous discussions of both types of oscillators have been published in the various amateur-radio magazines. If the oscillator is to be self-excited, it is easily possible to tell when it is operating exactly on 100 kc. by adjusting it so that its harmonics will zero beat with the various broadcast stations that operate on multiples of 100 kc.: 600, 700, 800—1400, 1500 kc., etc.

After the 100-kc. oscillator is in operation, pick out some point on a high-frequency receiver, say 2500 kc.; then start the frequency meter and set the secondary dial to zero, corresponding to full mesh of the condenser plates. Now tune the main condenser until it comes into zero beat with the standard at the 2500 kc. point on the receiver. Now tune condenser B, and if it tunes more than 100 kc. you will hear the beat note as it passes 2600 kc. Adjust the tickler coil slightly one way or the other and retune the main condenser A to 2500 with B

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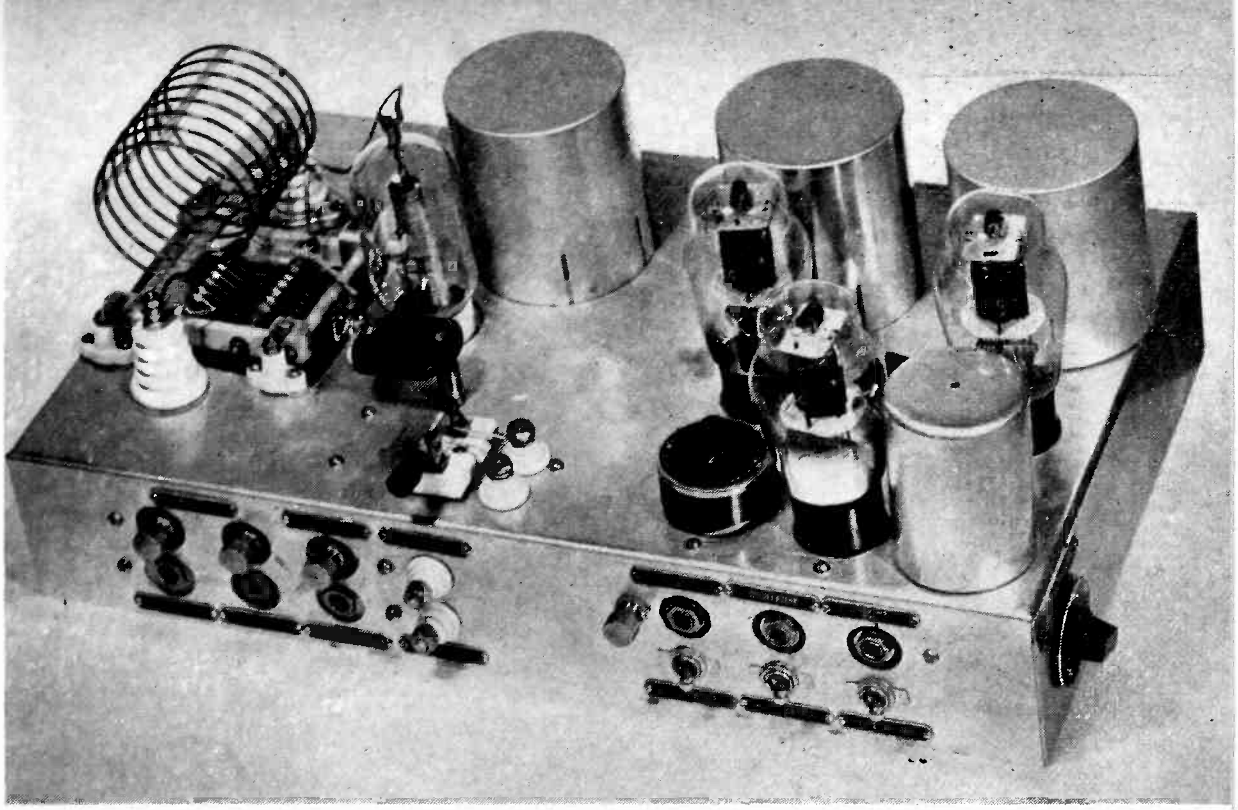

Here is the pan-full—6L6G's, 35T, and variable-frequency crystal

R. F. . . . By the Pan-full

By GEORGE DAVIS,* W6SJ

Upon starting out on the job of designing an excitation line-up for the final amplifier of the writer's transmitter, two very important questions arose. Since the transmitter was in the process of being built, there was only a given amount of space available for the oscillator, doubler and buffer stages, and yet there was a definite amount of grid driving power needed for the final amplifier. Therefore, it can readily be seen, the job required some forethought.

Of the two considerations mentioned, it soon developed that the space situation was going to be of primary importance. After all, the wattage output of the buffer-driver could be varied over a considerable range by merely shifting the value of plate voltage, but a metal chassis simply cannot be stretched and still maintain its usefulness as a means of holding coils and gadgets in the required relationship to each other. Obviously, there was going to be a little checker playing done with the parts to be used before any socket holes were punched.

The circuit design of the exciter transmitter was to center around one of the new variable crystals—this much had been decided upon the acquisition of one of these units. In this day and age, the amateur will quickly grasp the benefits of having this means of shifting frequency and still maintaining the stability of the fixed crystal-controlled oscillator. In line with this thought, the writer was no exception. Since the variable crystal idea works out satisfactorily only with 80-meter cuts, it therefore became necessary to plan an oscillator circuit operating on that band. For operation on the higher frequencies a system of doubling or quadrupling from the crystal frequency was required. Since considerable difficulty had been encountered with previous oscillators in trying to get sufficient third- and fourth-harmonic output to drive a buffer, it was decided to rely on doubling only and to use enough doublers to get from 80 meters to whatever bands on which it was desired to operate.

The Tube Line-up

Eighty, forty, and primarily twenty-meter phone were the bands particularly useful to the writer and thus another requirement had been settled upon. The final decision to be made before actually going to work was the tube line-up, and after much deliberation, it was decided that there was lots of merit in using 6L6G tubes for oscillator and doublers due to their

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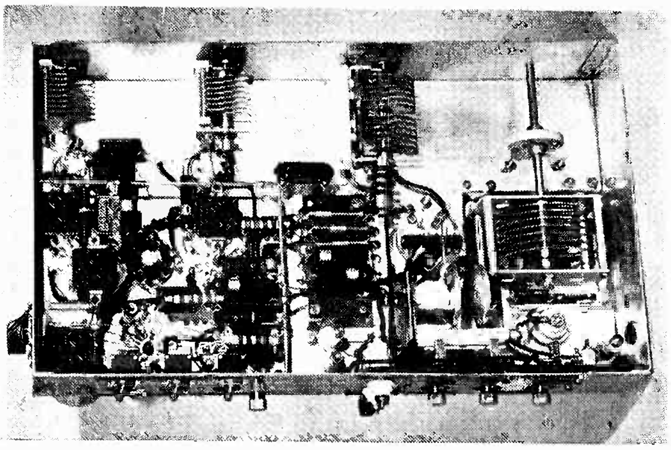
*1634 Keith Drive, Whittier, Calif.



Bottom view of the unit showing the numerous parts and their careful placement.

low cost, ease of excitation and high output at low plate voltage. For the buffer (or final amplifier if the exciter is to be used as a complete transmitter) a good old favorite, the Eimac 35T, was decided upon—mainly because there we had a tube which, due to its high amplification factor, could be driven to full output when excited either directly from the oscillator, or, depending on the frequency desired, from any combination of oscillator and first, second, or even third (for ten meters) doubler tubes.

Bandswitching

A reference is made to the circuit diagram which shows how the selection of excitation was accomplished through the use of a switch in the link circuit that couples the grid coil of the 35T stage to its source of excitation.

The oscillator and doubler stages are capacitively coupled. By simply removing the plate voltage from the unwanted tubes with the plate-voltage switches in the supply leads, it would then become necessary only to adjust the link switch to pick-up excitation from that stage operating on the frequency for which 35T excitation was required. Thus it is possible to eliminate all the fuss of changing coils and possibly that of re-neutralizing where a tube which ordinarily works as a doubler would become a buffer-amplifier.

Mechanical Construction

Having decided definitely on the tube line-up and knowing that there was only a 10" x 17" space available for the components, (five tuned circuits, four tubes, link-switch, variable crystal unit, etc.) there remained to be done only the actual laying-out and marking of the chassis before assembly could be begun. By using large coil shields the job was greatly simplified; through their use it was possible to mount each tube and its associated circuits close together without fear of detrimental interaction between the various stages. Since it is seldom necessary to readjust the tuning of a crystal oscillator, this circuit was placed in the rear corner of the chassis. This allows a little more room along the front for the setting up of the remaining four circuits.

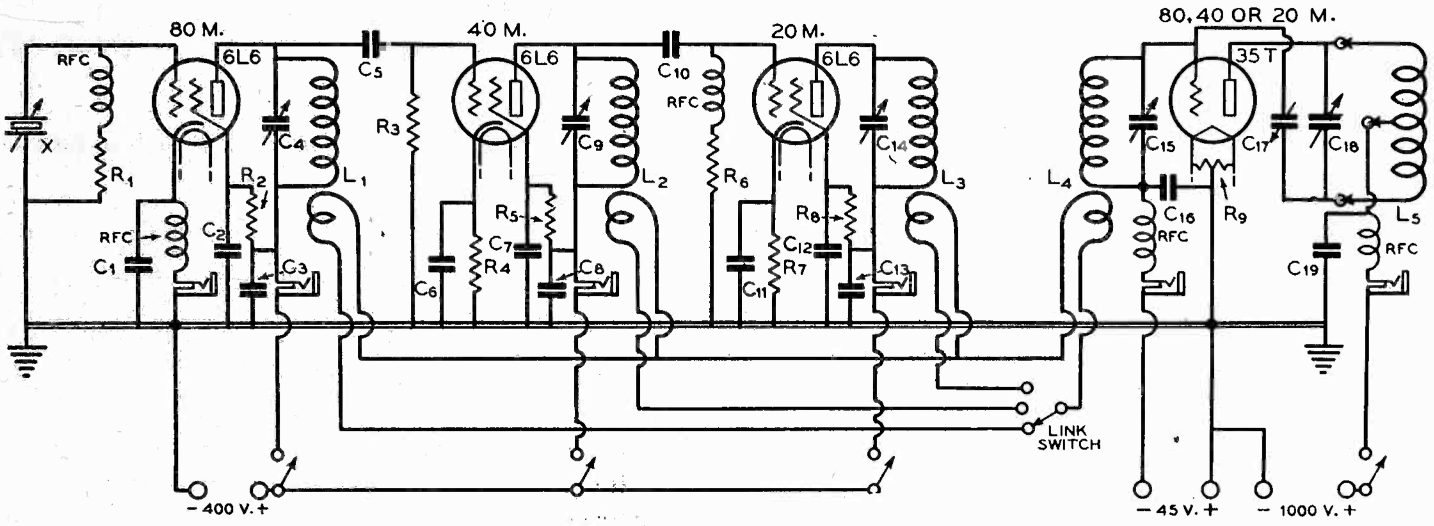
The link switch was mounted in the middle of the group of three 6L6 tubes and wired so that the knob would be pointing directly at the tube from which excitation was being taken. Keeping in mind the necessity of short leads for efficient high-frequency operation, it was decided to mount the plate tank condenser of the 35T stage upside down and lower it part way into the chassis. In this way the coil could be placed directly over the condenser without increasing lead length. Similarly, a desire for short connections prompted the placement of the neutralizing condenser underneath the chassis rather than above deck as is more common.

Metering jacks were incorporated in all of the plate circuits as well as in the grid circuit of the 35T. It was necessary to insulate these sufficiently to withstand the respective plate and grid voltages to ground. Ordinary bakelite mounting plates were used for this purpose

The under-chassis view shows the placement of the necessary by-pass condensers, coupling condensers, resistors, etc. Of particular interest and importance is the heavy bus-bar mounted in one corner of the chassis and directly under the 6L6 stages. It can readily be seen that this not only serves as a ground connection but also as a very convenient mounting for all the by-pass condensers and many of the resistors. There is considerable apparatus attached to this bus and in order to hold these parts in place and keep them from falling into other wiring, only a heavy bus can be used.

Link Switching

About the only remaining feature which might require explanation is the method of connecting the links to the switch. A glance at the circuit diagram will show that one side of all three link-pick-up coils as well as the 35T grid circuit link coil is common. The actual switching is done in the other side of these links. This was done primarily because



SCHEMATIC DIAGRAM

C_1, C_2, C_3—.01 µfd. mica
C_4—100 µµfd. midget variable
C_5—.0001 µfd. mica
C_6—.01 µfd. mica
C_7—.006 µfd. mica
C_8—.002 µfd. mica
C_9—50 µµfd. midget variable
C_{10}—.0001 µfd. mica
C_{11}—.01 µfd. mica
C_{12}—.006 µfd. mica
C_{13}—.002 µfd. mica
C_{14}, C_{15}—50 µµfd. midget variable
C_{16}—.002 µfd. mica
C_{17}—"800-type" neutralizing condenser
C_{18}—50 µµfd. 3000 volt variable
C_{19}—.002 µfd. 5000 volt mica
R_1—50,000 ohms, 3 watts
R_2—20,000 ohms, 10 watts
R_3—50,000 ohms, 3 watts
R_4—300 ohms, 10 watts
R_5—20,000 ohms, 10 watts
R_6—25,000 ohms, 3 watts
R_7—300 ohms, 10 watts
R_8—20,000 ohms, 10 watts
R_9—75 ohms c.t. resistor
RFC—2 mh., 125 ma. chokes
Coils—See coil table
X—Variable-frequency crystal

it was difficult to obtain a small switch that would disconnect both conductors of the link circuit and would be capable of carrying the comparatively high currents existing in link coupling lines.

By switching one side only it was possible to parallel contacts and double the current-carrying capacity of the switch. Incidentally, it is necessary to take this type of switch apart and recamp it for this work as it is intended only to be used as a four-pole-single-throw. By removing the stop-pin and soldering a flexible pig-tail to one of the wiping contacts it is readily converted into a single-pole-three-position switch having paralleled conducting surfaces in each of the three positions.

As for the balance of the constructional details, ample information can be obtained by a study of the various photographs of the unit. The remainder of the work necessary to complete this unit is nothing but straight-forward radio construction, all the "tricks" having been mentioned in the foregoing description. The coil-data table shows coil design for operation on the aforementioned three bands. Manufactured coils were used in the working model although they can be hand-wound if desired. It should be mentioned, however, that regardless of whether you use manufactured coils or home-made ones they should be readjusted or

[*Continued on Page 79*]

Coil Chart

Band	Oscillator	1st Doubler	2nd Doubler	35 T. Grid	35 T. Plate
80	Close Wound No. 22 D.S.C. 37 T. 1¼" Dia.	Spaced Dia. Wire No. 16 Enamelled 22 T. 1¼" Dia.	Spaced Dia. Wire No. 16 Enamelled 12 T. 1¼" Dia.	Spaced Dia. Wire No. 16 Enamelled 12 T. 1¼" Dia.	Spaced ½" No. 14 Enamelled 8 T. 3" Dia.
40	....	....	....	Spaced Dia. Wire No. 16 Enamelled 22 T. 1¼" Dia.	Spaced ¼" No. 14 Enamelled 22 T. 3" Dia.
20	....	....	....	Spaced Dia. Wire No. 16 Enamelled 30 T. 2" Dia.	Spaced Dia. Wire No. 14 Enamelled 30 T. 3" Dia.

Front view of the rig as seen from the operating position. The two high-voltage power supplies are mounted behind the large bottom panel, the speech on the next above, then the modulator, Bi-Push, and final in order.

PHONE AND C.W.

Dressed up in

By RAY L. DAWLEY,* W6DHG

In the design, from scratch, of a complete 500-watt transmitter for phone and c.w. use on the higher frequency bands, one is beset by a multitude of conflicting considerations: What tubes to use? High or low-level modulation? Band-switching or plug-in coils? What type of antenna coupling? To include or not to include the speech amplifier? Rack-mounted, enclosed-cabinet mounted or breadboard? What type of control arrangements? On and on we could list them. But sooner or later we must make up our mind as to just exactly what the rig is to contain, how it is to be controlled and what it is to be built into. Once we have decided upon these points the greater part of the battle is won. From then on it is just straightforward design.

In the laying-out of this rig, it was decided at the outset that, although it was to be capable of handling 500-600 watts input on phone or c.w., its cost was to be held within reasonable bounds. All the unnecessary gadgets and doubtful conveniences were eliminated before the word "go."

The transmitter does not incorporate band-switching; it is a matter of just a few moments to move the "Bi-Push" coils around and to change the grid and plate coils in the final. Appearance was considered important; the neat enclosed-relay-rack mounting is evidence of that. This type of mounting is also convenient and allows easy accessibility to the various decks and stages. High-level plate modulation is used for phone and, by throwing a switch, the modulating equipment may be cut off and the rig keyed at somewhat greater input for c.w. use.

Antenna terminating equipment is not included; it was felt that this could be dispensed with since most modern antenna arrangements are fed either by twisted-pair or by a medium impedance transmission line. Both types of lines may be most conveniently fed by means of a one- or two-turn link around the final tank.

Mechanical Construction

The entire transmitter is housed in an enclosed relay rack. The rack was built by Ralph

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*Technical Editor, RADIO.

. . . 500 WATTS

an enclosed rack

Constructed for* W6PDB *by
FAUST R. GONSETT,[1] W6VR

Gordon, W6CLH, of Radio Development Labs., as were the panels and the sub-chassis. Standard drilling is employed on the uprights of the front of the cabinet and the panels are drilled accordingly. The back of the cabinet is closed by means of a hinged door with an electrical interlock to remove the plate voltages when the door is opened. Also, to make sure that someone will not open the door during a transmission (and also to insure that the tubes and crystals will be in the rig after a gang of practical jokers, or otherwise, have swept through the shack) the back door can be securely locked and the key placed in a carefully chosen spot.

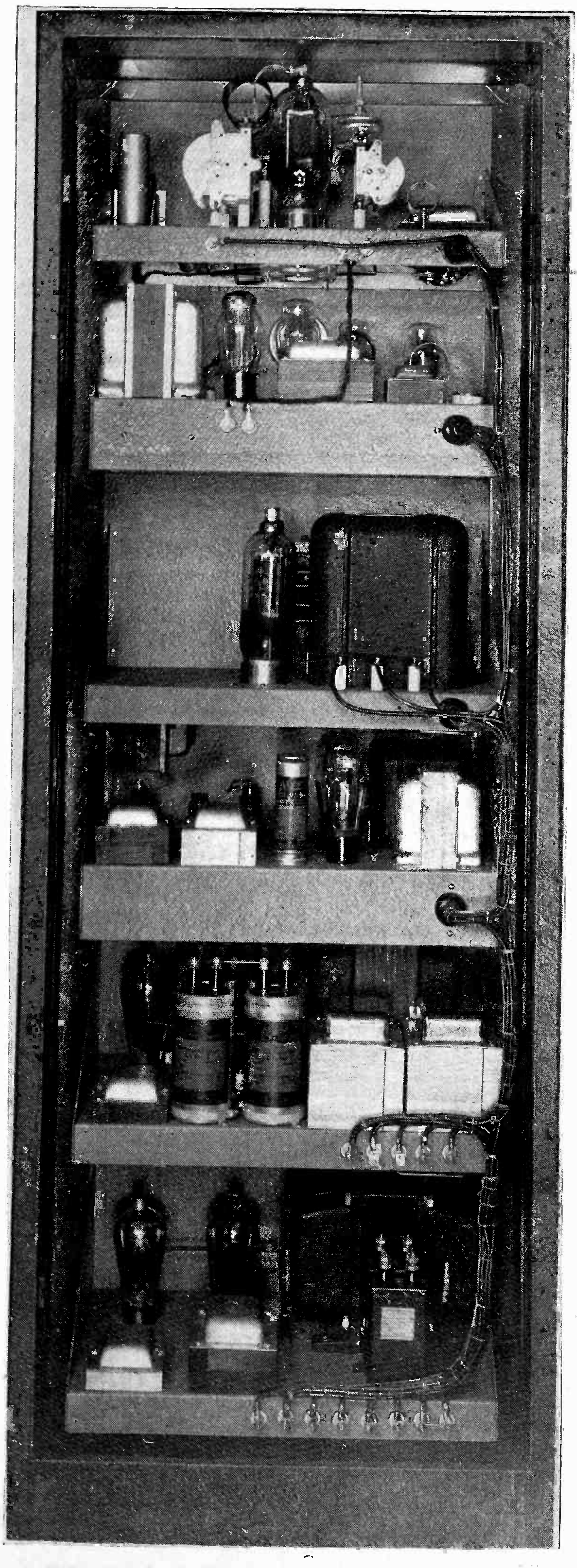
The overall dimensions of the cabinet are 60″ high, 21″ wide, and 14″ deep. It is finished in a dark aluminum-gray crackle. The standard 19″ panels are finished in a somewhat lighter shade of the same paint. This combination gives a very pleasing effect—the light gray panels bordered and enclosed by the darker gray cabinet.

The chassis themselves are finished in the same gray aluminum-crackle as the panels. To keep from marring the finish, the chassis were all completely laid-out, drilled and punched before the paint was applied. Then, after the painting, the equipment was mounted and the unit wired. The front panels were treated in a like manner to the chassis; they also were drilled and punched before the painting.

Connections throughout the rig from one deck to another are made by a plug-and-cable arrangement for all the low and medium voltage leads, and by porcelain feed-through insulators for all high voltage. This allows any stage to be removed from the cabinet for repairs or alterations. Also, since the interstage leads are amply long, should it be desirable to operate the particular unit outside the cabinet, this can in most cases be accomplished simply by shorting-out the protective door switch.

The Exciter

The exciter is a "Bi-Push"; it furnishes ample excitation for the operation of the final at full input, phone or c.w., on the 3.5, 7, 14, and



Back view showing the neatly cabled power leads connecting the various decks. That blank space to the left of the 203Z's on the modulator deck might be used as a storage space for spare coils, etc.

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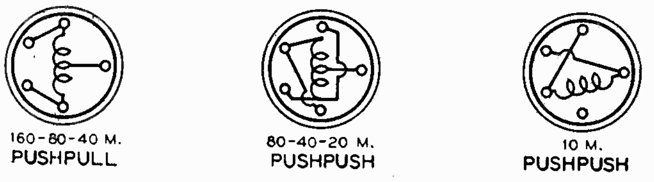
[1] Laboratorian, RADIO.

28 Mc. bands. The layout of this unit is almost exactly the same as that of the similar rig described in the May, 1937, RADIO. Some small modifications have been made, but for the most part the descriptions given in the previous "Bi-Push" articles[1] will answer any questions that may arise. However, the connections for the plug-in coils are shown below.



BOTTOM VIEWS OF SOCKETS AND FORMS

Among the modifications that were made was the provision for metering the various stages of the exciter by means of a single tap switch, and the installation of two sockets for crystals at the grid of the first 6A6 with a switch to select either one or the other. Both of these changes are simple revisions and the complete circuit diagram of the transmitter shows them clearly.

The output of the exciter is brought out to a pair of feed-through insulators mounted in the back of the chassis. A short link connects these to a similar pair mounted upon the back of the final shelf. Since the Decker coils as used in the exciter have no coupling link wound on them, a small two-turn link, mounted by a pair of insulators upon the chassis, is coupled to the p.p. 6L6G plate coil to bring the output to the insulators on the back of the chassis.

The switch on the right of the front panel is the meter switch. The keying jack is also mounted upon the front panel and is located between the meter switch and the knob for the 6L6G tuning condenser.

The Push-Pull T-125 Final

A pair of Taylor T-125's are used in push-pull in the final stage of the transmitter. They have quite a high transconductance, hence they are easily excited; the Bi-Push furnishes a reserve of excitation—even when operating on 28-Mc. phone.

The circuit arrangement is conventional in most respects although the method of mounting the neutralizing and grid-tuning condensers is worthy of note. The grid condenser is a Cardwell Midway, 70 μμfd. per section, and is mounted vertically (the shaft is horizontal but the condenser has been rotated through 90° around the shaft so that one set of the stator connections is at the bottom and the other set

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[1] "The Bi-Push Tri-Band Exciter," W. W. Smith, W6BCX, RADIO, April, 1937.

"A De-Luxe Version of the Bi-Push Exciter," F. R. Gonsett, RADIO, May, 1937.

"All Bands with the Bi-Push," RADIO, June, 1937.

Caption for Circuit Diagram

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Final Amplifier

C_1—50 μμfd. per section, 6000 volt spacing
C_2—70 μμfd. per section, 3000 volt spacing
C_3—16 μfd. 450-volt electrolytic
C_N—"800-type" neutralizing condensers
R—10,000 ohms, 100 watts slider type
M_1—0-500 d.c. milliammeter
M_2—0-100 d.c. milliammeter
RFC—2½ mh., 500 ma. r.f. choke
T_1—10 volt, 10 ampere filament transformer
T_2—Midget b.c.l. power transformer, 700 c.t. h.v.

Bi-Push Exciter

C_1—.004 μfd. mica
C_2—100-100 μμfd. midget split stator
C_3, C_4—150 μμfd. mica
C_5—.004 μfd. mica
C_6—100-100 μμfd. midget split stator
C_7,C_8—500 μμfd. mica
C_9,C_{10},C_{11}—.004 μfd. mica
C_{12}—-50 μμfd. midget, 1000 volt spacing, isolantite insulation
C_{13}—.004 μfd. mica
C_{14}—4 μfd. 600 volt oil condensers (2)
R_1—300 ohms, 10 watts
R_2—5000 ohms, 50 watts, wire-wound
R_3—10,000 ohms, 10 watts
R_4—300 ohms, 10 watts
R_5—5000 ohms, 50 watts, wire-wound
R_6—Two 100,000 ohm, 2 watt carbon resistors in parallel (50,000 ohms)
R_7—200 ohms, 10 watts
R_8—15,000 ohms, 10 watts
R_9—40,000 ohms, 20 watts
$R_{10,11,12}$—50 ohms, 1 watt each
M—0-200 d.c. milliammeter
SW_1—D.p.d.t. crystal-selector switch
SW_2—Milliammeter selector-switch
SW_3—Bias-shorting switch
T_1—6.3 v. at 4 amp. and 5 v. at 3 amp.
T_2—700 v. each side c.t., 150 watts
CH—5-25 hy., 300 ma. swinging choke

Class-B Modulator

T_1—10 volt, 7.5 ampere filament transformer
T_2—300-watt, multi-match output transformer

Peak-Limiting Speech Amplifier

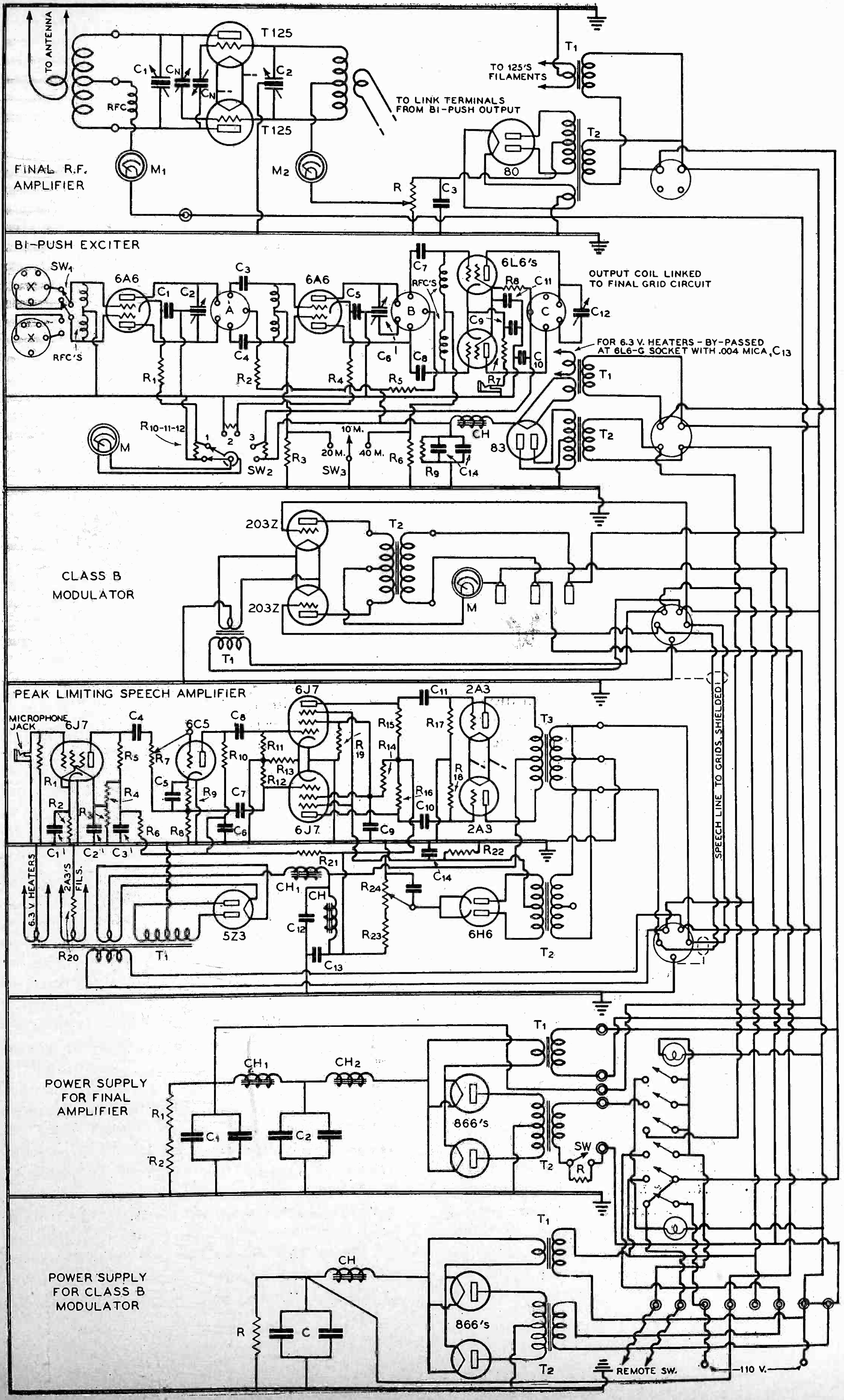
C_1—10 μfd., 25 volt elect.
C_2—0.5 μfd. 400 volt tubular
C_3—8 μfd. 450 volt elect.
C_4—0.1 μfd. 400 volt tubular
C_5—10 μfd. 25 volt elect.
C_6—8 μfd. 450 volt elect.
C_7,C_8—0.1 μfd. 400 volt tubular
C_9—0.5 μfd. 400 volt tubular
C_{10},C_{11}—0.1 μfd. 400 volt tubular
C_{12},C_{13}—8 μfd. 450 volt elect.
C_{14}—0.1 μfd. 400 volt tubular
C_{15}—1.0μfd. 400 volt tubular
R—5 megohms, ½ watt
R_2—5,000 ohms, 1 watt
R_3—50,000 ohms, 1 watt
R_4—250,000 ohms, 1 watt
R_5—250,000 ohms, 1 watt
R_6—10,000 ohms, 1 watt
R_7—500,000 ohm potentiometer
R_8—50,000 ohms, 1 watt
R_9—5,000 ohms, 1 watt
R_{10}—50,000 ohms, 1 watt
R_{11},R_{12}—250,000 ohms, 1 watt
R_{13}—2,000 ohms, 1 watt
R_{14}—250,000 ohms, 1 watt
R_{15},R_{16}—250,000 ohms, 1 watt
R_{17},R_{18}—250,000 ohms, 1 watt
R_{19}—50,000 ohms, 1 watt
R_{20}—750 ohms, 10 watts
R_{21}—20,000 ohms, 1 watt
R_{22}—250,000 ohms, 1 watt
R_{23}—30,000 ohms, 1 watt
R_{24}—15,000 ohm potentiometer
T_1—Power transformer; 750 c.t., 5 volts 3 amps, 6.3 volts 3 amps., 2.5 volts 2 amps.
T_2—1½/1 ratio interstage transformer reversed, primary to secondary
T_3—Multiple-match driver transformer
CH_1—200 ma. swing choke
CH—20 hy., 100-200 ma. filter choke

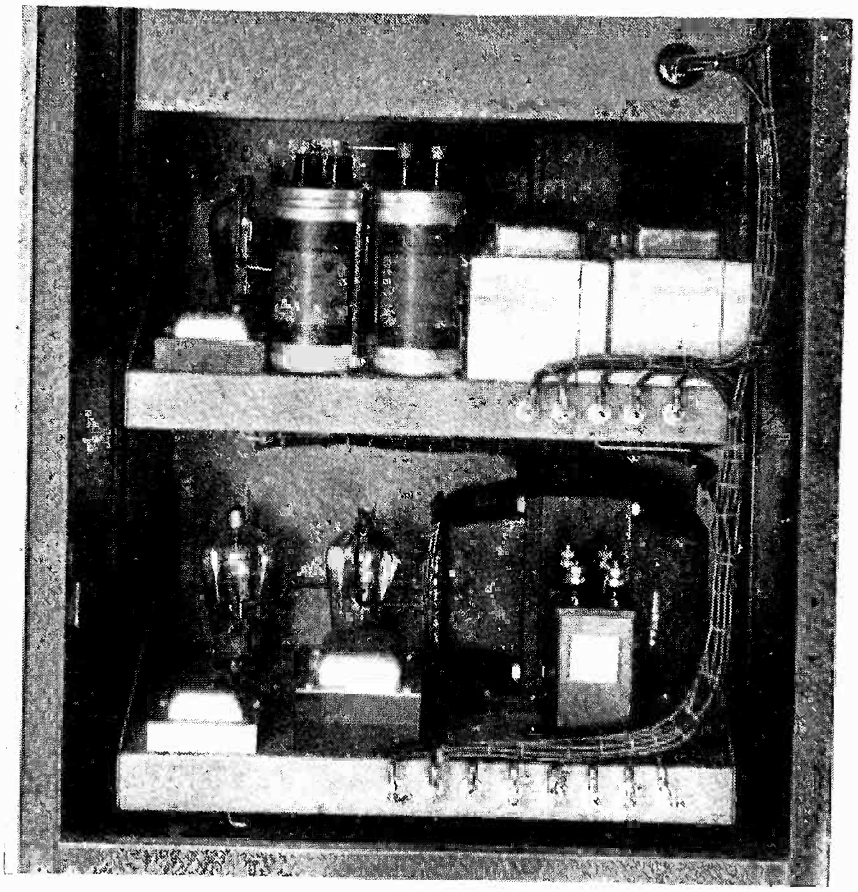
Final Power Supply

C_1, C_2—2 μfd. 2000-volt filter condensers (4)
R—500-watt heater element, used when tuning up under low power
R_1, R_2—50,000 ohm, 20-watt resistors
SW—Full-power reduced power switch
CH_1—20 henry, 500 ma. filter choke
CH_2—500 ma. swinging input choke
T_1—2.5 volt, 10 ampere filament transformer
T_2—4200 c.t., 500 ma. plate transformer

Modulator Power Supply

C—2 μfd. 1500-volt filter condensers (2)
R—100,000-ohm 20-watt bleeder resistor
CH—350 ma. swinging input choke
T_1—2.5-volt, 10-ampere filament transformer
T_2—3100 c.t., 350 ma. plate transformer


TO ANTENNA
T125
C1
CN
CN
C2
RFC
T125
TO 125'S FILAMENTS
T1
TO LINK TERMINALS FROM BI-PUSH OUTPUT
T2
80
FINAL R.F. AMPLIFIER
M1
M2
R
C3
BI-PUSH EXCITER
SW1
X
X
RFC'S
6A6
C1
C2
C3
A
C4
6A6
C5
C6
B
C7
RFC'S
C8
6L6's
R8
C11
C9
C10
R7
C
C12
OUTPUT COIL LINKED TO FINAL GRID CIRCUIT
FOR 6.3 V. HEATERS - BY-PASSED AT 6L6-G SOCKET WITH .004 MICA, C13
T1
R1
R2
R4
R5
R10-11-12
1
2
3
M
SW2
R3
10 M.
20 M.
40 M.
SW3
R6
R9
CH
C14
83
T2
CLASS B MODULATOR
203Z
203Z
T2
M
T1
PEAK LIMITING SPEECH AMPLIFIER
MICROPHONE JACK
6J7
C4
6C5
C8
6J7
C11
2A3
R15
R17
T3
R1
R5
R7
R10
R11
R13
R12
R19
R14
R18
R2
R3
R4
C5
R9
C7
R16
C10
C1
C2
C3
R6
R8
C6
6J7
C9
2A3
R21
R22
C14
6.3 V HEATERS
2A3'S FILS.
CH1
CH
C12
R24
R23
5Z3
6H6
T2
R20
T1
C13
SPEECH LINE TO GRIDS, SHIELDED!
POWER SUPPLY FOR FINAL AMPLIFIER
CH1
CH2
R1
C1
C2
R2
866's
T1
T2
SW
R
POWER SUPPLY FOR CLASS B MODULATOR
CH
R
C
866's
T1
T2
REMOTE SW.
110 V.



To the left, detail view of the main power supplies. Modulator supply on the bottom, final plate supply on the shelf above. Almost in view, just below the final supply, is the row of a.c.-line switches that control the rig.

To the right, the final amplifier shelf. The grid-bias supply can be seen behind the plate tank in the rear. The trick neutralizing-condenser grid-condenser assembly can be clearly seen in the foreground. The filament transformer, through-deck mounted, can be seen in the right rear of the chassis.

is at the top). The condenser is then mounted upon a pair of small stand-off insulators from the chassis. The two bottom stator connections go through a pair of rubber grommets and, below chassis, are connected to the two appropriate connections on the grid-coil socket.

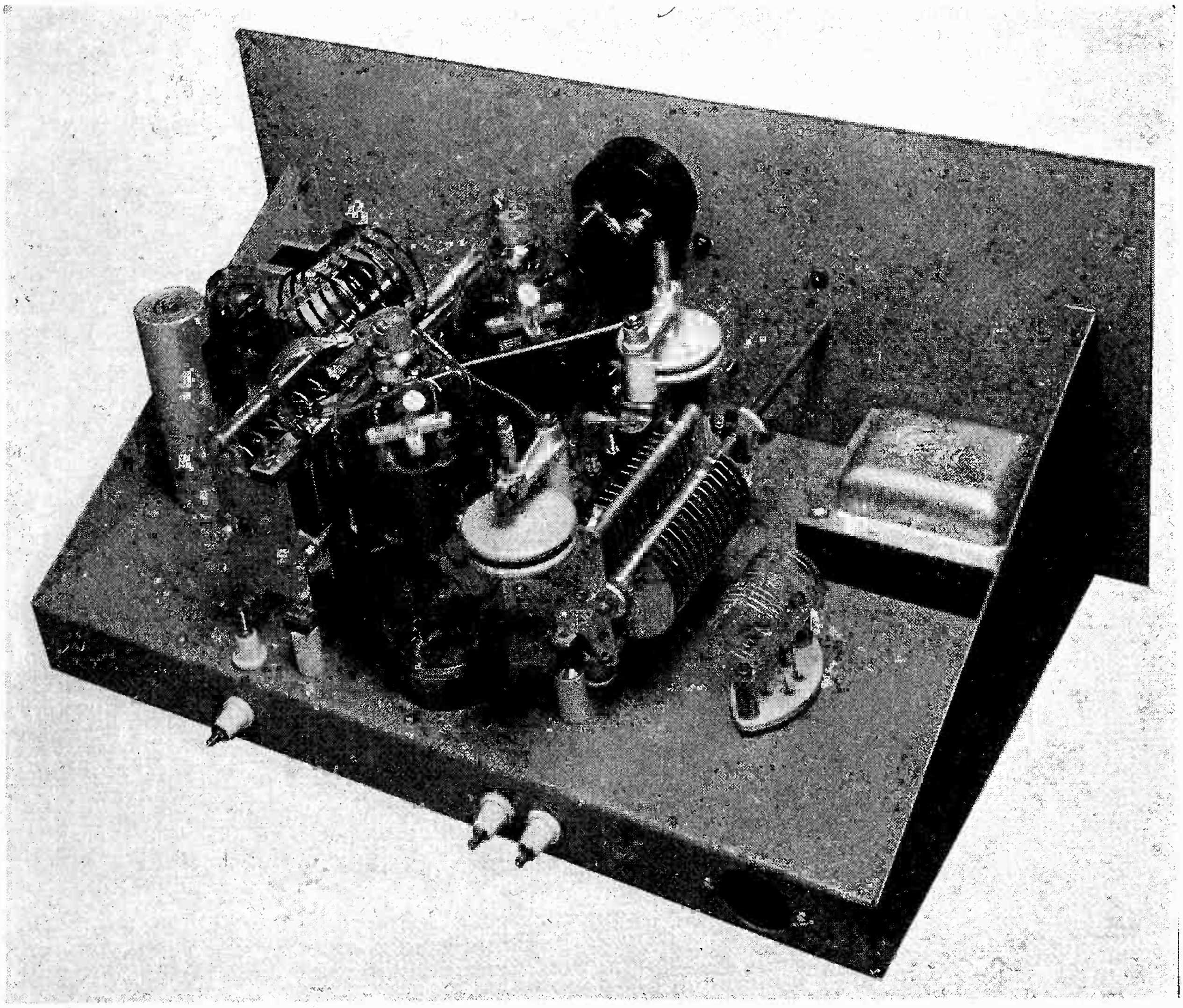
Then, the two neutralizing condensers are mounted upon the top connections of the stators of the same condenser. These neutralizers are re-vamped "800-type" condensers, the kind whose top plate moves up and down upon a thread and whose bottom plate is mounted upon about a 1″ stand-off insulator. The insulator for the bottom plate is removed and the one for the bracket that holds the top plate is reduced from about 2½″ to 1″. Then a small bracket is made that mounts upon one of the stator connections and to it are fastened the bottom plate of the neutralizing condenser (direct electrical connection) and the 1″ insulator for the top-plate bracket. The amplifier is then wired conventionally. The final stage photograph shows these connections in some detail.

The grid coil for the final, also of the plug-in type and made by Decker, has its link wound integral and brought out to the socket. Thus the two socket leads are brought out to the feed-through's for the excitation from the Bi-Push.

Grid bias for the tubes is obtained by a combination of resistor and power supply. The small bias supply, as seen to the left of the final chassis, consists of a midget power transformer, an 80, a filter condenser of 16 μfd., and a bleeder. Since this little supply is capable of about 400 volts output and as only 125 volts of fixed bias are needed, the tap for the final grid return is made to the bleeder about one-third of the way up from the ground end.

With no excitation to the final stage, the tubes are biased to cut-off by the 125 volts taken from the tap on the bias supply bleeder. This allows the Bi-Push to be keyed for break-in operation of the entire rig. As the excitation is applied, the 5000 ohms of resistance between the bottom of the bleeder and ground acts as resistance bias, assisted by the voltage of the bias pack. Since the majority of the bias, under normal operation, will arise from the rectified grid current of the tubes, it is possible to "get away" with very little filter on the bias pack. That is the reason for the small amount used in this case.

Also mounted upon the chassis proper of the final stage is the filament transformer for the T-125's. This allows the use of short, heavy connecting leads with a consequent small drop in filament voltage. Also, it allows the 110 a.c.



to be conveniently brought up to this deck for the bias supply.

Metering is accomplished by separate milliammeters in the plate and grid returns. A 0-500 ma. serves in the plate and a 0-200 ma. in the grid.

Neutralizing

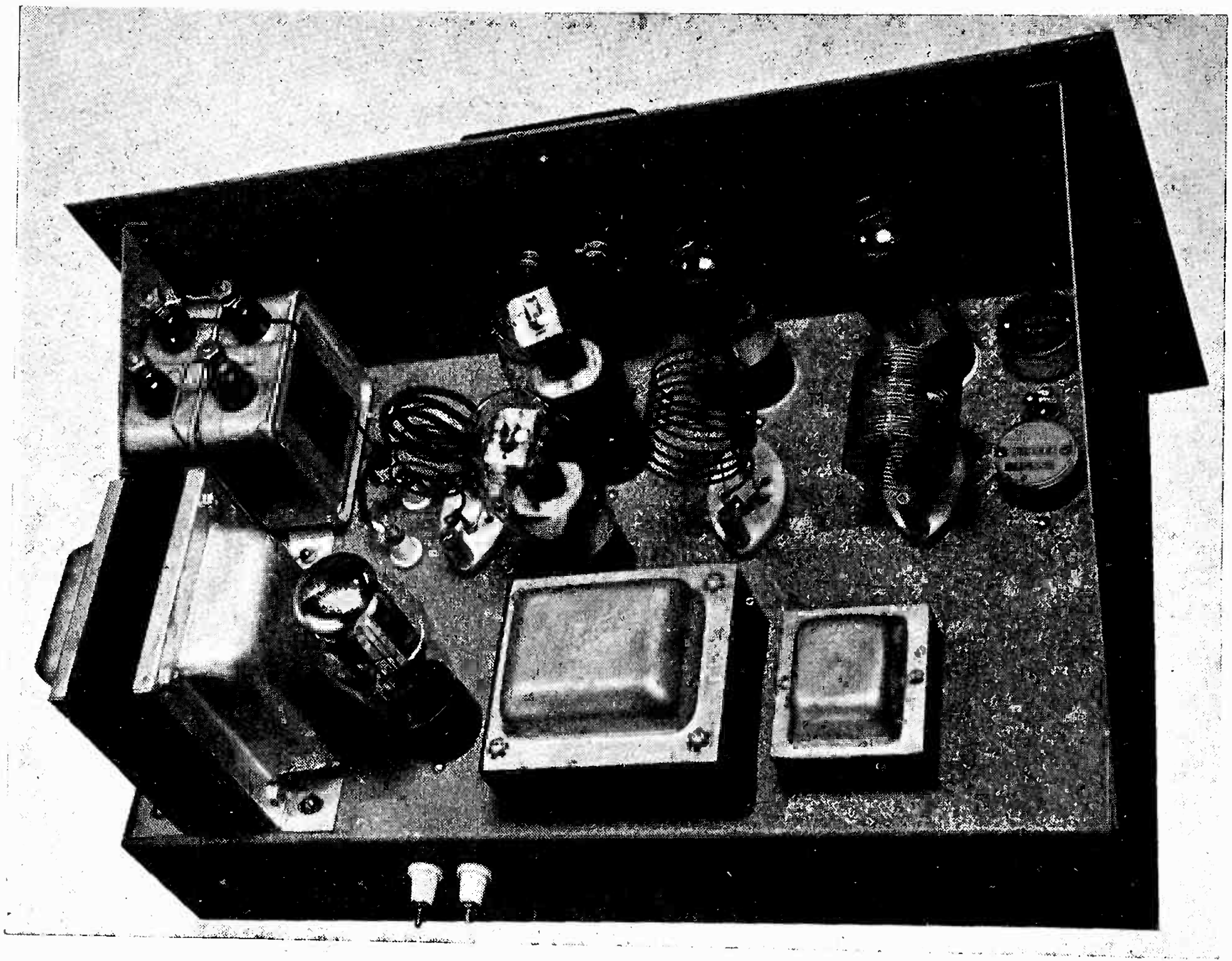
Due to the symmetry and short lead-length of the final stage, it will neutralize very well with no direct return in either the grid or plate split-stator condenser. However, if an unbalanced load were coupled to the final tank, an unbalance might easily arise in the neutralizing circuit. To prevent such an occurrence from having any possible effect on the neutralization, the rotor of the grid condenser has been grounded. The plate condenser, however, is not returned and is mounted upon stand-off insulators.

No provision has been made for an antenna coupling arrangement since, as was mentioned at the head of the article, the rig is to be coupled to the load circuit by means of a link around the final tank.

The r.f. choke between the center-tap of the plate tank and the plate milliammeter is one of the solenoid-wound h.f. variety. It is especially designed for operation on the 28-Mc. band. However, since the rig is designed primarily for operation on 28 Mc. and since there is really but little need for this choke in a properly-designed amplifier, the small amount of inductance furnished by this choke will not hinder operation.

The Speech Amplifier

The speech amplifier used with this transmitter is the one described in RADIO for last month ("Peak Compression—Applied to the Speech Amplifier", RADIO, Nov., 1937). As a matter of fact, that speech amplifier was designed for use in this rig. The only change that was required in it after the installation of the amplifier in the rig was to place a shield, a piece of 20-gauge sheet steel, over the bottom of the chassis. Before this was done there was a certain amount of a.c. that was capacitively coupled into the speech amp. from the power



The Bi-Push and power supply. Excitation for the final stage comes out through the two insulators in the back-drop of the chassis. The two crystals and their switch can be seen to the right of the deck.

supply immediately below it. The installation of this shield completely eliminated the trouble.

The plate and filament power for the speech amplifier come on at the same time and are applied when the filaments of the transmitter are lighted. However, when the c.w. switch on the power supply panel is opened, the power is removed from the speech amp. at the same time as it is removed from the modulator and the modulator power supply. Thus, only the units that are actually required are in use when operating on c.w.; all others are removed from the line.

The jack for the crystal microphone is brought out to the front of the panel. This is permissible since the transmitter will be installed only a short distance from the operating table. If it were to be remote controlled, some other means of coupling the speech energy from the microphone to the speech amplifier would be required. Under most conditions a pre-amplifier at the microphone, coupled to the speech amplifier through a low-impedance line, would be the most satisfactory solution.

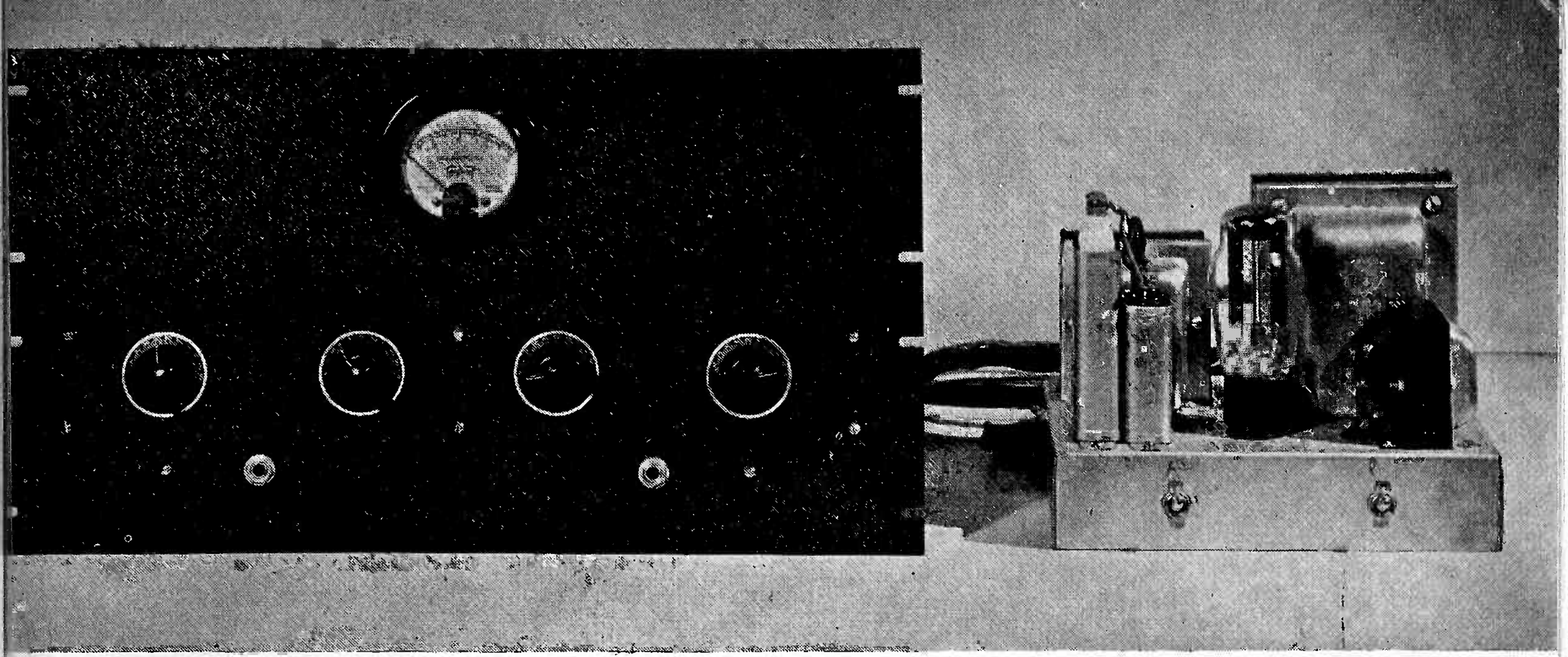
The Modulator

A pair of Taylor 203Z's are used in the high-level class-B modulator. They operate at 1250 volts and are supplied their plate voltage from a separate power supply.

There is really very little to describe on this deck; there are only the tubes, their filament transformer, the Thordarson Multi-Match output transformer and the plate milliammeter mounted upon it. The driving transformer for the class-B tubes is mounted on the chassis below, in the speech amplifier, and the grid energy is brought to the tubes through a cable and plug arrangement.

The output transformer is adjusted (by means of the taps on the primaries and secondaries) so that the two modulator tubes are operated into a load of about 10,000 ohms plate-to-plate. Since the final amplifier operates normally at 300 ma. with 1800 volts applied, this represents a load condition of 6000 ohms at 540 watts. By adjusting the transformer impedance ratio so that the 203Z's are

[*Continued on Page 76*]



The exciter, built for rack mounting, and its power supply.

40 WATTS ON SIX BANDS

Instant 2SY

By M. A. McCOY,* W6OMP, ex-W5CXJ

Two crystals and five single-winding coils cover five bands or one crystal and the same number of coils cover four bands, all at full power output. By the addition of one coil, five meters may be covered at somewhat reduced output. These are some of the unusual specifications of the exciter-transmitter to be described in this article.

Other features are the fact that all tubes are used on all bands except the two lower frequency ones, 80 and 160 meters, and the desirable convenience that 80- or 160-meter crystals are used in the oscillator stage for output on all bands, even down to 5 meters. This is highly desirable since the new variable-frequency crystals are commercially available only for operation on the 80-meter band.

To get even fair coverage of a 40-kc. wide band on ten meters by changing crystals, at least five crystals are needed and even then the carrier is limited to only five spots in this band. However, there are available on the market several variable crystal units of the 80-meter AT-cut type in which variations of the fundamental frequency of 5-kc. or larger are obtainable. This variation is accomplished by means of an adjustment of the pressure and air-gap of the crystal holder. These units sell for only a dollar or so more than a single fixed 40-meter crystal. The saving is obvious; one crystal for one spot in the band, or, for a few dollars more, your choice of any spot within 40 kc. on 10, 20 kc. on 20, etc.

Since forty meter variable-frequency crystals remain flimsy experimental objects, it was decided to use one of the eighty meter units and to design the exciter for "octupling" or doubling three times instead of twice as is more common.

The final result is quite similar to the "Bi-Push" in many respects. In fact, the final 6L6 stage of the original unit is used intact; only the two 6A6 stages have been changed. There is little to discard in building the new unit from the old, and only a few additional low cost parts and a pair of 6L6's to replace the 6A6's are needed. Thus, is one desires a variable frequency crystal on 14 or 28 Mc. with a variable gap 80 m. crystal, he need but modify his "Bi-Push," to conform to the exciter described here.

There are no changes in the coils with the exception of the jumpers on the forty meter coil which have been changed from push-pull to push-push arrangement. Additional coils for the one-sixty and eighty-meter bands have been added and information is given for a five meter coil should it be desired. The five prong crystal

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*3228 Estara Ave., Los Angeles, Calif.

COIL TABLE

Coil	Band	Wire Size	No. Turns	End Connections At Pins	Jumpers From	Center Tap To Pin
L_{1A}	160	No. 24	66	2 and 4	2 to 1 and 4 to 5	3
L_{1B}	80	No. 24	34	2 and 4	2 to 1 and 4 to 5	3
L_2	80	No. 24	34	2 and 4	4 to 1 and 2 to 5	3
L_3	40	No. 18	18	2 and 4	4 to 1 and 2 to 5	3
L_4	20	No. 14	8	2 and 4	4 to 1 and 2 to 5	3
L_{5A}	10	No. 14	4	1 and 3	3 to 5 and 1 to 4	none
Also needed when using a forty-meter crystal to go to five meters						
L_{5B}	10	No. 14	4	2 and 4	4 to 1 and 2 to 5	3
L_6	5	No. 12	2	1 and 3	3 to 5 and 1 to 4	none

socket has been replaced with one of the six prong variety for very definite reasons to be explained later.

If 160-meter excitation is not required from this unit, a single eighty-meter crystal will suffice for all the other bands. But in this case the 160-meter coil is replaced with a second eighty-meter coil, L_1, with its jumpers arranged for push-pull.

The arrangement, coil placement, etc., for different bands is as follows:

Five and Ten

For ten meters plug the crystal into S_1 placing the prongs into socket holes 2 and 5. The forty-meter coil is placed in S_2, the twenty-meter coil in S_3 and the ten-meter coil in S_4. The rig is now operating with VT_1 as a doubling oscillator, VT_2 as a single-ended doubler, and VT_3 with VT_4 as a push-push doubler. It is practically impossible for the push-push doubler to radiate any of the fundamental or odd harmonics of the frequency driving it, so this set-up makes a safe doubler-final.

The output in this case with only a three-hundred-volt B-supply is a good twenty-five watts. With a five-hundred-volt B-supply, and with R_9 to keep the plates of the first two 6L6's at 350 volts or less, the r.f. output from the final stage is a good forty or forty-five watts.

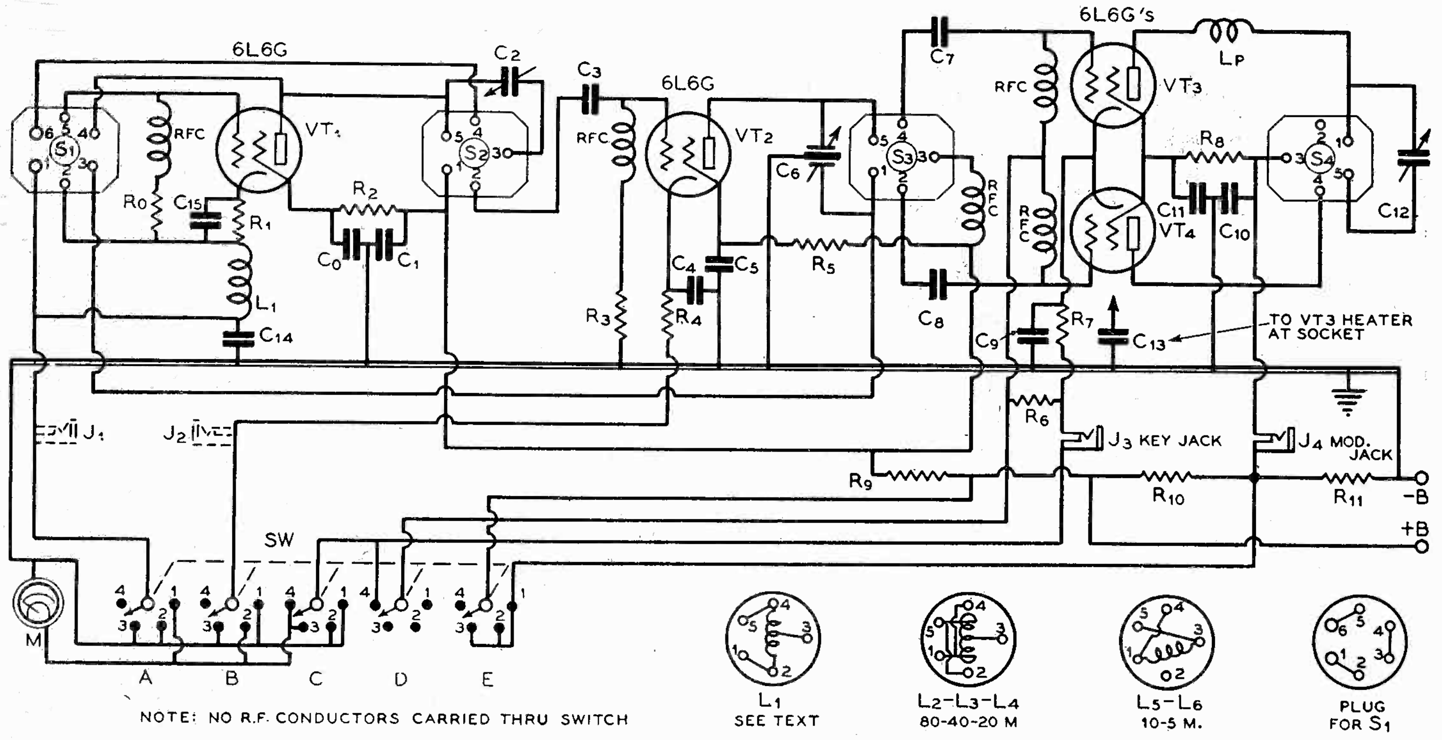
To work the rig on five use the same set up as for ten but replace the ten-meter coil with the five-meter one. The 6L6's work here as a fairly efficient quadrupler with an output of fifteen or twenty watts with a five-hundred-volt B-supply.

Twenty

For twenty-meter operation the crystal remains in S_1 and the eighty-meter coil L_2 replaces the forty-meter coil in S_2. The forty-meter one moves up to S_3 and the twenty-meter coil goes into S_4. The rig now operates as a 6L6 straight oscillator driving a single 6L6 doubler which drives the 6L6 push-push final on twenty meters.

Forty Meters

To change to forty meters move the crystal to S_2, insert the shorting plug (see diagram) in S_1, move the eighty-meter coil to S_3 and place the forty-meter coil in S_4. Now the shorting plug has shorted the cathode coil of VT_1 and connected that tube so that it works with VT_2 as a push-pull eighty-meter oscillator driving VT_3-VT_4 as a push-push doubler to forty meters.



SCHEMATIC DIAGRAM

C_0, C_1—.01 μfd mica
C_2—100 μμfd. midget variable
C_3—.0001 μfd. mica
C_4, C_5—.01 μfd mica
C_6—100 μμfd. per section split-stator
C_7, C_8—.0005 μfd. mica
C_9—.004 μfd. mica
C_{10}, C_{11}—.004 μfd. mica (.002 μfd. for phone)
C_{12}—50 μμfd. 1000 volt spacing varible
C_{13}—.004 μfd. mica
C_{14}—.01 μfd. mica
R_0—50,000 ohms, 2 watts
R_1—400 ohms, 10 watts
R_2—25,000 ohms, 10 watts
R_3—50,000 ohms, 2 watts
R_4—400 ohms, 10 watts
R_5—25,000 ohms, 10 watts
R_6—2-100,000 ohm, 2 watt carbon in par. (50,000 ohms, 4 watts)
R_7—200 ohms, 10 watts
R_8—15,000 ohms, 10 watts
R_{10}, R_9—2000 ohms, 100 watts adjustable
R_{11}—25,000 ohms, 25 watts, adjustable
M—0-250 d.c. milliammeter
SW — Four-position five-contact switch
RFC—2 mh., 125 ma. chokes
L_P—6 turns wound on pencil (3 turns if 56 Mc. is used)
Coils—See text
$VT_{1, 2, 3, 4}$—6L6G tubes

Note that so far every tube has been used for every band.

Output on Eighty

If it is desired to use the eighty-meter crystal and operate the exciter with its output on eighty meters, the crystal is plugged into S_3 eliminating all the coils except the eighty meter coil L_1 which plugs into S_4. VT_1 and VT_2 are eliminated by placing the meter switch in position four. VT_3 and VT_4 operate as a push-pull oscillator. Note that the eighty-meter coil L_2 is used when the rig is operated on twenty and forty, and that the eighty-meter coil L_1 is used only in S_4 when that stage is the oscillator. This is because L_2 is connected for push-push and L_1 for push-pull.

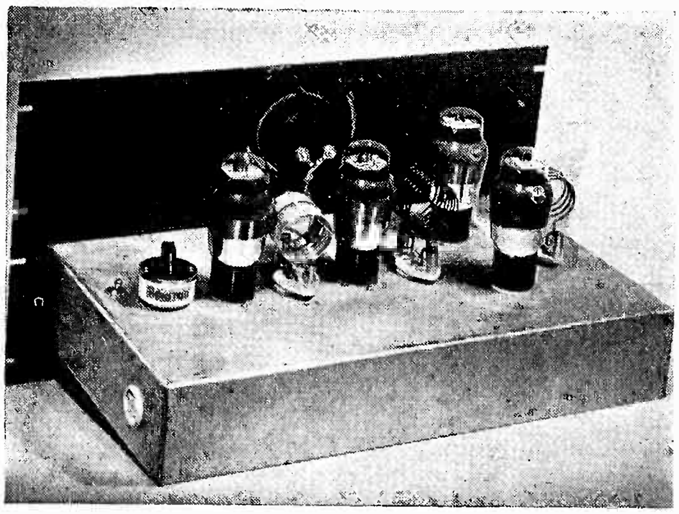
If a 160-meter crystal is to be used when the rig is operated on eighty, L_3 is wound for one-sixty instead of eighty meters. Then, with the 160-meter crystal plugged into S_2, the shorting plug in S_1, and the 160-meter coil in S_3, the eighty-meter coil L_2 plugs into S_4 to operate the final as a push-push doubler to eighty meters. It is, in this case, driven by VT_1-VT_2 as a push-pull oscillator.

One-Sixty

For 160-meter operation the crystal plugs into S_3, the 160-meter coil into S_4, and the meter switch is placed in position four. VT_1-VT_2 are thus eliminated and VT_3-VT_4 operate as a push-pull oscillator.

Full Output on 5

For greatest output efficiency on five meters but with no ability to QSY, a forty-meter crystal may be plugged into S_1 and the cathode coil, L_1, changed to ten turns. The twenty-meter coil then goes into S_2 and the ten-meter coil is changed to correspond with the connections on the other push-push coils. It then plugs into S_3 with the five-meter coil in S_4. With this arrangement VT_1 acts as a doubling oscillator to twenty with VT_2 a single doubler to ten and VT_3-VT_4 a push-push doubler to five.



Back view of the rack-mounted exciter. Note the power-supply plug on the left end of the chassis.

Coils

Several manufacturers have marketed coils designed especially for the original Bi-Push, but for the benefit of those who prefer to roll their own and who do not have a copy of April RADIO the necessary dope is given herewith for the original coils and for the special coils required by this arrangement.

All coils are wound on 1½" diameter forms. The five- and ten-meter coils are spaced to be 1" in winding length. The other coils are spaced to cover 1¾". Isolantite or "air wound" forms are much to be preferred for five, ten, and twenty and are recommended for the rest of the bands.

The Metering-Switching Arrangement

Seven-prong coil forms could be used instead of five and a jumper run between the two extra prongs. The cathodes of VT_1 and VT_2 could then be run through the socket S_3, so the extra jumper would return them to ground only when a coil was in S_3. This would automatically disconnect the B supply from VT_1-VT_2 when their plate voltage was removed, thus protecting their screens from overload.

The switch S as shown could be replaced by a plug-jack system for metering. Seven-prong sockets would then be needed to disconnect the screens automatically as described above. Also, a double-pole-double-throw toggle switch would be required to short out R_6 in one position, R_{12} in the other to change VT_3-VT_4 from a push-pull oscillator to a push-push doubler. However, S is recommended as it makes a much neater metering arrangement and accomplishes all switching at the same time.

When S is in position number one the milliammeter is in the cathode of VT_1. In the second position the meter is in the cathode of VT_2, and in the third position it is in series with the cathodes of VT_3-VT_4. In positions 1, 2, and 3 the cathodes not running through the meter are connected to ground, R_{12} is shorted out to place full B-supply voltage on the final, and R_6 is in the circuit thus allowing it to bias properly the final for doubling.

With S in position number four the cathodes of VT_1 VT_2 are open (thus protecting their screens), R_6 is shorted out to bias VT_3-VT_4 properly as an oscillator, the cathodes of VT_3-VT_4 pass through the meter to ground, and R_{12} is not shorted out (left in the circuit).

Insuring Your Crystals

The best way of obtaining long crystal life is to be certain no strain is placed on the crystal from abnormal voltages. For this reason the voltage on VT_1-VT_2 is kept at all times below three hundred and fifty volts. With this voltage the crystal current is very low when the crystal is plugged into S_1 or S_2. Since neither of these stages is keyed, there is no keying strain on the crystal.

When the crystal is plugged into S_3 so that VT_3-VT_4 act as the oscillator, the plate voltage on these two tubes is lowered by placing the switch in the fourth position, thus removing the short from R_{12}. When this stage is keyed as the oscillator, care must be taken to insure that the voltage across R_{10}, the bleeder resistor, does not exceed four hundred fifty volts with the key up. With the key down it should be held below four hundred volts. This is done by adjusting R_{10} and R_{12} until the proper voltages are obtained. With R_{12} at approximately 1500 ohms and R_{10} at 14,000 ohms a five-hundred-volt, well-regulated B-supply will produce about 450 volts across R_{10} with the key up and about 350 volts with the key closed.

It is recommended that the plate voltage on VT_1-VT_2 be adjusted to 300 volts or lower by means of R_9. Higher voltages may be used under certain conditions, but the strain on the crystal will be proportionately greater.

The Doubling Oscillator

For those who have had trouble in making a doubling oscillator work properly, VT_1 as such an oscillator in this rig will be a revelation. It is actually easier to make work than a straight oscillator, the only critical element being the cathode coil. This coil should follow the specifications quite accurately. It is wound of twenty-three turns of number eighteen wire wound one and a quarter inches long on a form seven-eighths of an inch in diameter.

This oscillator tunes very broadly in the plate circuit, there being a total absence of the sudden jump into oscillation noticed on straight oscillators. However, with the values given here it is practically impossible to get the circuit into self-oscillation; and at no time does the crystal lose control of the frequency.

This type of oscillator is quite active; it will often work perfectly with the crystal in such a poor condition that it will hardly oscillate in a straight oscillator.

A small parasitic choke L_p is placed in the plate circuit of VT_3, because the high transconductance of the 6L6 tube causes a tendency toward u.h.f parasitics no matter what the circuit design. This choke is wound from number eighteen wire with a lead pencil as a form and is composed of six turns unless the final is to be used also on five meters, in which case it is reduced to three turns. It must be placed exactly at the plate pin on VT_3—not an inch or so away.

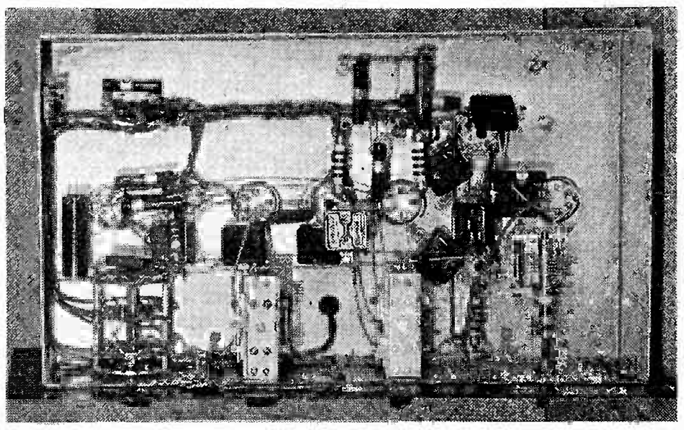
In order to isolate tuning condenser C_2 from the crystal circuit when the crystal is inserted into S_2, it was necessary to connect the condenser from the plate of VT_1 to pin number three of S_2. With this method the condenser is only from plate to center tap of whatever coil is placed in S_2. In spite of the reduced tuning range of this condenser, the effective capacity is ample to tune the entire amateur band on any coil.

Use number fourteen or sixteen wire in wiring this unit. Number fourteen enameled with spaghetti is ideal. In case a wooden chassis is used, a common ground (a piece of heavy copper strip, wire, or tubing) should be run the length of the chassis.

The Power Supply

The power supply to be used depends on the output desired. A supply similar to that used on the Bi-Push will be very satisfactory. Any well regulated 300- to 500-volt supply will do as long as it will stand a steady drain of 250 to 300 ma. Be certain that the condensers will stand any rise in plate voltage that may be brought about by the changing current requirements of this unit. Because of the common filament supply, if the rig is to be keyed it is recommended that the filaments not be connected to ground except through the r.f. grounding condenser C_{13}.

If the power supply does not deliver more than 350 volts, R_9 and R_{12} may be eliminated. In order to remove the heat that they produce from the r.f. chassis, it is recommended that these two resistors be mounted on the power supply.



Bottom view. The 3-gang Yaxley switch on the left is used as meter switch, and to short out the grid leak on VT_3-VT_4 when they are used as oscillators.

Keying and Modulation

Keying is accomplished by breaking the cathode lead VT_3-VT_4 as indicated in the schematic diagram. The key is always inserted in this jack, J_3, regardless of the band of operation. The small amount of cathode bias on the 6L6G's is enough to hold the plate current within reasonable limits during the tuning process but not enough to allow one of the previous stages to be keyed. For this reason the final stage is keyed on all bands.

By using a screen-dropping resistor, it is possible, as in the "Bi-Push", to plate and screen modulate the 6L6G's from a single winding on the modulation transformer. A single output winding of 3000 to 3500 ohms is required on the modulation transformer.

Tuning Up

When the final is used as a push-pull oscillator, be certain that switch S is in position four. Then tune for maximum output. This stage as an oscillator will draw from 100 to 200 ma.

Be careful not to pick the wrong harmonic of the crystal's fundamental. An absorption-

[*Continued on Page 90*]

Application of

6L6'S AS DRIVERS

●

With the mere mention of the 6L6 as a driver possibility, a lot of well-informed engineers would probably throw up their hands. But they could not have thought of how easily the plate impedance of these tubes may be lowered by stabilized feedback—and thus to suit them to use as excellent class-B drivers.

●

By DOUGLAS FORTUNE,* W9UVC

The adaptability of beam power tubes as class-B drivers is of particular interest, especially to phone operators whose modulators require a considerable amount of grid driving power. Usually, the driving merits of a tube are judged on the basis of power output alone, and in these cases the trend is quite naturally toward the use of beam power tubes. The choice of these tubes is an unfortunate one if they are used as ordinary tetrodes; however, if they are operated with a certain amount of inverse feedback, the beam power tubes may surpass the performance of even the best triodes.

Assuming that the output of a prospective driver tube is adequate to supply the grid losses of a given class-B stage, another important consideration is that the driver tube have low plate resistance. Although the power output of a pair of 6L6's, for instance, may be sufficient for most amateur purposes, the plate resistance of these tubes is so high that their use will result in severe driver distortion.

At this point it may be well to review briefly the requirements imposed on the driver stage. A power tube may be considered a source of perfect regulation which supplies power through its plate resistance. In the case of a driver, this power must be supplied to the variable impedance of a class-B grid. In figure 1 is shown an equivalent class-B grid circuit.

Power is supplied to R_G, the instantaneous class-B grid impedance, through R_P/N^2, the equivalent impedance of the driver tubes referred to one class-B grid. So long as R_G remains constant, the voltage across R_G bears a constant relation to μE_G (the voltage applied to the driver grids) regardless of the value of R_P/N^2. However, R_G does not remain constant but varies over the audio cycle, decreasing as μE_G increases. The voltage drop across R_P/N^2 is thus a variable resulting in a voltage across R_G which is not proportional to μE_G, and the larger the value of R_P/N^2 the greater will be the variation in voltage across R_G. The actual value of R_P/N^2 varies directly with the impedance of the driver tubes and inversely as the square of the step-down ratio of the driver

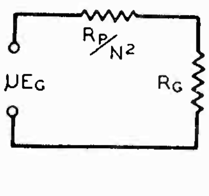


FIGURE 1

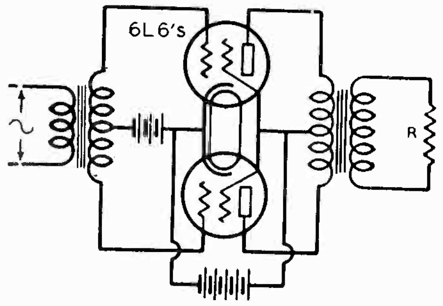


FIGURE 2

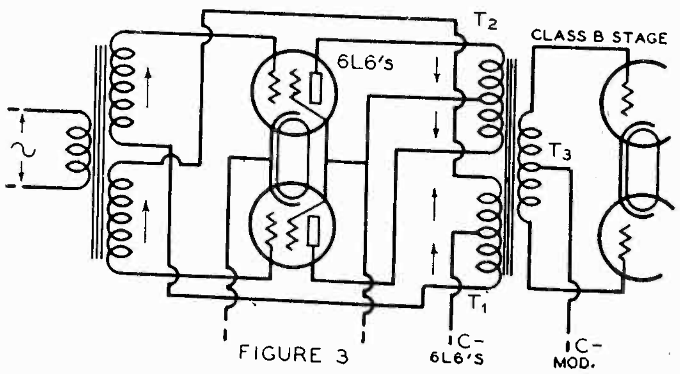


FIGURE 3

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*500 West Huron Street, Chicago, Illinois.

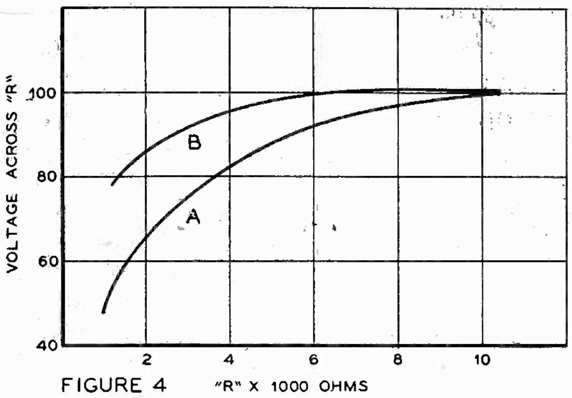

FIGURE 4

transformer. Thus it may be seen, if the class-B stage is to be driven properly, that the plate resistance of the driver tubes must be low and the driver transformer must have as high a step-down ratio as possible.

Plotting Figure 4

In order to show the effect of high plate resistance, a pair of 6L6's operating as tetrodes at 300 volts was set up in the circuit of figure 2, and the value of R was varied from 1000 to 10,000 ohms. The plate resistance of the 6L6's and the turns ratio of the output transformer in figure 2 correspond to R_P/N^2 in figure 1 and likewise R to R_G. The actual measured values of voltage across R with a steady signal applied to the 6L6 grids are shown in figure 4, curve A.

It may be seen that, as the value of R decreases, the voltage across R drops off rapidly due to the high plate resistance of the 6L6's. Actually, if R were a class-B grid, the waveform of the signal would be rounded off due to the fact that at the peak of the wave where the value of R is least, the voltage has decreased.

If, while still retaining its high output capabilities, the plate resistance could be reduced to a reasonable value, the 6L6 would make an ideal driver. This reduction in plate resistance may be accomplished through inverse feedback, by means of which the beam power tube may be made to take on the characteristics of a triode, the plate resistance of which decreases in proportion to the amount of inverse feedback.

In figure 3 is shown a push-pull circuit with inverse feedback. A certain amount of voltage developed across the tertiary winding T_1 is fed back out of phase with the signal applied to the grids, the net results being a reduction in the amplification factor of the tube and, most important in this case, a reduction in the plate resistance. The effective plate resistance of the 6L6 is now a function of the ratio of T_1 to T_2, and it is equal to the normal plate resistance of 22,500 ohms in parallel with an impedance of T_2/G_MT_1, in which G_M is the mutual conductance of the tube. With 10 per cent feedback, the plate resistance of the 6L6 is 1600 ohms, which is considerably less than the original value of 22,500 ohms. With 16.6 per cent feedback, the plate resistance decreases to 960 ohms. Higher values of inverse feedback may be used with a corresponding decrease in plate resistance; however, the necessary grid driving voltage may become excessive.

In order to show the improvement in regulation obtained by inverse feed-back, 10 per cent feedback was applied to the circuit of figure 2. The same output transformer was used so that any improvement in regulation would be due directly to the decrease in plate resistance. For ease of comparison, the input signal was adjusted to bring the voltage across the 10,000 ohm value of R to 100 volts. The values of voltage across R are shown by curve B, figure 4. It may be seen that there is a considerable improvement in the regulation; a further improvement results with 16.6 per cent feedback.

Since comparatively high voltages may be used on the 6L6, the driver transformer may have a fairly high step down ratio. It is interesting to compare the driving merits of the 6L6 with those of the 2A3. Although the plate resistance of the 6L6 with 16.6 per cent inverse feedback is 960 ohms, which is higher than the 800 ohms of the 2A3, the value of R_P/N^2 in figure 1 is considerably less for 6L6's due to the higher permissible step down ratio of the driver transformer. Assuming that the class-B stage consists of a pair of 203A's, the driving power is 10 watts and the peak grid voltage is 155 volts. With push-pull 2A3's operating at 300 volts, the effective value of R_P/N^2 in figure 1 is 240 ohms. With 6L6's operating at 400 volts with 16.6 per cent inverse feedback, the value of R_P/N^2 is only 120 ohms. The peak grid-to-grid signal voltage is 112 volts for the 6L6's compared to the 120 volts required by the 2A3's. It may be seen that a pair of 6L6's is somewhat superior to a pair of 2A3's, and in some cases compares favorably with push-pull parallel 2A3's.

In conclusion, there is one caution to be observed in connection with the feedback operation of 6L6's as drivers. With regular class-A tubes, it is customary to excite the driver grids up to the point of grid current in order to obtain a high driver transformer step down ratio. However, in the case of the 616's (which for driver purposes, operate with a plate to plate load several times greater than the optimum value for maximum power output), grid excitation should be somewhat below the grid current point. The maximum allowable grid signal may be determined as follows: without feedback, the signal voltage E_p developed in the plate circuit is equal to μE_G, where μ is the amplification factor of the tube and E_G is the grid signal. With a certain amount of feedback N, the necessary grid signal is increased by $N\mu E_G$, so that the total grid voltage is now $N\mu E_G + \mu E_G$. The amplification factor with feedback μF is thus

$$\frac{\mu E_G}{N\mu E_G + \mu E_G} \quad \text{or} \quad \frac{\mu}{N\mu + 1}$$

Now consider a hypothetical curve $E_G = 0$ on the reconstructed plate family of the 6L6 with inverse feedback. The tube drop due to the static current I_S is $I_S R_F$, where R_F is the equivalent plate resistance with feedback. The difference between the supply voltage E and the tube drop is equal to the peak plate signal. Thus $E - I_S R_F = \mu_F E_{GF}$, where E_{GF} is the peak allowable grid signal with feedback.

$$\text{Therefore } E_{GF} = \frac{E - I_S R_F}{\mu_F}$$

and for a push-pull driver

$$E_{GF} = \frac{2(E - I_S R_F)}{\mu_F}.$$

$$\text{Since } \mu_F = \frac{\mu}{N\mu + 1},$$

$$\text{Then } E_{GF} = \frac{2(E - I_S R_F)\ (N\mu + 1)}{\mu},$$

remembering that R_F is the parallel combination of R_P, the original plate resistance of the tube without feedback and $1/NG_M$.

Distortion will result if a grid to grid signal greater than E_{GF} is applied, although E_{GF} is well below the grid current point. In the case of 6L6's with 16.6 per cent inverse feedback, the maximum permissible value of E_{GF} is 112 volts, although grid current does not flow until the peak grid to grid signal is 152 volts. The value of E_{GF} is based on the assumption that the 6L6's are operating with full grid excitation into an open load. This condition, of course, never occurs because, with full grid excitation there is a definite load on the 6L6's, and the permissible grid voltage is somewhat increased. However, to be on the safe side, the maximum value of grid excitation is E_{GF}. This limitation must be taken into account in the design of the driver transformer, so that maximum class-B output occurs with a peak driver signal of E_{GF}.

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● Radioddities

Every VQ3 call is an abbreviation of the owner's name.

•

W4DLH grows and packs *CQ* brand tomatoes.

•

The energy equivalent to that in a pound of porterhouse steak would keep a dry-cell tube burning continuously for 8 hours.

•

We always thought hams were not supposed to drink. Now we are sure we were correct. A printed list of cocktail recipes in our possession is captioned *not for amateurs.*

•

A news item in a Philadelphia daily (tnx to W3HCY) says that hams are not permitted below 180 meters, but that often they may use the "special low of 20 meters."

•

A single electron passing a given point in one second produces a current of one ten-million million millionths of an ampere.

A crystal at the yearly tick-rate of a watch would generate just a little over a hundred kilocycles.

•

Current is carried through the human body by ions instead of electrons. This accounts for the fact that a high frequency current is not as injurious as one of low frequency. When the frequency is high, the heavy ions cannot be displaced very far.

Let the winds blow. VE3QK thrusts out his lower lip and determinedly balances himself on the housetop to measure the voltage at the base of VE3WX'S vertical antenna. The measuring device—a neon lamp.

DEPARTMENTS

- **Dx**
- **Yarn of the Month**
- **Postscripts & Announcements**
- **56 Megacycles**
- **The Open Forum**
- **Radio Literature**
- **Question Box**

Following is the frequency list for c.w. stations, although there are a few 'phone frequencies listed too, as marked. We do not guarantee the exact accuracy of these, as no two hams report a station exactly the same. However, this is more or less an average taken from all the reports received. We hope it will help. Cut this list out, add to it the one to be published next month.

7 Mc.

FP8PX	7020
VP2LA	7135
VP3BG	7012
PK1MF	7018
ZE1JI	7012
YS1FM	7028
UT3AC	7028

14 Mc.

UPOL	13995
CN8AG	13990
U1AP	14425
U8ID	14405-14430
U9ML	14390
U9AW	14420
U9AC	14416
U6SE	14418
U3FB	14410
U5OF	14430
U9MF	14435
U6AN	14445
U9AX	14390
U9MI	14000
U5AH	14430
CR7AW	14300
VU7FY	14380
ZC6AQ	14275
AA5CN	14450
F2AQ	14420
TG1S	14430
PF2DB	14300
FA8DA	14035
XU3MA	14070
VU2FH	14150
VQ8AS	14130
VO6D	14400
VO6JQ	14300
YV2CU	14400
YI7LC	14400
XU8HM	14015
EA7AV	14420
VQ8AF	14350
VQ8AB	14300
HS1BJ	14070
FI8AC	14300
FB8AB	14260
UX1CR	14420
HH3L	14320
FY8E	14425
YV5AB	14250
PK1RI	14380
UK8IA	14300-14370
VS4CS	14265
YU7TE	14410-14445
CN8AR	14320
HB9CE	14300
YR5CF	14420
LY1S	14410
SU2TW	14400
FP8PX	14300
SV1RX	14280
HH4AS	14325
HA3Q	14415
VU2CV	14290
SU1DB	14300
ZE1JN	14360
ZE1JI	14375
VU2LJ	14300
ES2D	14350
SV1KE	14270
YM4AD	14415
YR5HC	14415
MX2B	14300
LA3I	14310
OK3TW	14380
VQ8AE	14000
VS7RF	14320
YI2BA	14280
ES8D	14350
VU2AV	14415
ZS4A	14385
VP2LA	14030
VQ8AG	14430
ZS3F	14330
ST2CM	14360
CT1ZZ	14005
HB9AZ	14390
OX2QY	14360
VE5LD	14030
FF8AH	14320
J2OY	14140
ZA4X	14420
XZ1S	14260
VR2FF	14140
YS2B	14410
HZ5NI	14410
XU8AZ	14440
VQ8AE	14015
FR8VX	14420
XU8RL	14320
KA1CS	14325
HC1JW	14400
HP1AA	14300
FT4AZ	14010

28 Mc.

VO3X	28115
PA1PN	28060
ON4AU	28020
G2XC	28025
GM6NX	28100
G6RB	28100
G2PL	28160
ON4RX	28050
ON4HC	28040
OK1PK	28040
D3DSR	28060
G5BJ	28225
PA1AZ	28010
EI6G	28310
EI7F	28200
EI5F	28300
F3CX	28060
G6IR	28030
OK1AA	28010
F8EO	28100
F3KH	28080
G5QY	27175
G6YL	28180
ON4FT	28150
G6WY	28100
GM6RV	28050- 28250
F8TQ	28150
PA1GN	28040
TF5C	28175
G2TK	28215
GW6KJ	28110
VU2AU	28075
U9MI	28200
VU2CQ	28200
U3FB	28150
U9AW	28160
U9ML	28120
SV1RX	28190
LA4P	28160
ZS1AH	28050-28092
ZT1J	28330-28550
ZE1JJ	28230
ZT6Y	28100-28330
ZT6AU	28200
ZT2Q	28070
ZT6AK	28100
ZU6P	28325 (fone)
ZS6T	28120
ZS6AJ	28085 (fone)
ZE1JR	28175 (fone)
F8WK	28135
F8BS	28130
F8GQ	28075
G8HS	28470
F8RR	28200
G5BD	28500
OK2MV	28125
OK3VA	28135
OK1FF	28040
CT1KH	28210
CN8AV	28530
K5AY	28050
HR4AF	28350
EI9J	28220
D3BMP	28000
D4FND	28075
YL2CD	28170
OH2NM	28300
OH2NB	28075
YR5CF	28040
I1KN	28260
YM4AA	28000
PY1BR	28320 (c.w.fone)
PY3BY	28290
LA4P	28240
J3FJ	28050
OA4J	28300
LU6AX	28200
LU5AN	28030
LU7AZ	28200
ZL1DV	28125
ZL1MR	28100
ZL4DQ	28200
FQ8A	28000
LU3DH	28180
GM5KF	28200
VU2CQ	28320
VK5KO	28000
K5AG	28170
TI2RC	28115

DX

HERB. BECKER, W6QD

Readers are invited to send monthly contributions for publication in these columns direct to Mr. Becker, 1117 West 45th Street, Los Angeles, Calif.

Here we are rolling into the last part of the year. Now when you look back doesn't it seem that plenty of dx has gone under the bridge? Yessir, I'll bet that if we could tabulate all of the good stuff you fellows have knocked over we could take their QSL cards and when placed end to end would reach from W8CRA's shack on the hill to Antarctica . . . and then maybe back again to W1JPE . . . 'way back there on his Connecticut "farm". Speaking of W1JPE, "By" Goodman, reminds me of the few days he spent with us around "town", after he had attended the Southwestern Division convention in Tempe, Arizona. He met a lot of the boys around Los Angeles and after seeing the "sights" we put him on the train . . . he just did make it, too, as it was pulling out. "By" looked like a ballet dancer when he made the flying leap for the car platform.

And now, speaking of the convention, a thousand bouquets should be tossed to "Red" Harkins, W6BUQ, who put on one of the best conventions we ever attended . . . and he did it almost single handed. Tempe, a small western town, was with us 100 per cent. "Red" had the whole town decorated and met the train from L. A. with a parade of cars including the fire engine. W6BUQ had a program that should set an example for others to follow. I asked W1JPE if California was the first leg of his "Dx Expedition" and his reply, "Phooey, we got your dollar." CXW and CUH hopped on him because they are both blasting holes in the "layer" again and could use a few countries.

Here is a good spot for a correction. Last month we recorded the 'phone WAC of W6NNR in 1 hour and 40 minutes as being made on September 28th. This should have been September 8th, not the 28th. To think, in the eyes of many hams, we could have made a prevaricator (?) out of W6NNR. Our apologies. Incidently, how many 'phone WAC's have been made in this time or less? NNR's was made without previous schedules.

A word from Bob Jardine, G6QX, says he still has 35 zones and 75 countries. Bob is doing a bit of rebuilding including a couple of new sticks. He is also changing his transmitter around some, and has installed a Bi-Push exciter.

W5BB in Austin, Texas, has been doing some swell work on both c.w. and fone. He has 38 zones and 91 countries at present. Some of the best include FL8AC, GM6RG, FY8E, HH3L, YV5AB, CR7AW, YI2BA, UK8IA, VS4CS, YU7TE, CN8AR, HB9CE, YR5CF, LY1S, SU2TW, and XU1CR. W5BB uses a couple of 100TH's with about 750 watts, and the receiver is an NC101X. He is the brother-in-law of Wilmer Allison, W5VV, the tennis whizz. They live right next door to each other; in fact 5VV's transmitting antenna is within 50 feet of 5BB's. Incidentally, W5VV now has 94 countries.

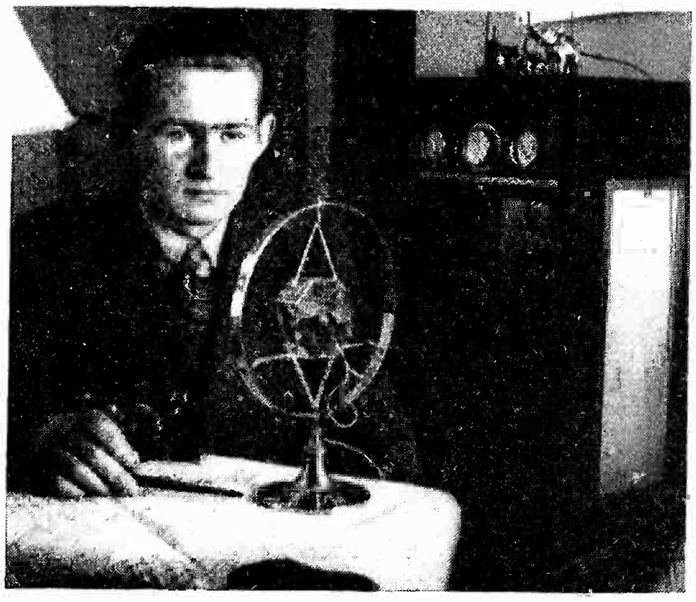
Hank Jones, W6GCT, at Mission Beach, Calif., hit a queer night a while back. To be exact it was October 18th and starting at 10:40 p.m. P.s.t. he worked the following on 20-meter phone: LA6A, F3HM, F3NF, F3OO, F3LR, F3HL, F8DC, F3HZ, and finished with F8UE at 1:15 a.m. All QSO's were 100% and the reports were all 8 and 9. Henry is wondering if any others found conditions unusual that night.

W6MCG has been running 225 watts to his 838 and from July 4th to October 10th he has hung up an extraordinarily good record by working 155 different European stations and 8 Africans. Among these were: 58 G's, 6 OZ's, 7 OK's, 20 F's, 3 GI's, 4 EI's, 3 OE's, 3 SM's, 15 ON's, 9 PA's, 12 D's, and 6U's. This was all done on 14 Mc. and I think it's swell. G6WY has added new ones by hooking up with FQ8A and FQ8AB, located in Senegal and Gaboon respectively. SU1WM told G6WY that he worked AC4AA who gave his QRA as Tsin-ho, Kan Postal Office, Llasa. Both G6WY and G2ZQ have received their cards from AC4YN confirming QSO's. FQ8A is on 28 Mc. only and possibly is old FQ3AA. Our old friend OK1AW is heard from and informs us that he has 31 zones and 86 countries. W6FZY works UX1CR for his 38th zone and U9ML for his 39th. Countries are 101.

We can't prove it, but this is W7BYW. We don't know if he got this way going after dx, or if the dx bug got him instead. After looking at this picture we have decided it was the dx bug that got him and he should be in the dx bughouse.

VE3TO is all for getting on 40. He has checked and found that last year in November, December and January with 30 watts input he had good QSO's with the following on 7 Mc. SP7IH, G6SW, OE3AH, G6VQ, CX1BN, F8NE, HAF4H, F3AU, F8WQ, D4IZI, HAF8C, SV1AZ, OK2PN, GM5YG, GM6NX, ON4SL, D3BIT and a flock of XE's, CM's and VP's. All of them seemed to be between 7000 and 7100 kc. W9ALV received a card from VS6AO just 25 days from the date of the QSO. New stations for W9ALV are VQ8AS, FI8AC, U8ID, YU7XX, CN8AV, VU2FX, KA1QL, YV5AP and UK8IA. Hey, you guys . . . how about the frequencies for all the newer stuff. We'll put it in the frequency list. W8CKY has been on 10 most of the time, and was the first W to work a U9 on 28 Mc. He also hooked J3FJ on 10 which is a good piece of work.

The gang in southwestern Michigan is heard from. W8QQE, W8DYK, W8IFD, W8DM, W8HYC. 8HYC is using a pair of Eimac 300T's with a Michi-



SP1FB . . . Poland c.w. and 'phone

gan Kw. W8QQE first received his license on March 10, 1937. One hour later he had snagged YR5AA and 24 hours later he had 5 continents to his credit. Then 14 days later he made his WAC by hooking J2IN. He has 26 zones and 49 countries, but will soon be up in the list. W9UBB gets himself a few new ones with PK1RL; YV2CU, 14400; YI7LC, 14400. YI7LC is using 900 watts and the antenna is a diamond beam. QRA is Duncan Smith, Baghdad, Iraq. According to W2BJ, his friend W2IOP hooked AC4YN in Tibet. If that is so that's a good one to nab. W3EXB informs us that XU3MA is coming through on 14070 kc. 3EXB worked ZB1C on 28 Mc. As far as anyone knows, this may be the first W-ZB QSO on 10. XB1C was on 28600 Mc.

ZN1B is a brand new one and W8DWC got him on 20 c.w. at about 11 p.m. l.s.t. His complete QRA is W. Gray, Box 106, Mafeking, Bechuanaland, frequency 14010. On 10 we learn through G2YL that G6DH worked ZL4FW at 2020 g.m.t. and G2WQ has heard VK3YP as late as 2145. W6HEW landed OQ5AE for his 34th zone. Did you know that the correct QRA of the present ZE1JI is Box 424, Bulawayo, Southern Rhodesia? And that Hal Kemp, the very popular band leader, is a ham?

It looks very much as though W6NKY, a club station in Los Angeles, has gained top honors in the VK-ZL contest. They have 176 QSO's to their credit. W6FZL has 156, W6CXW has 142, W3EVT 134 and I heard that W9ARL and W8ZY had about 150 QSO's.

W6DRE in Arizona is still using QRP, 25 watts to an 801, but has put up a diamond beam with 3¼ waves on each leg on 14 Mc. It must work OK as he has hooked ZU6B, ZT2U, PK1BO, ZU6AD, KA1SL, ZS6K, ZU5J, ZS6H, ZT2Q, ZS5T, ZU6AN, KA1YL, ZS1AV, G5BD and plenty of others. G6GH has increased his totals to 35 zones and 84 countries. HS1BJ and HC1JW are the two latest zones. He's still looking for states though. W7ALZ breaks into the 'phone section of the zone list, as does W5ASG and W2IUV. W7ALZ has 20 zones and 25 countries. W5ASG has 20 zones and 38 countries, and W2IUV sums his up to 21 zones and 38 countries. From all reports the boys on 'phone during the past month have not done much in the way of new dx. It is entirely due to conditions, I guess, as such phone men as W6NNR, W6ITH, W6OCH, W6GCT, W6LLQ, W6FTU, W6MLG, W6ISH have not folded up. While conditions are down, a couple of the above have switched over to c.w. to boost their standings in this section. W6LYM took a six weeks trip into Oregon to hunt deer, so he said. I thought he would get away from ham radio for a while but here's what happened, Almost as soon as he got there, his cousin was bitten by the "radio bug" and so Norol spent most of his time teaching the code and theory for the exam and then ended up by putting a Bi-Push transmitter on for him. In other words a brand new W7.

WAC on 10

W6JJU, Jerry Gorman, did a nice bit when he worked all six of them in 8 hours for a fone WAC . . . 100% two way fone with no pre-arranged skeds. This shows the fine possibilities of ten. The stations were F3KH, ZU6P, LU7AG, J3FJ, K6MVV and W6MSQ. Jerry is located in Sunland, Calif., and has been on 10 almost exclusively during the past few years.

W2GTZ has increased his standings to 36 zones and 104 countries. A few of the news are FQ8AD, K7GIE, K7DAM, VU2FH, VU2FV and XU8RL. Now then . . . W6GPB catches up with FA8RY and VE5LD for new zones making 37 with 81 countries.

J. N. A. Hawkins Now a Daddy

J. N. A. (Johnny) Hawkins, W6AAR, known by everyone for his expert articles in the field of ham radio, has something new to write about. On November 2nd . . . at 0900 G.m.t. to be exact . . . his wife (W6AAL) presented him with Nancy . . . a y.l. As Johnny put it, "That should add a new zone to my list." The Hawkins' are doing very well, thank you . . . including Daddy Hawkins.

Charlie Perrine Adds One, Too

Not to be outdone, the Perrines have an addition to their household—it's the best police dog you ever saw, in fact it's just a puppy weighing only about 80 pounds. CUH says he's a real dx hound.

K6CGK, that "died-in-the-wool" c.w. man, is on 14 Mc. 'phone. We had a swell chat the other p.m. and CGK was telling about his recent trip to Japan. He saw a bunch of the old timers . . . J2GX is apparently working for a commercial outfit building transmitters, J3CR is in a shipbuilding yard, J2GW is a doctor, M.D., and the y.l. J2IX is now an xyl living about 100 miles south of Tokyo. She didn't marry a ham . . . but maybe he'll be one soon. More from K6CGK next month.

W1BUX, Doug Borden, has held off for a long time for sending in some of his doings but now breaks down with the news that he has 38 zones and 120 countries. Incidently his x.y.l., Dorothea, is W1KQO. Sometime ago we put in print about W8DWV working a station in Inini which is the penal colony in French Guiana. Well, this shouldn't be counted as a country, but anyway he needed just one more country to complete South America. He has worked this one and the station was FY8C. W8DWV worked a swell one, ZN1B, frequency 14010, located in Bechuanaland, at about 11 p.m. E.s.t. That's really a good one and you can thank W8DWV for the information.

Here's Wyoming

W7DES on 14375 kc. and W7CJR on 14295 are looking for European QSO's. You boys out of the country can look for 'em around 0300 to 0800 g.m.t. When W7DES and W7CJR call CQ it will be thusly: "CQ DX de Wyo" and then sign their call. This should help. Both of these fellows are in Casper, Wyoming.

And Here's Nevada

W6JYA in Sparks, Nevada is rarin' to go. He says he has worked OK2PN, so evidently his sigs are getting there. W6JYA will be on almost every evening (that is, evening here) at 0400 g.m.t. and stay on while conditions hold up. The frequency of W6JYA is 14060 kc. Now, for the phone boys who want Nevada we will toss a couple at you . . . W6BIC and W6CW. Both of these boys are on 14 Mc. phone and are working some very good dx. There you are gang— go get 'em.

W7ALZ has been doing good work on 20 phone. He contacted OX2QY in zone 40 for his twentieth zone. W2GTZ has hooked up with these new ones: FI8AC, FP8PX, OX2QY, U8ID, UX5AE, PK1VX, XU8RL, VS6AF, VU2FH, VU2FV, VU2DR. He now has 38 zones and 105 countries.

More from W8IGQ and the Yacht Yankee

The following is taken from a letter written to Carl Madsen, W1ZB, by Alan Eurich, W8IGQ. Alan is the op on the "Yankee" and this was written while at anchor in Port Moresby, Papua.

"I wish that you fellows could take my place some time and I yours, and see just what the other end is like on this sked. You sure would get some kick out of operating keeled over at an angle of 20 to 30 degrees and have spray splashing down your back. The dead run you leave the rig with generator running or the receiver going when the call comes for all hands and the squall hits. Out on deck into the flying spray and driving rain to struggle with wet canvas. And the eternal moisture troubles. They sure have yet to design a set that will work for any length of time in this climate. Of course, W1TS has had quite a bit of experience along these lines but I don't think the rest of you have. Oh yes, try to make a bug work right when you are rolling from ten to fifteen degrees one way to the same the other way. I'm not excusing my fist but that really doesn't help matters at all.

"You will probably have read in the papers by this time of the mess that Rabaul was in while I was there, so I won't bother to repeat what you should already know. However, I will say that the Yankee crew were the first whites to climb the new volcano mountain. I'm sorry that I missed you there but we weren't able to run the generator and charge the batteries while hemmed in by the sea of pumice. I hope the few new countries and the qso's with the local-"for me" stations that I dig up will serve to make up a little for the fruitless hours you spend looking for me.

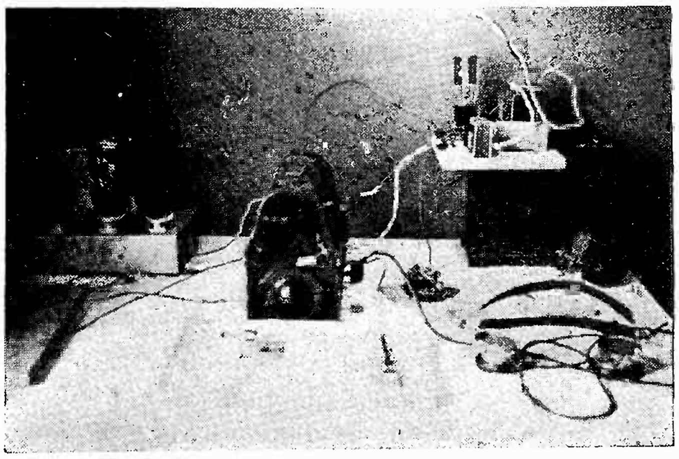
Anne Williams, XYL at W1APA

"I have been looking for VS1AA but to no avail. I guess he just isn't on because if I can hear you folks, I surely ought to be able to hear VS.

"Say, I've found out about that VIG who has been working in the ham bands. Or rather very close to 7100 at various times as we were coming across the Pacific and causing me a great deal of trouble with my skeds with you. He is the local commercial here at Port Moresby and has an MOPA with a KW and RAC on the plate. He has been working some outfits in the interior who have receivers for the ham bands only. He also likes the frequency. I also am finding a few rotten notes from stations in the Philippines!! They talk about the off frequency operation of the amateurs. It isn't half as bad as that of the commercials. At least, we only lap over the edges in most cases, while they just move right in wherever they wish."

YU7XX, ex-YT6MEN, ex-W6MEN

As was mentioned last month, W6MEN is in Jugoslavia and was signing YT6MEN. I guess that didn't go so well so he changed his call to YU7XX, which by now is official. Anyway the photograph will show the elaborate station he is operating. It is rather hard to tell where it begins and where it ends, but on the left will be seen a 210 Hartley. In the center is the receiver built in a lunch box. This is the true ham spirit . . . the guy probably took his lunch to Jugoslavia and when he had eaten it, built a receiver in the box. The thing works and consists of a 36 detector and 76 audio. To the right you will see the power supply with an 83 rectifier (donated by W6GAL). YU7XX says he got a transformer from an old three tube BC set which he says "groans like h—— when I press the key." Says the price for the transformer was 120 dinars, (whatever that is) and then another 60 for a filament trans. The "cans" were donated by W6OEH before he left. The antenna he says is "uncut for length, quality and tone." YU7XX is located in the city of Split (I hope that's right) but spends some time on the island of Brac. For you fellows who have hooked up with him, please send your QSL card to W6MEN, c/o W6OEH, D. W. Wells, 1331 19 St., San Pedro, Calif.



The super-transmitter (lunch-box and all) at YU7XX.

"40 Meters in December"

Judging from the response received by this department in regard to 40 meters in December, it would appear that everyone is going to be in for a lot of fun. The gang as a whole are taking to it and some of them who haven't had their rigs on 40 for a couple of years are winding new coils. Most of the fellows are treating it as a sort of an "old home week" and all in all I think we may do some pretty good dx. This goes for all of you dx men in other countries, too. If the first part of December doesn't prove very good . . . don't give up . . . the last part may be just what we want. There is no law against getting on before December; in fact, it would be a swell idea. The other p.m. I cranked up my ol' "Corn Fed Kw" on forty and the first guy I bumped

"WAZ" HONOR ROLL

	Zones	Countries
ON4AU	40	
G2ZQ	40	116
W8CRA	39	135
W6CXW	39	122
W6ADP	39	119
W6GRL	39	110
ON4FE	39	110
W6FZY	39	101
G6VP	39	
W8BTI	39	
W7BB	39	
W3SI	39	
W3ANH	39	
G6WY	39	
W4DHZ	39	
W8BKP	38	132
W6CUH	38	122
W1BUX	38	120
G5BJ	38	120
W8OSL	38	112
W2GTZ	38	105
W9ALV	38	102
W6AM	38	101
W8LEC	38	100
W5BB	38	91
VE4RO	38	85
XE1BT	38	69
W9TJ	38	
G5YH	38	
W8HWE	38	
W8ZY	37	114
G2LB	37	111
W6KIP	37	109
W6HX	37	107
W1CC	37	106
W6GAL	37	104
W6QD	37	104
W7AMX	37	104
W9PTC	37	103
W8KPB	37	100
W9AJA	37	99
W2HHF	37	95
W2AAL	37	93
W8AU	37	92
W3EXB	37	90
W6LYM	37	82
W6GCB	37	81
W2BSR	37	
W2GW	37	
W8DFH	37	
W2GWE	37	
G6NJ	37	
W2DTB	37	
LY1J	37	
W4AH	37	
W6VB	37	
W1ZB	36	110
W9AFN	36	105
ON4EY	36	97
ZL1HY	36	95
W9KA	36	92
W6FZL	36	91
G2UX	36	83
W4AJX	36	
W8KKG	36	
G6RB	36	
W9ARL	36	
W3EDP	36	
W20A	36	
W6KBD	36	
VK3EO	36	
W2BJ	35	105
W8CJJ	35	98
W9EF	35	94
ON4FQ	35	92
ON4FT	35	92
W6BAM	35	90
W8OQF	35	89
W1GDY	35	89
W3AYS	35	85
G6GH	35	84
W6FKZ	35	83
W6ITH	35	78
G6QX	35	75
W6DOB	35	71
W9CWW	35	70
K6AKP	35	
W6NHC	35	
W6GRX	35	
W2AIW	35	
W3BBB	35	
W2IOP	35	
W3EVW	34	95
W2GVZ	34	94
W6FZL	34	91
W3EVT	34	90
LU7AZ	34	89
ON4SS	34	80
W6HEW	34	86
W6GHU	34	83
W9UBB	34	69
W8JK	34	
W3EMM	34	
W3EGO	34	
W2FAR	34	
W9PK	34	
W1AQT	34	
W7BYW	34	
W8AAT	34	
W6TI	34	
W8CNZ	34	
W8DWV	35	106
W9LQ	33	84
W3TR	33	78
W7AYO	33	73
VE4LX	33	69
OK2HX	33	66
W8LDR	33	
K6JPD	33	
W6LDJ	33	
W9LBB	33	
W5AFX	33	
ON4TA	33	
G6CL	33	
VK2VQ	32	99
ON4VU	32	86
W6JBO	32	81
W9FLH	32	80
ON4NC	32	79
W3CIC	32	75
W6AX	32	74
W3GAP	32	70
W6KZL	32	67
W9DEI	32	66
W8HYC	32	
W8BTK	32	
W5EHM	32	
VE2EE	32	
OK1AW	31	86
W9LW	31	82
W6LEE	31	57
W6IES	31	57
W6MHH	31	54
K6CGJ	31	
W3DCG	31	
W5CUJ	31	
W6HXU	31	
W6KRM	31	
I1TKM	31	
W4MR	30	90
W6DRE	30	78
W3UVA	30	76
W6GNZ	30	73
W2WC	30	72
W3GAU	30	72
W6CEM	30	69
W4DTR	30	68
W9PGS	30	63
W6KEV	30	58
W8PHD	30	57
W6LCA	30	46
W6JJA	30	
W2BXA	30	
W8MAH	30	
W7AVL	30	
W6KWA	30	
W8DED	30	
W9IWE	30	
W6DIO	30	
W1APU	30	

PHONE

W6ITH	33	57
W6AM	31	
W4AH	31	
W6LLQ	30	60
W4DSY	30	
W6NNR	29	58
W6OCH	28	60
W9ARA	27	53
W9BBU	27	45
W2HUQ	27	
W5BDB	27	
W6MLG	26	45
VE2EE	26	
W6BGH	26	
W9TIZ	25	36
VK2ABG	25	
W3SI	25	
W1BLO	24	50
W6FTU	24	35
W8JK	24	
W3EMM	24	
W9NLP	24	
VE5OT	24	
W9QI	24	
W6AAR	23	
W2IXY	22	61
W7AO	22	
XE1BT	22	
W2IUV	21	38
W3FAM	21	36
W6MVK	21	22
YV5AK	20	45
W5ASG	20	38
W8QDU	20	33
W6GCT	20	26
W7ALZ	20	25
W1COJ	20	
W6GRX	20	

If you have worked 30 or more zones and are ready to produce confirmation on demand, send in your score of zones and official countries (see Jan. issue) on a postcard.

Phone stations need work but 20 zones, but stations must be raised on phone. Stations worked may be either c.w. or phone.

Revisions and additions to the honor roll will be made every other month.

into was . . . er . . . ah . . . that is, oh shucks,, it was a W9 . . . and W9RFA to be exact. That's dx for me and anyway the band sounded good, but lacked a lot of the old timers. Don't worry, they'll all be there. VK's are adding their approval to the idea . . . several G stations have OK'd it, and Ham Whyte, G6WY, is especially in favor of it. Ham thinks it such a good idea that he wants to make January an *80-meter* month. G6WY has done some good stuff on 80 but the furthest into W he has gone is W9NNZ. Last winter, on just one isolated test, G2PL heard W6CXW. He was rather weak but had they made further tests they might have had some good contacts. G6RB has worked a W7 on 80. Anyway, if enough of you fellows want to take a whirl at this 80-meter dx stuff, let's hear about it and I'll give it a good plug next month.

Getting back to 40 and for the benefit of those who have tuned in late, December is the month we are going to concentrate on 40 meters to see if the band has really folded up or if it just lacks the dx stations to make it worth while. Let's all of us pass the word around to the boys we work to get on 40 in December. In the meantime, if any of you do any good dx on 7 Mc. let's hear about it. Get out those 40-meter tank coils, save up on a little sleep and fix up that antenna. W6CXW will be there, W6GRL, CUH, FZY, ADP, HX, FZL, BAX, LYM, W7AMX, W8BTI, W8ZY, W9ARL, W9RFA, W1JPE, W1FH, W2BJ, W4DHZ, W1BUX and plenty of others that would take pages to fill. What d'ya say gang . . . "I'll see you on 40 in December."

Something New

This month we are starting something new in this department. It is simply this; instead of showing the frequencies and tone after a dx station worked by some other dx man, I am going to compile a list of these stations and show their frequencies and tone, in a table similar to those in this column last month for the phone men. This table or list will be made up from each man's contribution, so hereafter very few frequencies will appear in the regular text. This should be a help to the c.w. men in locating the approximate spot in the band of some dx station. Naturally, I would be interested in knowing from time to time if it is really a help to you—and if so it will be continued. While we're on this subject I'd like to ask that all of you, in sending in dx stations worked or heard, always to list their frequencies. In this way, it will be helping the whole gang. After

[*Continued on Page 96*]

YARN *of the* MONTH

●

"X"

They didn't call it QRN or QRM in "ye olden days" of the wireless craze; they didn't know what a "Q" signal was, nor did they have a law-administering body that told us what to do and how to do it. You'd call another operator and labor for hours at a time, trying to get a message through. And after the s'teenth request for a "repeat" you'd finally lose your temper and tell the fellow at the other end precisely what you thought of him.

Most of those who were engaged in wireless telegraphing in the olden days were the graduates or discharged employees of the land-line telegraph and railroad companies. They were men who wouldn't think of contaminating their stomachs with water; many of them couldn't telegraph worth a whoop until they'd first polished off at least a pint.

There are many who read RADIO who will recall the incidents which follow in this narrative. And it is to those readers that an appeal is made for fact-material to continue this series of almost-forgotten tales. "The Old Timer" will not divulge your identity, if you so prefer.*

"X" to me, in the olden days, was what you younger fellows of today commonly label "QRM," "QRN," or static, or interference of any kind. When we couldn't get through, either because of atmospheric or physical disturbances, etheral or alcoholic, we always had our alibi: "X"! The Morse operators who quit the land-lines and the railroads to get into wireless, also made good use of the letter "X"; for it, too, was the staunchest alibi they possessed while engaging themselves in the self-tutoring art of learning the Continental Code.

"X" was, therefore, our greatest friend and enemy. It died hard.

So let's confine our "X" in this narrative to the cruel trick that static played at a time when it should have known better . . . Christmas Eve, 1917.

It was at a time when the United States was engaged in the World War. Many of those who were previously in commercial wireless saw fit to join the forces of the army or navy in the capacity of wireless operators . . . better known as "electricians, radio," in navy parlance. They had a better name for them in the army, but I've forgotten what it was, because I chose the navy. I joined the U. S. Naval Reserve Force; rather I was put into it by somebody at a naval station who probably figured he could get rid of me easier after the war was over than if he'd chosen to sign me up in the regular navy instead. The U. S. Naval Reserve Force was the bane of the "regulars," and they made much of the word abbreviation "U.S.N.R.F." by interpreting it to mean: *"U Shall Never Reach France."*

I didn't.

I asked to be sent to the Atlantic, where I could roam the seas on a battle-wagon and come back home with a Congressional medal, or two, and the rear-ends of a few submarines in my suitcase as proof that I had done my share to win the war. Others who joined the U.S.N.R.F. at the same time as I, asked that they be sent to a more comfortable berth . . . Honolulu, for example. Those who asked to be sent to Honolulu were sent to the Atlantic Coast . . . those who asked to be sent to the Atlantic Coast were sent to Honolulu. Perhaps the man in charge of the Naval Intelligence Department figured that each of us had some definite reason for wanting to be sent to some definite location; so he turned the tables on all of us, and sent us to places decidedly in reverse to where we wanted to go.

Instead of gazing through the porthole of a battleship to watch the submarines go by, we found ourselves on dry land.

---

*Readers: Do you welcome this type of material in the pages of RADIO? Publication of additional true-to-life tales of this nature will become an occasional feature if a sufficient number of readers approve the plan.—EDITOR.

By "The Old Timer"

Six of us were shipped to Honolulu on a passenger liner—the old *"Sierra."* Two of our company were regular navy men, "electricians, radio." Four of us were former commercial "wireless" operators. We received $40.00 per month for our pay, and thus we had no edge on the navy wireless ops, who received far more from Uncle Sam than we were painfully paid by the commercial wireless "trust." And so it griped those regular navy men, because now we were on a par with them—were given the same rating as they, received the same pay. We were in the "outfit" for only a few hours, they for years. Why shouldn't it gripe a "regular"? Those navy men secured a better understanding of us "outsiders" before the ship reached Honolulu, and we all became fast friends.

When we reached Honolulu we had our first inkling of what we had to fight—"X"—that static thing, again! They have a choice grade of static down there in the Islands. A persistent kind of "X" that stays with you like a brother.

The navy officials were kind to us upon arrival. They gave us the first night off. We took the "Toonerville Trolley" to the Beach at Waikiki. We rode the trolley over the washboard rails for a few hours, or less, and the conductor ordered: "end of the line." We got off and strolled to the water's edge. We wanted to see the Beach at Waikiki. So we asked a native how to get to the Beach. "You're standing on the beach now," he said. And six brave wireless operators had all they could do to keep from committing suicide, upon finding that the famed Beach at Waikiki was no more an imposing sight than the fish-pool in mother's back yard.

The hard-boiled sailor who handed our clothing to us, later, at the Navy Yard brings back other memories of sweet Hawaii. We received the usual assortment of navy clothing. The fellow who handed the adornments to us was quite proficient in his work. He could guess at the size of lid you wore (or were); he could tell from a glance just what size sox and ten-pound navy shoes you'd wear. So he'd pass you a pair of regulation shoes. You'd put 'em on. "Too big," you'd say. "Wash 'em; they'll shrink," he'd reply. Then you'd try on your cap. "Too small," you'd say. "Wash it, it'll stretch," was his comeback. Everything worked both ways with him. Everything came out in the wash.

The six of us buddies who made that trip together comprised the following: Cooper, McCarthy, Hatch, Stirling, Dewing and the writer of this yarn. If you want to know the identity, ask any of the foregoing five. Some of us were crack operators, the others were only cracked.

Within a short time we were assigned to duty. The navy had taken over the commercial wireless stations of the then Marconi Wireless Telegraph Co. and the Inter-Island stations of the Mutual Telephone Co. The old Federal Telegraph Company's arc station at Heeia (KHX) was also gobbled-up in the wartime madness.

I was sent to the ex-Marconi station at a place fenced-off from the wilderness and named Kahuku, where stood a score or more of iron sticks which performed yeoman service in holding up about a mile of stranded phosphor-bronze antenna wire so as to enable the high-power 500-kw. spark transmitter to play a tune on something above 2,000 meters, right where the static found its choicest nesting place.

We had schedules with another ex-Marconi station 'way over in the sea-gull infested fields of Bolinas, California. And we also had a regular schedule with JJC in Japan. We'd receive the traffic and trash from Bolinas, and then relay it along to Japan, dropping off such portions of it as was intended for the unfortunates in the Hawaiian Islands proper.

We handled this traffic when the static permitted. And the "X" down there was *terrible!* You could actually see the lightning collect on the antenna wire, roll along the wire and shape itself into a ball; then the ball of fire would roll down the antenna lead-in and butt its nose smack against the concrete wall of the big power house and blow up (not the power house —the ball of static).

You could actually hear the static coming, or a static storm, I should say. It would begin rather faintly, then increase in intensity and regularity, until you heard nothing but a continuous, deafening roar that made a snare-drum outfit sound like crickets with sore throats in comparison.

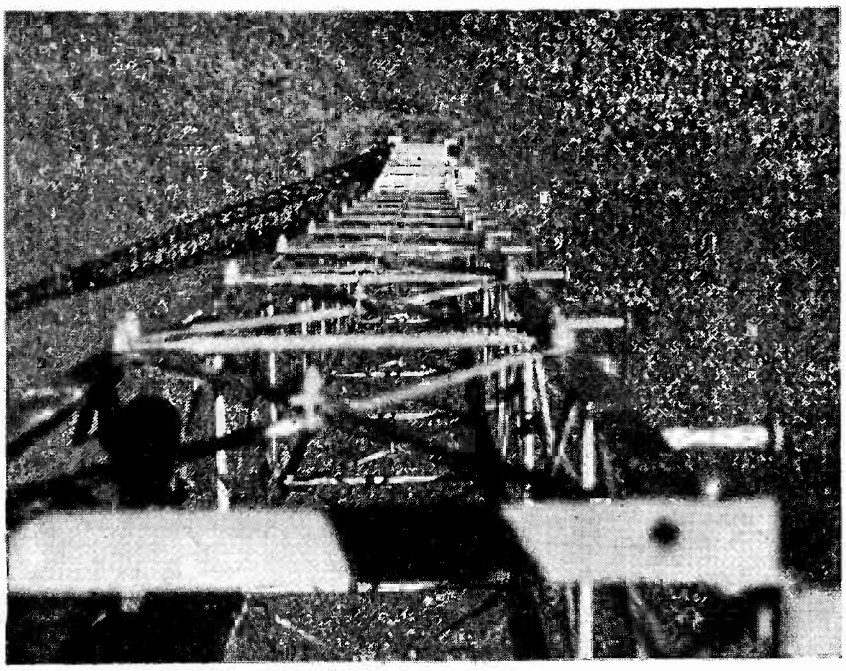
A few days of fighting this maddening blast of static was enough to put all but the best of operators in the mad-house. I went!

I believe the Bolinas station had something like 300 or 500 kilowatts of spark-gap wireless

[*Continued on Page 93*]

POSTSCRIPTS...

and Announcements



DOWN-N-N . . . . . .

• W7GDV, L. E. Randle, who works at KMED, Medford, Oregon, between contacts, remarks that he has grown tired of seeing antenna towers photographed from the ground looking up. Just to be different, he took this one the hard way—from the top of KMED's 183-foot vertical looking down at the base.

The photograph has interest, also, because the shadow of the tower, as it can be seen on the ground, shows the radiators' true shape contrasted with the distorted perspective of the direct image.

Stamp-Collecting Hams

After our reminder last month on page 95 of Radio, the stamp-collecting hams have been responding enthusiastically to our query: Do you collect stamps?

Here are a few who are duo hobbists:

Irving C. Grabo, W2AEB, 129 Midland Avenue, Glen Ridge, N. J.—collects U. S. and British Colonial stamps. He says he welcomes correspondents interested in exchanging stamps.

Clarence Seid, W2CCD-W2KW, 25 Willoughby Street, Brooklyn, N. Y.—specializes in U. S., Hongkong, and British-American stamps.

J. W. Scrivener, W3EXI, 5208 North Washington Blvd., Arlington, Va.—writes that he has been exchanging stamps with PY1AZ and RY5II. He would like to swap uncancelled U. S. stamps for other countries. He'll also send first day mailings.

•

We Apologize

Lloyd Jones has just called us and asked that we please insert an erratum notice in connection with the 56 Mc. superheterodyne as described by him in the May, 1937, issue of Radio. It was only a little mistake in the circuit diagram, but those little ones can make quite a difference in the operation of the set (and in the number of letters received by Lloyd). Here it is. The condenser C_2 in the circuit diagram of the aforementioned set should by-pass the first cathode of the 6H6 to ground instead of jumping over it. Also, it should *not* continue over to the junction of R_6 and R_7, the lead from C_2 should just go to the cathode and end there.

•

Next Month

Don't forget—next month Radio will offer its annual 200-page issue . . . packed full of technical information, features, news, and photographs.

You Mathematicians

We regret to state that there was a slight typographical error made in one of the derivations given in the appendix of the article "Adjusting the Horizontal Rhombic" by Morton E. Moore and F. L. Johnson in the November Radio.

It wasn't a very large one, but it did rather change the meaning of the whole derivation. It was just the insertion of the "not" in the expression "If α is equal to zero:", making it read "If α is not equal to zero:", in the derivation of equation (2) on page 91. Of course the former statement is correct; were α not equal to zero, the effective resistance of the line would not be zero, an additional reactance would be introduced, and equation (2), with the circular functions, could not be arrived at.

•

You Photographers

The photograph at the head of the Departments page, VE3QK measuring the voltage at the base of VE3WX's vertical, was taken by VE3RO with on Argus Model A. A 2x filter was used as it was 2:30 in the afternoon and the camera was more-or-less pointed at the sky. Exposure, 1/25 at f5.6 on Eastman Panatomic film.

•

There is no English word that uses each of the dot letters without repetition. The German word for see, *sieh,* does.

56 Mc. . . .

Dx Affected

By ELMER H. CONKLIN,* W9FM

As expected, the sporadic-E layer type of five meter dx over a path of 500 to 1100 miles has practically disappeared with the coming of autumn. On September 19 there was a report of a New England station, W1SS, hearing a modulated code station copied as signing W9MB, but the latter wasn't on the air that day and is not using 56 Mc. The call may have been in error. However, on September 13, W1EFN operating from Mt. Greyback heard W9CLH in Elgin, Illinois.

There have been numerous reports on the east coast covering two-way work up to 330 miles or so, apparently by low-atmosphere bending, but since the early days of five meter work, practically nothing of this sort has been done in the middle west. Lately, however, W9CLH in Elgin, Illinois, has been able to make some contacts with W8CVQ in Kalamazoo, Michigan (in August and September), and has been heard regularly at several points in Michigan. Sometimes the signals are so weak that modulation cannot be heard, but by resorting to code and to receivers that can copy c.w., communication has been carried on. On September 6, W8KAY in Akron, Ohio (330 miles airline, approximately), heard W9CLH from 7:45 to 9:10 p.m. with an R4-5 signal. On September 9, David Naylor of Cincinnati wrote to W9CLH reporting reception, but didn't keep an exact record of the date. It may have been on the 6th or as late as the 8th, at 8 to 10 p.m. This is another good piece of dx of this type. Both reports give evidence of having taken place via low-atmosphere bending rather than by ionosphere skip, the distance being rather short for the latter. W8KAY said that the signals were not fluctuating much, changing only slowly compared with the sharper fades on his reception of W5EHM and others.

Reception via the ionosphere over distances as short as 500-650 miles is not as common as over 900-1100 miles. One such report came from W8PTG in Springfield, Ohio. On August 18 when W9CLH was heard in New York, W8PTG at 4:20 p.m. Eastern time heard W1KLT; then a station in New York City (500 miles) was heard, using the name Marvin, but the call was not copied. At 4:52, W1BBM operating portable-mobile was heard.

In the review of the summer dx in the October issue of RADIO, we mentioned a report by two Kansas City stations hearing a call like W8CWH, and hearing a station signing W5FHT (who is in Beaumont, Texas) replying to the effect that the other operator's name is Al Burgess in Edwardsville, N.Y. No doubt there is some mistake in the call because Alan Burgess whose call is W8CWH and who lives in Syracuse rather than Edwardsville, N.Y., hasn't been on five meters lately. However, W5FHT was not heard to be calling the other station thought to be W8CWH. But on the whole, we are surprised at the relatively few reports so far received that have not been confirmed. We still need some data from some bashful hams.

E. H. Swain, G2HG, has been in on some more dx. On September 5 he heard F8CT on 56 Mc. apparently working 28 Mc. stations. A QSO on "ten" followed, and F8CT switched off his 28 Mc. transmitter, continuing the contact with the five meter transmitter, cross-band.

Beacon Transmitters

Several stations have accepted our suggestion to put an automatically keyed low power transmitter on the air almost continuously, so that when the five meter band does open, there will be someone to hear. As these stations get into actual operation, we shall give the complete data. More such transmitters are needed, but in the meantime we like W3EZM's suggestion. Newbold asks that we give the exact frequency of medium and high power 56 Mc. crystal controlled transmitters. We shall be glad to publish frequencies of *all* automatically keyed transmitters, and those crystal controlled stations that give us the data. Here is a start:

W6OFU	Jerome, Arizona	56.8 Mc.
W3EZM	Langhorne, Pa.	58.32 Mc.
W9CLH	Elgin, Illinois	56.58 Mc.
W9DN	Portable—Illinois	56.70 Mc.
W9TXU	Chicago, Illinois	56.92 Mc.
W9UAQ	Oak Park, Illinois	56.58 Mc.
W8CVQ	Kalamazoo, Michigan	58.15 Mc.
W8CVR	Marshall, Michigan	58.00 Mc.

[*Continued on Page 96*]

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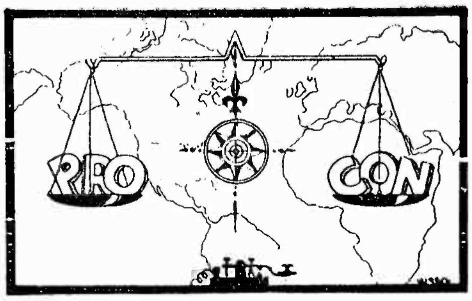
*Associate Editor, RADIO.

The . . . OPEN FORUM



Stop and Think

Marblehead, Mass.

Sirs:

All I want is to ask one question, and that is:

How many of you birds that are always making such a fuss over QRM have been on the air long enough to remember when the best ham shacks (with a few exceptions, of course) were using homemade regenerative receivers, such as the Schnell, when most of the signals on the air were self-excited, near d.c. notes?

Just stop and compare this to the present setup. Today, even the newcomer has a superheterodyne receiver and crystal controlled rig with all the meters and power supplies necessary to make his rig tops. What wouldn't I have given to have been able to buy a 1500-volt transformer for less than ten dollars or a superhet for under one hundred dollars.

Just imagine what this would have meant to the old timer who had to put up with receivers as broad as barn doors and signals that covered anywhere from twenty to forty k.c., depending on the amount of money a fellow could afford to spend on filter condensers which were selling for something like ten or twelve dollars each—2μfd., 2000v.—enough to take the wind out of the best man's sails. And today we're using receivers with one and two kc. selectivity and crystals that make the side band of transmitted signals three kc. or thereabouts wide even on forty and twenty meters.

I've been on the air for seven years and I know from experience. I've gone from a Schnell to T. R. F. and then to a super single signal receiver—from five watts on a 201-A tube to three or four hundred watts today, and I wouldn't trade today with its modern equipment even for the small number of hams that there may have been in 1930. Ask the old timer if I'm not correct. Ask him if he ever paid nine dollars for an old type-10 tube which might give you 375 volts and 7½ watts rating, provided you were really in earnest and your rig was running just about perfect after three or four weeks getting an antenna that would work as well as a Zepp could work.

So you fellows that think about QRM so much, just stop and consider some of these things the next time your QSO with some local stations is busted up by another local sitting on his key. Maybe you'll begin to realize that the other fellow isn't such a big puddle to jump after all.

H. U. OHM, W1DIA.

●

Buckle Down

Omaha, Nebraska

Sirs:

After reading Mr. Wellar's letter on the trials of learning the International Code, I decided to put in a word.

Before knowing *any* code I felt as did Mr. Wellar. I was thoroughly disgusted with learning such balderdash, but as I later learned, the only way any person can be an amateur is to buckle down and *learn* that code. I have been listening to code for about three weeks and am ready to take my examination when time permits.

The only trouble that is involved is the fact that a person usually has to appear in some other city or town and this involves a great deal of unnecessary time. With a city as large as Omaha, I don't see the reason an examination point can't be established in Omaha. If you can give me a reasonable explanation, would you kindly do so.

Also, Mr. Wellar, try a little bit more and you'll be able to read code as well as send.

STANLEY GERBER.

●

Speaking of radio names, we came across a *Phil Coe* in Cleveland.

●

Common to most of the early newsstand pictures of radio was the scene with listeners enjoying both headphones and speaker at the same time and with the same set. We can't say, however, that we ever saw listening done in that fashion in any period.

●

At one time it was unlawful for some manufacturers to sell tubes for use as detectors, but perfectly OK to peddle them around for amplifying purposes.

NEW BOOKS

AND REVIEWS of CATALOGS

[Books submitted to the Review Editor will be carefully considered for review in these columns, but without obligation. Those considered suitable to its field will also be reviewed in RADIO DIGEST.*]*

AUTOMATIC FREQUENCY CONTROL SYSTEMS, John F. Rider. Published by John F. Rider, Publisher, 1440 Broadway, New York City, N. Y. 142 pages; illustrated; $1.00 in U.S.A.

A.F.C. systems require a rather specialized method of treatment for their adjustment and alignment. In this book Mr. Rider completely analyzes their theory of operation and the correct procedure in their servicing.

The book is divided into six main divisions: General review, the discriminator, the oscillator control circuit, commercial a.f.c. circuits, aligning a.f.c. circuits, and servicing a.f.c. systems. Ample information is given to allow the receiver-design engineer to employ the system in new receivers or to assist the service engineer in the proper adjustment of existing receivers incorporating the system.

●

TELEVISION, VOLUME II. Published by RCA Institutes Technical Press, 75 Varick Street, New York, N. Y. 435 pages, printed in U.S.A., available from the publishers.

"Collected addresses and papers on the future of the new art and its recent technical developments," to quote from the complete title of the work. The book is a compilation of some 29 recently published works and papers of the RCA Manufacturing Company concerning television itself and the various factors associated with the art.

●

TUBE COMPLEMENT BOOK. Published by Hygrade Sylvania Corporation, Sylvania Radio Tube Division, Emporium, Pennsylvania. 165 pages, 4½" by 9", $0.25 in U.S.A.

A new-type reference book, pocket size, for the service man. Tube complements are given on over 10,000 radio receivers, i.f. frequencies for those that are superhets and information on tube replacements for all receivers from early models to the 1938 sets. Other additional information on sets, their manufacturers, and the addresses of the manufacturers is given.

●

ADVANCED DISC RECORDING. 30 pages, 3½"x6½". Published by Universal Microphone Co., Ltd., Centinela at Warren Lane, Inglewood, Calif. Illustrated, price, $0.10.

A rather small book but it gives a quite comprehensive practical treatment of the subject at hand. The various types of recording blanks are discussed with the proper mode of treatment for each. Recording heads are taken up as are recording styli, motors, amplifiers, cutting angle, and reproducing equipment. All the information that might be required to assist in the proper making of home recording is given in this condensed but complete work.

EXPERIMENTAL RADIO, R. R. Ramsey. Fourth edition, 196 pages, 6"x9". Published by Ramsey Publishing Company, Bloomington, Indiana.

A laboratory manual of 132 experiments in the field of practical radio. Designed for the use of second-year college students as an adjunct to a standard textbook.

●

The success of the standard 6-volt series of Mallory Vibrapacks has resulted in an insistent demand for a 12-volt vibrator power supply to be used on airplanes, busses and motor boats for powering radio transmitters, receivers, direction finding equipment and other scientific apparatus. Mallory has announced such a unit; its drain is just about half that of the 6-volt supply.

A technical data sheet on Mallory Vibrapacks, called "Perfect Portable Power" may be obtained without charge from any Mallory-Yaxley distributor, or from the factory in Indianapolis, Ind.

●

The "Plastic-Sealed" line of radio transformers introduced by the Jefferson Electric Company has been expanded to include audio, input, output and interstage transformers and chokes. A complete listing of the various transformers which are manufactured in the "Plastic-Sealed" style can be obtained by writing direct to the Jefferson Electric Company, Bellwood, Illinois.

Question Box

In tuning antennae with a number of half-waves in phase by means of ¼-wave and ¾-wave phasing sections, it seems that the point of resonance (as found by the shorting bar) becomes increasingly sharp as the spacing is decreased between the wires of the phasing section. I have tried a number of different values of spacing, the smallest always giving the sharpest indication.

Is this a normal condition? Will too great or too little spacing impair the operation of the system?

It appears that with the closer spacing of the two wires, the resonance point occurs at such a position as to make the matching stub slightly shorter than with the wider spacing. This seems to be an indication of a higher C/L ratio. Would this account for the sharper resonance point?

●

To answer your questions in order of presentation, first, this is a natural condition. If you will refer to the article in the November RADIO by Mr. Robert M. Whitmer, the reason will probably become apparent.

The surge impedance of the matching line is the geometric mean between that of the antenna end and that of the shorting-bar end. The terminal impedance of the antenna end will remain substantially constant regardless of any variation in the spacing of the matching stub. Consequently, as the spacing of this line is varied, its impedance is also varied, and the

[*Continued on Page 93*]

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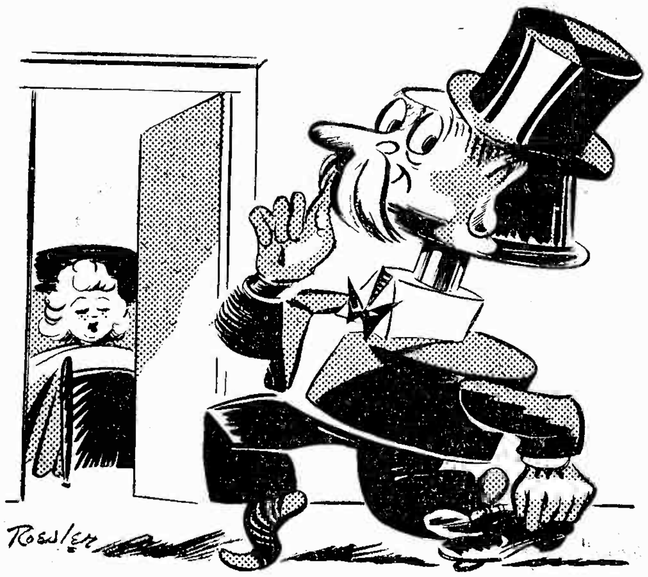
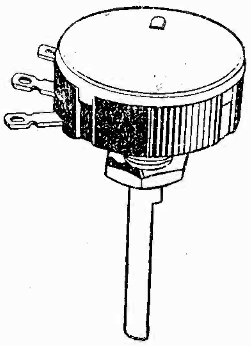




Phone and C. W. . . . 500 Watts

[*Continued from Page 54*]

operating into about a 10,000-ohm load, they will have an output of about 225 watts at 1250 volts. This is more than ample to modulate fully the T-125's in the final at 540 watts. As a matter of fact, there is ample power output to modulate fully the final stage with sine-wave audio. Since the power requirements of speech audio are somewhat less, the 203Z's do not have to be driven to full output on voice. Actually, 100% modulation can be obtained with the plate milliammeter on the modulators kicking to about 200 ma. on speech peaks.

To take full advantage of the peak compression as it has been incorporated in the speech amplifier, a constant-tone input should be applied to the speech system and, with the compression control backed off to minimum action, the gain on the speech or on the source-of-tone should be adjusted until the transmitter is being modulated 75% to 80%. Then, the compression control should be advanced until the point is reached where a slight increase in its setting will reduce the modulation percentage. Thus the compression has been adjusted so that the action will begin to take place at approximately 75% modulation. Peaks of modulation above this percentage will be reduced in proportion to their strength.

The Power Supplies

Five power supplies are used on this transmitter: the grid-bias supply for the final on the final deck; the plate supply for the Bi-Push, mounted on the exciter deck; the speech-amplifier plate supply, built into the speech; and the modulator and final amplifier plate supplies, separately built and mounted one above the other at the bottom of the cabinet.

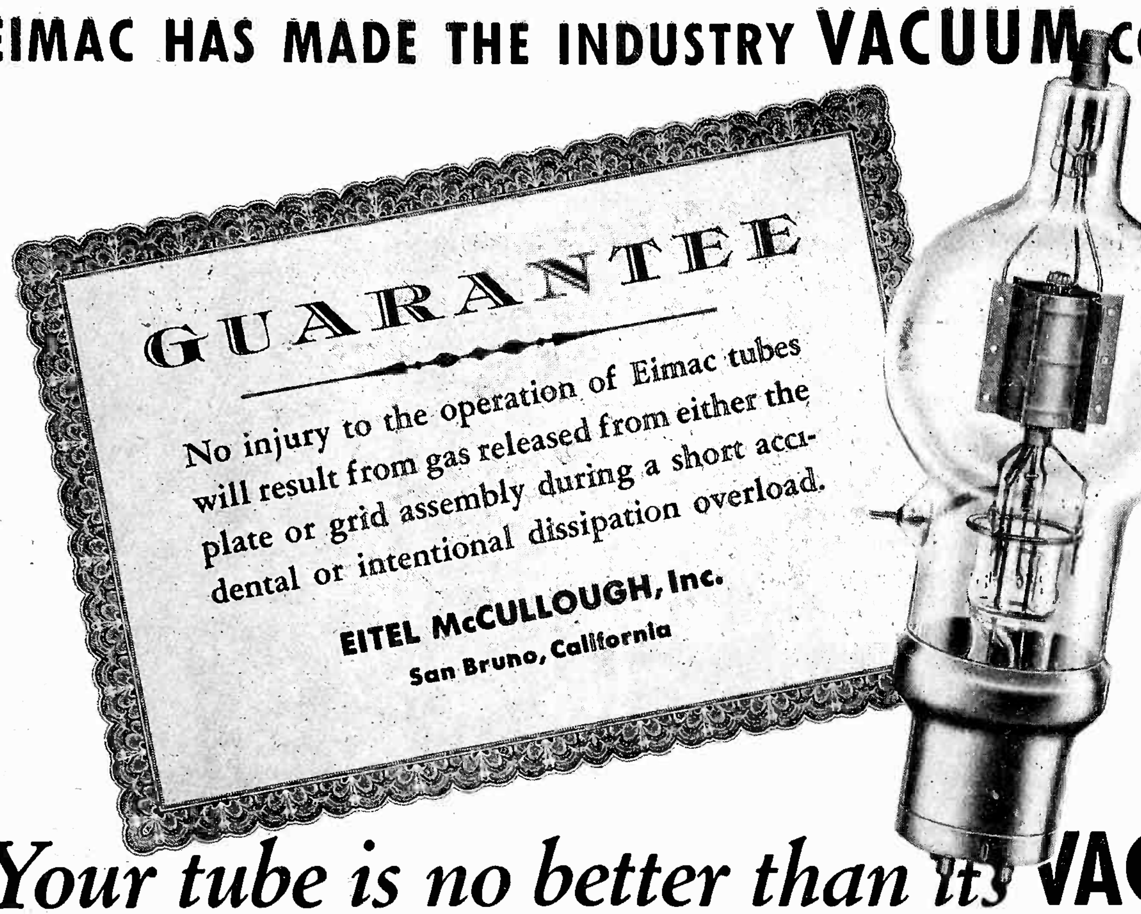
These two power supplies are entirely separate from each other so that when c.w. is used, the one for the modulator may be removed from the line. Both use a pair of 866's as rectifiers and choke input filters.

The final-amplifier supply is adequately filtered by a heavy input choke, a husky filter choke, and 8 μfd. of 2000 volt condensers (4 μfd. each side of the filter choke). This supply must be amply filtered since any variation in supply voltage will be applied to the carrier as hum modulation.

The modulator supply, however, does not require so much filter. Since any reasonable variation in supply voltage is applied to both tubes at the same time, it is cancelled out in the secondary of the output transformer. How-

[*Continued on Page 79*]

EIMAC HAS MADE THE INDUSTRY VACUUM CONSCIOUS



GUARANTEE

No injury to the operation of Eimac tubes will result from gas released from either the plate or grid assembly during a short accidental or intentional dissipation overload.

EITEL McCULLOUGH, Inc.
San Bruno, California

EIMAC
250TH

Your tube is no better than its VACUUM!

Long filament life . . . uniformity of characteristics . . . outstanding performance and *Complete Freedom from Failure Caused by Gas* depend entirely upon one important factor . . . *Vacuum.*

Obviously the material of which the elements are fabricated has a direct bearing on vacuum. Eimac uses Tantalum because this material has a very low initial gas content, and when properly handled can be completely degassed. Gas content of Tantalum is but 1/10 that of molybdenum and only 1/1000 that of conventional carbon anode. While Tantalum has many advantages, its use alone does not necessarily produce a better tube. This material requires expert handling to get full advantage from its peculiar properties. Eimac engineers developed an exclusive process (patent pending) for the fabrication and exhaust of their tubes. That's why Eimac tubes are guaranteed never to fail because of gas released internally.

Eimac disproves the popular fallacy that anode temperature affects emission. In conventional tubes, high anode temperature releases gas that should have been removed in the original exhaust. This gas is what affects . . . or poisons . . . filament emission. The temperature of the anode in an Eimac tube will never affect filament emission because the gas has been properly removed. Eimac tubes are conservatively rated as to plate dissipation. Momentary overloads of 400% to 600% which is sufficient to cause the anode to become incandescent will positively not release gas.

Ceramics as used for vacuum tube insulators are incapable of complete evacuation and therefore are a potential source of gas. Since Eimac tubes have no internal insulators this source of gas is entirely eliminated. The proper use of Tantalum . . . the elimination of all internal insulators . . . plus a severe exhaust on high speed diffusion and oil pumps, produces a better and more dependable vacuum than can possibly be obtained by the use of a chemical agent or "getter." Eimac uses no "getter."

Try Eimac Tubes in your transmitter and you'll agree that the use of the more expensive materials, the long severe exhaust and the unique construction produce outstanding results.

Eimac TUBES

EITEL & McCULLOUGH, INC. • San Bruno, California

Rotary "Flat-Top" Beam Antennas

[*Continued from Page 16*]

running from the gondola pole to the telephone pole, are used to erect the gondola and its pole. A pair of yokes clamp the gondola pole to the telephone pole when the former is upright. To hold the top of the gondola pole, which extends many feet above the telephone pole, four rope guys are used (3/8 to 1/2 diameter manila, soaked in linseed oil).

At the top, these are connected to the pipe framework shown in figure 5. This outrigger framework is off-set from the pole so that the gondola can be turned through about 220 degrees before the feeders strike the pipe. 180 degrees would be sufficient, but the extra angle is often handy. The horizontal part of the guy rope frame is made of 3/4 inch pipe with 3/4 inch solid shafting inside. The angle braces are of 3/8 inch pipe. When the photograph of figure 6 was taken these braces had not been added.

One use for the gondola which was not foreseen is that of a bird roost. Almost 100 birds have been observed sitting on the structure at one time.

The 60-Foot Rotary

This structure, which was the one actually used first, is shown to good advantage in figure 9. This view, taken from below, shows the type of construction used. The drive and general construction are the same as for the 30-foot gondola. The center 30 feet of the 60 footer are of white pine construction. Bamboo outriggers extend out 14 feet from each end of the center portion. The overall dimensions are about 57 feet long by about 9 feet wide. The center portion is 3 feet high at the middle and the flat-top is 5 feet above the top of this center portion. In spite of its size, the 60-foot gondola weighs only a bit in excess of 100 pounds.

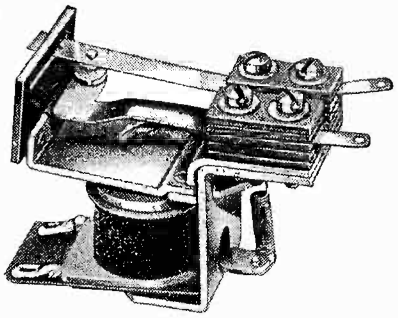
Due to its large "wing spread", it seemed advisable to provide means for holding it in place when not in use and not to rely entirely on the gear and worm. This was done by two ropes fastened at one end of the center portion. Feeding was by a two-wire line spaced 6 inches, the same as the smaller rotary. As used on 14 Mc., the line alongside the pole acted as a three-quarter wave stub, terminating in a short a few feet above the ground. A 600 ohm line connected on about two feet above the short.

Performance

Both antennas were operated on 14 Mc. and excellent results were obtained. The 60-footer performed exceptionally well and the 30-footer almost as effectively.

On rotating the antennas through 90 degrees, a large change in signal strength is observed.

[*Continued on Page 80*]



Phone and C. W. . . . 500 Watts

[*Continued from Page 76*]

ever, since each tube is operating individually (over each half of the audio cycle) it is important that the output capacity of the plate supply be large so that it will furnish a low-impedance return for the audio voltage and so that it will be able to hold the plate supply voltage up between audio half cycle. For these two above reasons the modulator power supply consists of a large swinging choke and a 8 µufd. filter condenser across the output of the supply.

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R. F. . . . By the Pan-Full

[*Continued from Page 47*]

wound so that they tune with comparatively low capacity. This makes possible considerable change in frequency before necessitating retuning of the plate circuits. Remember—when a variable-frequency crystal is used the L/C ratio of the tuned circuits must be high enough so that retuning will not be required. The best procedure is to set the crystal in the middle of its range and tune up at this frequency. Then there will be only half the frequency change with respect to the original frequency.

Operation

As to operation, this unit is capable of giving all that could be desired. The unit can be run as a complete transmitter either for phone or c.w. or as an exciter. With the plate tank condenser as indicated in the diagram, the 35T may be plate modulated at 150 watts input (1000 volts at 150 ma.). On c.w. it may be loaded up to 225 to 250 watts input with 1250 to 1500 volts on the plate of the 35T.

When operating as an exciter (and that is what it originally was designed for) the unit will give ample excitation for a 750-watt to 1-kw. final. The particular final used by the writer has a pair of Taylor T-125's with about 800 watts input. Ample excitation is secured on all bands.

Rotary "Flat-Top" Beam Antennas

[*Continued from Page 78*]

Figure 10 shows the field strength variations in the horizontal plane for the 60-foot rotary. The small circles indicate experimental points, obtained with a calibrated field strength meter[4] using a horizontal pick-up antenna, and located 5 wavelengths distant (about 330 feet). A decibel plot is used since this gives a picture corresponding more nearly to the ear response.

When the plot is made in terms of linear field strength, the beam appears much sharper. From the plot it is seen that the signal is very good over an angle of about 60 degrees. The signal is down only a little more than 3 db at this angle (30 degrees from the center of the beam). The signal is equal to or better than that from a single half wave antenna as far out as 40 degrees from the center of the beam. Beyond 30 or 40 degrees the signal drops off rapidly and reaches a "null" at about 70 degrees. The null is quite pronounced, being over 25 db down. This means that the maximum to minimum or front-to-side power ratio of the antenna is over 300 to 1.

The plot of figure 9 checks well with reports received from stations, both dx and nearby. Distant stations reported very large changes in signal as the flat-top was turned through 90 degrees. These tests were made on 14 Mc. phone and the position of the antenna was reported as the antenna was rotated. Stations often reported that the signals disappeared entirely when the flat-top was turned end on. Typical of dx reports on the rotation test is the following received from VK4JU (Brisbane, Australia): 0° (broadside) R9+; 10°, 20° and 30° no change; 40°, R6 to 7; 50°, R5; 60°, R3; 70°, R1; and beyond 70° the signal disappeared. The signal was observed to build up in the same way as the rotary was swung back to the 0° position.

The field pattern for the 30-foot rotary is much like that of figure 10. The pattern is a bit broader, and the "nose" is 2 or 3 decibels down from that of the 60-footer. The observed maximum to minimum or front-to-side ratio is over 23 db or a power ratio of more than 200 to 1. The pronounced null indicates that the feed system must radiate very little.

Since the pattern of the rotaries is bi-directional they do not aid, when receiving, in reducing the interference coming from stations in the back direction. The high front-to-side ratio is very effective, however, in reducing interference from stations at right angles to the beam. It is also possible to separate stations using the same frequency when the directions differ by only 30 or 40 degrees. For example, the beam may be pointed due east for "on-the-

[*Continued on Page 88*]

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[4] "Directive Antenna Systems," J. D. Kraus, R/9, June, 1935, p. 10.

". . . pair of 808's"

[*Continued from Page 36*]

circuit jack that can be seen in the center front of the chassis.

"Note that the plate leads to the 808's are made of 3/8" copper ribbon, 1/32" thick. The leads are soldered to the grid clips to take care of the high circulating current that flows when operating at these frequencies. This type of lead solved quite a problem—that of getting away from the usual copper braid, in which losses are quite high at ten meters, and still providing a lead with sufficient flexibility to prevent the possibility of producing strains in the glass of the tubes.

"The exciter that is being used with the amplifier consists of an 802 tritet, doubling from a 40-meter crystal, an 802 doubler to ten meters and push-pull 801's in the buffer stage."

There it is—should it be desired to operate the rig on other bands, the coil turns can very easily be calculated by noting the number required for operation on 28 Mc.—8 turns, 1½" dia. and about 4" long for the plate and 6 turns, 1¾" dia., 3½" long for the grid circuit.

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Portable A.C. Power Supplies

[*Continued from Page 34*]

perienced. We have seen several "California Kilowatts" which caused a far greater drop than this on house circuits. As a matter of curiosity, we put a meter on the local mains and discovered the voltage ran from 105 up to 135 volts throughout the day.

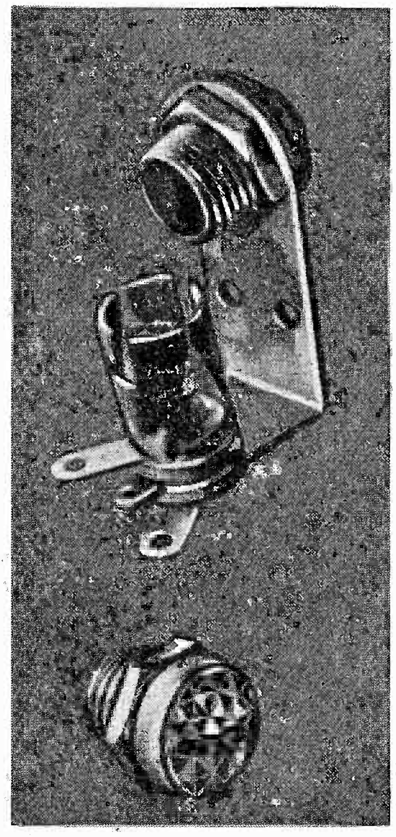
To allow time for the residual magnetism to build up, do not connect the load until the motor has come up to normal speed.

Eliminating Interference

When operating in the field, the plant should be set up 50 to 100 feet from the receiving location to minimize both electrical and mechanical interference. Although the small muffler attached to the engine is very efficient, it still makes considerable noise.

The amount of electrical interference is dependent on the sensitivity of the receiver used. It may be caused by the engine ignition system or by sparking at either the d.c. commutator, the a.c. collector rings or both. But probably the majority will be from the ignition system. Occasionally an ordinary auto type suppressor on the plug will eliminate the trouble. If not, the spark plug cable must be shielded and a shield placed over the plug so as to form a continuous ground from the magneto to the plug

[*Continued on Page 89*]



Ground Systems for Efficiency

[*Continued from Page 17*]

ground wires, and for other types of ground systems, using 0.2 watts of power and measuring the field intensity at 0.3 miles.

Three wire sizes were tested in the radials, no. 2, no. 8, and no. 14, without appreciable difference. Apparently, small wire can be used in a properly designed system to limit copper costs.

When only 2 wires separated 180° were used, the resistance was independent of the length, inasmuch as the current vanished from the wires within a few feet of the antenna—demonstrating that if there are few wires in the ground system, there is no point in having great length. Using only 15 buried wires, it was found that little current was flowing in them at distances greater than 90 feet (0.274 wavelength).

With 113 wires 135 feet long (0.411 wavelength) the system was nearly perfect. The short antenna (1/16 wavelength) gave a measured field strength only 8.5% less than the long antenna (99°, slightly greater than a quarter wavelength). With 90-foot radials, more than 15 wires did little good, though 2 wires were much worse than the 15.

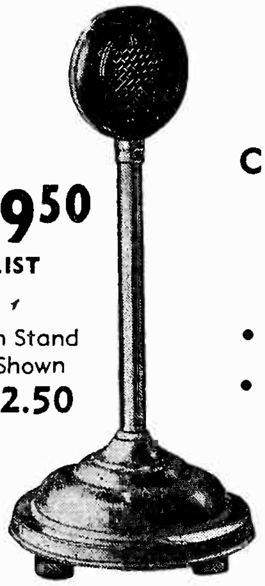
A square of copper screen nine feet on a side was placed on the ground beneath the antenna. There was no improvement when 113 buried wires were used, but there was a substantial difference when only 15 wires were used. If a satisfactory radial ground system is not employed, therefore, the screen idea should be given serious consideration as a means to reduce losses.

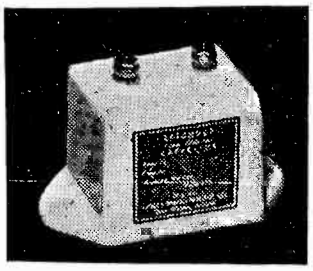
Another test was made with eight radial wires 135 feet long, laid on the surface and terminated in rods driven into the ground. This is a type of ground system often used with portable transmitters in testing possible sites for broadcast transmitters. This system was about the same as for an equal number of buried wires.

It is felt that vertical antennas 1/8 wavelength long are practically as good as quarter-wavelength antennas, if a proper ground system is employed. For any vertical antenna, 120 buried wires one-half-wavelength long are desirable. With the 1/8 wavelength system, of course, a coupling system at the base would be necessary unless some form of top-loading were employed to bring the current loop to the base.

On 80 and 160 meters, where much of the communication (particularly low power) is done within the "ground-wave" range, a good ground system can be quite beneficial. The cost is probably greater than for increasing the power enough to make up for the loss in the case of a very small transmitter, but is justifiable for a medium or high power rig.

Where a good radial ground system is not used, a "screen" on the ground at the base of the antenna is helpful. A large number of short radial wires might be used instead of a screen, but this should not be considered an entirely satisfactory ground system, particularly where the antenna does not extend upward a quarter-wavelength or more.





Audio Transformer Characteristics

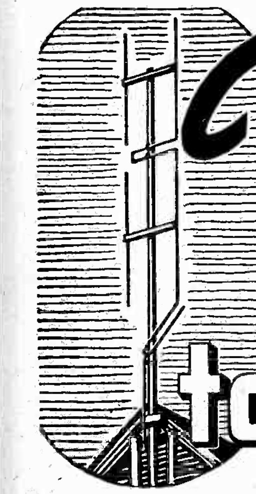
[*Continued from Page 22*]

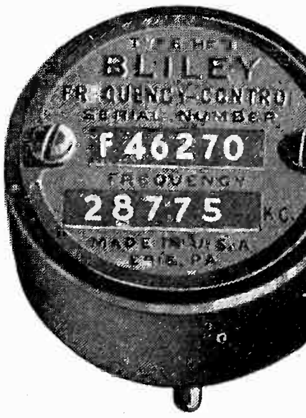
tain facts and precautions that apply to any installation and they should be kept in mind. The audio transformer is essentially an impedance adjusting device. As such, its constant must necessarily be varied according to the needs of the specific circuit. There is, nevertheless, a certain amount of leeway in the value of the constants which is often disregarded. The loss due to a mismatch in impedance between a tube and its load is shown in figure 7. This curve holds when greatest power transfer occurs with $R = r_p$. For greatest undistorted power output, i.e. $R = 2r_p$, a similar curve applies. (See *Radio Engineering,* by Terman, page 165.) From figure 7 it is evident that between the values of one-half and twice the optimum, the loss is ten per cent or less. In the case of $R = 2r_p$, the curve indicates power transfer variation with practically constant percentage harmonic distortion. For example, an output transformer designer to work between a tube and a 500 ohm load could have the load value varied between 250 and 1000 ohms with not more than ten per cent power loss due to mismatch. The harmonic distortion, however, would vary.

In sound reproduction for talking pictures, it is current practice to mismatch the output stage to the voice coil as much as four to one. This provides electro-dynamic dampening without adding inertia to the moving parts. The result is to prevent over-drive on powerful bass notes.

For installations subject to abuse and manipulation by careless operators, the high silicon steel core is preferable. The nickel-iron alloy core must be handled carefully after as well as during manufacture.

Trouble may occasionally be encountered due to reversed or misplaced terminals, or a





faulty transformer diagram. A continuity meter will enable the technician to spot the various terminals. Sectionalized windings may be phased out by applying a low value of a.c. voltage from the light mains and checking for the series aiding connection with a high-impedance voltmeter.

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Improved System of Voltage Stabilization

[*Continued from Page 20*]

this one, under proper operating conditions, will show an internal resistance of from 10 to 40 ohms, an extremely worthwhile and quite a sizeable reduction.

This latter feature of the power supply makes it an excellent source of voltage for a class B or AB modulator or audio amplifier where amplitude distortion would not be tolerable. The large variations in current drain will have little effect on the output voltage of the power supply. Another use for such a power supply would be as a source of plate voltage for a d.c. amplifier. D.c. amplifiers are particularly critical as to plate voltage stability; any small variation in supply voltage will render such an amplifier almost useless. Heretofore, it was a foregone conclusion that a d.c. amplifier must be operated from a battery plate supply. With these new voltage stabilization systems it is possible to operate d.c. amplifiers of all but the highest gain from a stabilized a.c. operated plate supply.

Still another use is as a plate supply for a vacuum tube voltmeter. These, in that they can be taken as a type of d.c. amplifier, are also very critical as to supply voltage. They can, however, be operated from a properly designed stabilized power supply.

Quite complete design data for these power supplies were given in the August, 1937, QST. Mr. Grammer, in this article, describes the RCA circuit, the W.E. circuit, and an adaptation of them that eliminates the stabilizing B battery. A small neon bulb is substituted for this battery. Although the stability obtained is not quite as good as that with the original circuit, it will be satisfactory in a majority of cases.

The circuit shown herewith will work under all normal conditions and will be satisfactory where unusual stability is required.

•

LOCAL COLOR

A ham put a pile of dough into a transmitter, with the idea in mind of placing plenty of QRM on some of the locals. He bought a pair of high power bottles for the final and some high power modulators. He had difficulty in making the final work right, and said that the only way he could get the final to draw as much input as he wanted was to turn the plate tank condenser all the way out. Although he did work a few stations that way, he said the plates of the tubes were always bright red. Perhaps the manufacturers should encourage this practice as a stimulus to business!

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The wavelength of the shortest known cosmic ray is 600 trillion times shorter than the longest assigned radio wavelength.

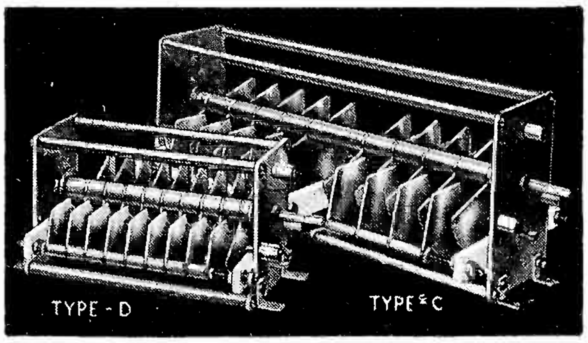
"Sparks" with the Tuna Clippers

[*Continued from Page 42*]

antennae and masts shot down. We kept silent for a couple of days but the suspense became too great and we opened up, using no calls, but calling each other by the operator's first names. In this way we even established communication with various U. S. land stations on the Pacific coast handling important traffic. The patrol boats spent a very busy couple of nights trying to keep those 15 tuna boats together. One night one of the patrol boats made a sudden turn and sped after a bright light on the horizon, probably thinking it was one of the clippers trying to escape. If a boat could look sheepish, this one did when it came back after discovering that the light was a star low on the horizon. We were released a few days later when it was found that there had been some kind of a mistake in Mexico City. Every one of the tuna clippers had a good load of fish aboard, representing close to $150,000 en toto, and the U. S. and Japanese consuls in Mexico City had been riding the Mexican authorities pretty hard.

Sea Cooks and Chow

The food on these boats varies greatly, being more or less dependent on the way it is handled by the cook. Fortunately on the "Northwestern," we have one of the best cooks available

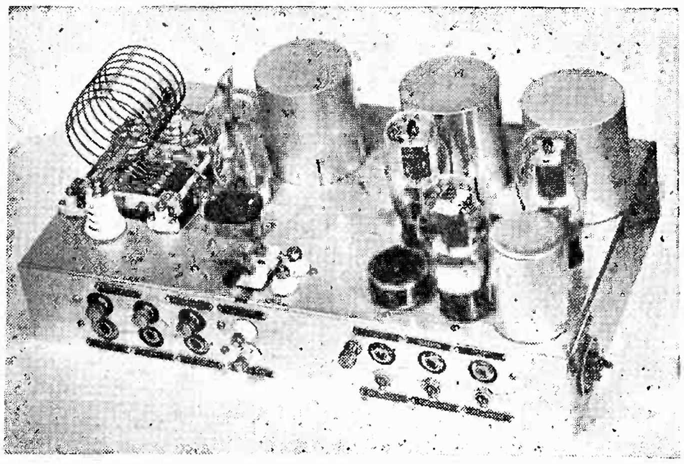


and we really eat well. On my first trip, the food was terrible for although we took on good supplies, the Japanese cook, not knowing American cooking, ruined it. We subsisted mostly on Japanese dishes—rice and more rice, raw fish twice daily and stewed fish eyes. I could never go to the last two items. Many of the Japanese boats feed pretty fair, the Japanese cooks making American dishes for the Americans on board.

The greatest percentage of the fishing crews are Portuguese, with Japanese second, and Americans greatly in the minority. Nearly all the boats carry American engineers, navigators and of course American radio operators since the boats are under American registry. Incidentally, at least a Second Class Radiotelegraph license is required of the operators as these ship stations are all open to public service.

When on the fishing banks, work starts at dawn and lasts until dusk. Of course not all of this time is spent in fishing, for often there will be days on end when nothing but steady cruising will be done, hunting for the elusive tuna. But when the fish are found, excitement and action run high. To add to the thrills, there are always several large sharks swimming around and one must watch his toes while in the fish racks. Several times I have seen sharks come up and try to chew on the edge of one of the racks, precariously close to one's pedal extremities. Every once in a while somebody gets pulled overboard by a large tuna, but in my experience no one has ever been bitten by a shark before getting back on the boat.

I used to laugh at the Skipper and crew when they told me that my turn would come one of these days, but now I know they weren't kidding as I have gone over the side twice since then. My first ducking occurred some time back while the boat was standing still and I was quickly back aboard. On this last trip, while cruising at half speed fishing tuna out of a school of porpoise, I was at the stern rack with my partner fishing two-pole. A large "three-poler" shot out from under the stern and grabbed our hook. My partner's pole slipped off his pad, and before I knew it I was doing

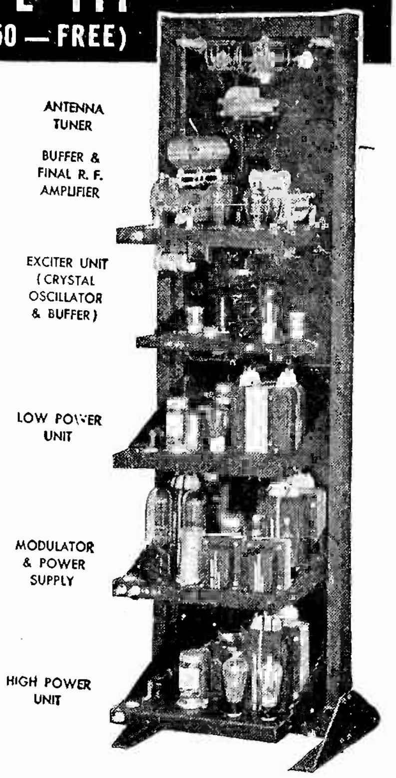


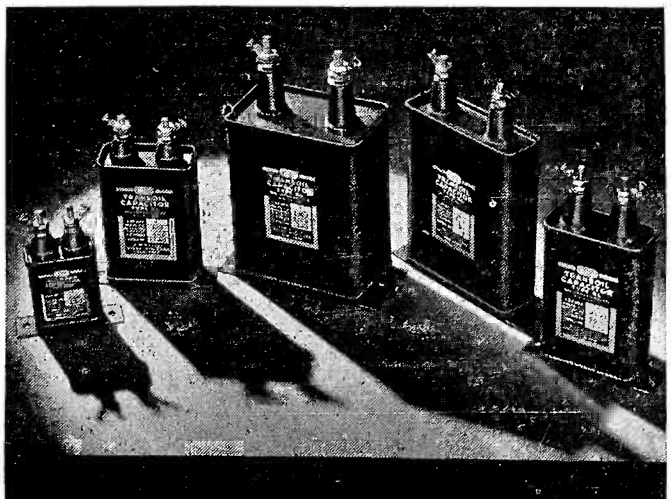
a neat nose dive into the briny deep. I had a very queer feeling, seeing the "Northwestern" rapidly moving away from me. They went nearly a quarter of a mile before they could stop and at that distance they looked very small and far away. A skiff was put overboard and they rowed back after me and nothing looked so good to me as that skiff as I clambered into the stern-sheets. Seated in the skiff, I looked down into the water and saw three 8 or 10 foot sharks giving me "the eye." The rest of the day I was pretty bashful about putting my line into the water.

Another time two of the crew, fishing two-pole, had their hook grabbed by a large three-poler that shot out from under the boat and away from it. They did a beautiful dive, in perfect synchronization, hitting the water about 12 feet from the boat. This time the boat was stopped and they were quickly aboard. Last year, while at Cocos Island, a visiting operator from another clipper told me that three sets of men and three pole gear had been overboard that day.

The long drag home from the southern banks is always the longest part of a trip. It takes from 10 to 13 days depending upon the weather conditions, and generally seems like ages. After unloading $20,000 worth of fish, a few days of relaxation at home and then to sea again.

When I started with the tuna clippers four years ago I expected to work at it for six months or so and then to settle down on land. But there is a certain fascination about the work, and so I am still at it, even though it does get tremendously boring at times. Some 28 trips have been made and always in the back of my head there is the dream of that perfect ham station I am going to have when I settle down ashore again. You know how it goes, that 1 kw. rack and panel, phone and cw. with instantaneous band changing and frequency control. Beams and rotatable antennae, special portable, deluxe receiver . . . better call a halt, before I ramble on forever.





Rotary "Flat-Top" Beam Antennas

[*Continued from Page 80*]

nose" reception of a station in that direction.

Interference may occur from a station situated about 40 degrees north-of-east. According to the field pattern, the north-of-east station would only be about 7 decibels down. By turning the beam 30 degrees south-of-east, the eastern station would be dropped about 3 db but the north-of-east station would go into the null and down almost 20 db farther than before. The rejection ratio of the antenna under these conditions would be of the order of 23 db. In a similar fashion, interference may be reduced from stations in the back direction when they lie somewhat off the line of the beam. Selectivity as provided in this way by the antenna is a most effective means of separating stations using the same frequency.

Transmission and reception take place normally over paths within a few degrees of the great circle route.[5] Large deviations, as when reception maxima are observed well off the great circle route, are apparent and not real.

Comparison With Other Arrays

For several years Bruce-type folded beam antennas[4] have been used on 14 Mc. with good results at W8JK. These arrays are about 140 feet long. Comparisons were made between a Bruce beam and the 60-foot rotary flat-top. With both antennas pointing in the same direction, both dx and nearby stations along the beams reported consistently that the signal from the flat-top was better, usually by about 2 R's. Since the flat-top's coverage is much broader, this difference was even greater in reports from stations lying somewhat off the beams. The top of the Bruce beam used in the tests was about 30 feet off the ground as compared to the 60 feet for the flat-top, so that the comparison was hardly a fair one. But considering the difference in size of the antennas, the results are of interest.

Further comparisons were made between the 60-foot rotary flat-top and a 110-foot, 8 element, flat-top beam used in place of the Bruce antenna. The 110-foot flat-top was about 30 feet off the ground. Owing to the greater height of the 60-foot rotary, reports from dx stations either favored the rotary or showed little difference. On short skip, however, the 110-foot flat-top was the better, sometimes by a couple of R's.

These tests indicated, as is well known, that the vertical radiation characteristics of a horizontal antenna depend greatly on its height above ground. The greater the height the lower the angle of radiation. A height of 50 or 60 feet seems well worth while for 14 Mc. dx.

Flat-top beam antennas obtain their gain not only by horizontal directivity but also to a large extent by vertical directivity. One of their most outstanding properties is, substantially, that regardless of height above ground, the radiation vertically is zero. Thus, much of the gain is obtained by shifting radiation from high angles to low, useful ones. In addition to giving a substantial gain over a single half-wave horizontal antenna at the same height above ground, the maximum of radiation may occur at a lower, more effective vertical angle.

As an idealized example, a half-wave hori-

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[5] "The Determination of the Direction of Arrival of Short Radio Waves," Friis, Feldman, and Sharpless, *Proc.* I.R.E., Jan. 1934, p. 47.

zontal antenna, one-quarter wavelength above ground, radiates a maximum vertically. A flat-top beam at the same height has no radiation vertically and according to calculations radiates a maximum at about 40 degrees above the horizontal plane. In other words, the vertical angle is lowered by 50 degrees. For greater heights above ground, the effect as given in the example is very much less, but is still important. It is a revelation than an antenna as small and simple as the flat-top beam can produce such large improvements in signal strength.

•

The rotaries which have been described are intended principally for 14 and 28 Mc. operation. These antennas can also be worked on a higher harmonic for 56 Mc. or one can construct the 30-foot design to half-size for 28 and 56 Mc. use. These antennas are all horizontal. If one desires vertical polarization on 56 Mc., a very practical arrangement for a 5-meter rotary would be to use an end fed 7-foot "flat-top" turned vertically, as shown in figure 11. Suggested dimensions are given. The gain approaches 3 fold in power, the maximum signal being in line with the wires, and the minimum at right angles.

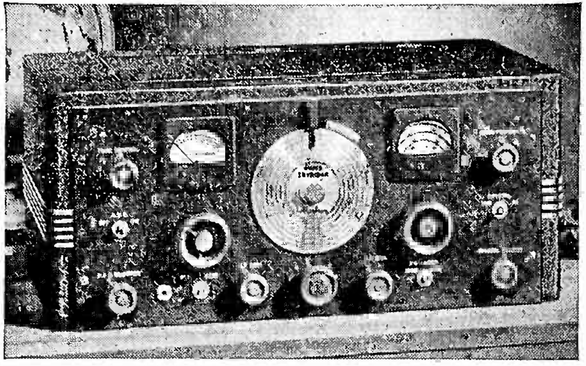
Portable A.C. Power Supplies

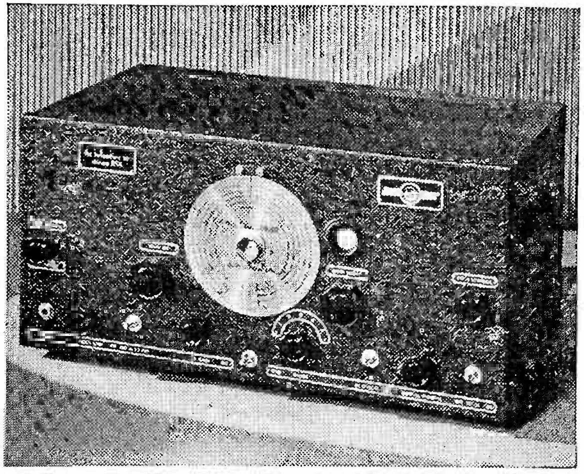
[*Continued from Page 81*]

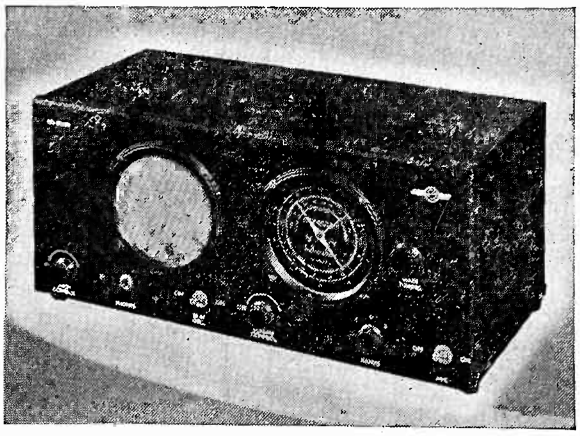
base. This means connecting the shield which covers the cable to the plug shield and connecting the other end to the point where the cable enters the magneto. Anything less than this will not work. Most manufacturers of stationary engines can supply both the plug shield and the thoroughly shielded cable on request, or the engine can be purchased with such shielding.

Hash, traceable to the a.c. side of the generator, is easily eliminated by installing a 1 μfd. condenser across the line. If it still persists, use two condensers in series, making an earth ground to the center tap.

Trouble experienced with sparking at the d.c. commutator is not so easily remedied. The first







precaution is to see that brushes and commutator are in perfect condition. Form the brushes to the shape of the commutator by placing a strip of 00 sandpaper (never emery cloth) between them and the commutator. Rotate the armature by hand until they assume the same curvature.

If the removable band which permits inspection of the brushes is missing, make a new one to shield this section of the generator more thoroughly.

Experiment with different values of condensers across the brushes and from each brush to the frame.

Sometimes an earth ground on the frame will cure the trouble although no definite rules can be laid down.

Other Applications of the Plant

By determining which d.c. brush is positive and which negative, a storage battery may be placed across these brushes in the self-excited plant and given a 3-amp. charge as long as the plant is running. Install, however, an automobile-generator cutout-relay to disconnect the battery when the machine is stopped.

Provision may also be made, particularly when the generator is mounted on motor rails, to remove it and substitute in its place an old automobile generator, using a pulley ratio of one to one, for recharging storage batteries at a higher rate.

The plant of course is an excellent light plant for locations remote from power lines. The generator may also be removed and the motor used to drive other machinery. Hardly any piece of amateur equipment is as versatile as such an a.c. plant. During any emergency, it is literally "worth its weight in gold."

See Buyer's Guide for information on source of supply for various parts. EDITOR.

●

Article Material 'Contest'

"RADIO" BUYS ACCEPTABLE STORIES AND IDEAS

Even with one of the best staffs in the world, "Radio" realizes that variety and pep and sparkle in a magazine can only come from many and varied sources of material.

Thus, we solicit more and better contributions from "outside" (for which, incidentally, we pay cash).

At present an "average" full-length constructional article brings about $30.00 if accepted; the exact amount varies with many factors. All technical items except shorts are paid for.

Have you a transmitter, receiver, or other item with a novel slant, perhaps not brand new, but one about which your fellows might like to know? Many of the most interesting ones come from fellows who hardly realized that they've "got something there". And have you a friend who's hiding his light under a bushel? Let's smoke him out!

(Note: If you wish to send us a detailed outline of your proposed story, we'll be glad to comment on it before you finish the manuscript; we cannot, however, obligate ourselves to accept the final product until we have had a chance to see it.)

40 Watts on Six Bands

[Continued from Page 59]

type wave meter is a most handy instrument for making sure you are on the right one.

Because of buffer-doubled VT_2 all circuits may be tuned for maximum output on five, ten, and twenty meters. When the first two tubes are used as a push-pull oscillator driving the final as a keyed or modulated doubler, it is advisable for the sake of stability to detune the oscillator slightly. Do not attempt to modulate the final when it is operating as an oscillator.

In laying out the chassis for short connecting leads, the one shown in the photographs and suggested layout is recommended. There is naturally a slight bit of r.f. loss in the extra length of the leads to the shorting socket S_1 and in the plug connections to that socket when VT_1-VT_2 are used as push-pull oscillators. But such losses are not noticeable as the tubes operate very smoothly and have plenty of output as oscillators.

QSY with a VF Crystal

Retuning is seldom needed when QSYing with this unit. A twist of the crystal knob sets the oscillator to the frequency desired. The various tuning condensers in the exciter can be tuned to the center of the range of the v.f.

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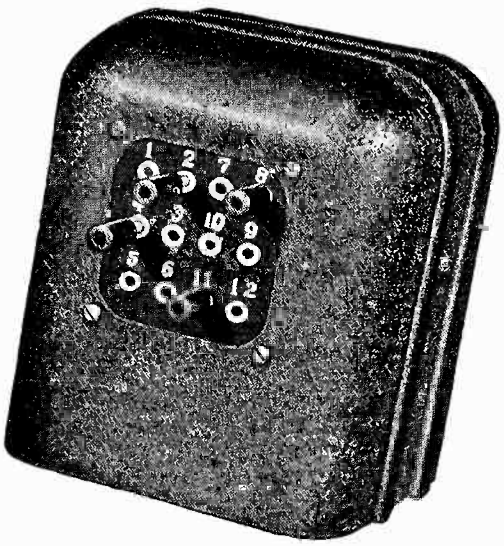

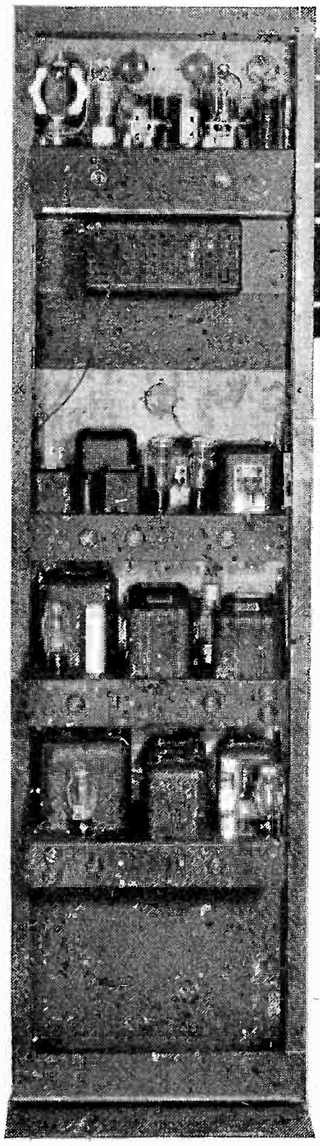

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crystal, thus allowing the variation of the crystal to be covered with almost no change in output.

If the crystal unit sings, it is being overloaded. If, for some reason, you must overload the crystal, move the knob to the low frequency end at which point the crystal is firmly clamped. This is also advised in the first tuning and experimenting with the rig when this type of crystal is used.

The variable crystal unit used here gave a variation of approximately five kc. on the fundamental of 3.5 Mc. This doubling to 7 Mc. gives a variation of 10 kc.; 14 Mc., 20 kc.; 8 Mc., 40 kc., and 56 Mc., 80 kc. This will be ample coverage to escape most QRM conditions.

A Few Precautions

Do not apply plate voltage without making certain that S is in the right position.

Do not change coils with plate voltage on.

Do not remove a coil from a plate of a 6L6 without also removing screen voltage (done here by the meter switch which opens the cathode circuit), as with plate voltage off the screen currents become high enough to ruin the tube.

Do not leave plate voltage on VT_3-VT_4 for more than a quarter of a minute without excitation.

Use high grade ceramic insulation throughout.

Don't try to double the power rating given here.

In inserting the crystal in S_1 be certain that it goes into pin holes 2 and 5.

•

The F. C. C. has outstanding nearly 55,000 station licenses of various classes.

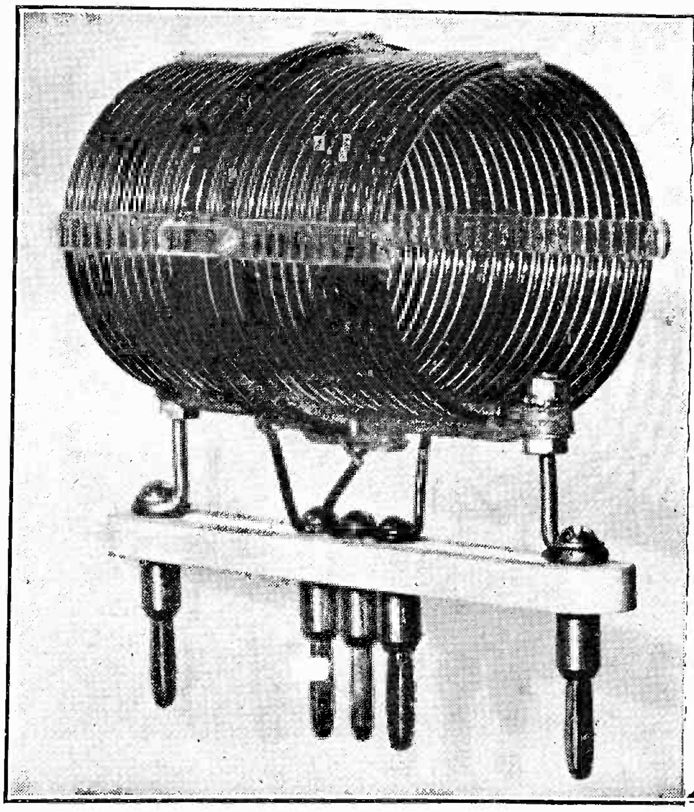
The Amateur's Frequency Meter

[*Continued from Page 44*]

returned to zero. Try B again and so on until B just covers the 100 kc. from 2500 to 2600 kc. Each division on B will now represent 1 kc. (assuming the dial has 100 evenly-spaced graduations). If a vernier is also installed, accurate measurement can be made to less than 100 cycles. Of course these adjustments must be re-made whenever the frequency-meter is to be used to cover a different range, such as the 2500-2600 kc. on in this case.

Checking for Linearity

To check if condenser B gives linear readings, leave the settings of the frequency meter at 2500 and find the fourth harmonic of 2500 on the receiver. The 100-kilocycle point of the standard will also be found at the same place. Now turn the B dial to 25 and tune the receiver to it; the point should correspond with the next 100-kilocycle spot of the standard. Do this for 50 and 75 on B condenser. Should it be found that the readings do not quite come at the points of the standard, it may be necessary to bend the two outside rotating plates of condenser B so that somewhat less capacity is presented at the 0 end of the dial than at the 100 end of the dial. It was found here that a slight bending in a symmetrical manner of the two outside plates took care of the matter very nicely, making the condenser readings of the dial linear, so that 25, 50, and 75 correspond to 25, 50, and 75 kilocycles respectively.



Question Box

[*Continued from Page 74*]

impedance at the shorting-bar end will vary proportionately. As the shorting-bar impedance is reduced, the values of current flow will be increased, resulting in an increase in the effective "Q" of the stub. As the "Q" is increased, the sharpness of the resonance indication also is increased.

The shorting-bar spacing is not critical; the primary function of this type of an element is to provide a phase reversal for the consecutive antenna sections. Anything from 2″ to 6″ will be satisfactory for this spacing.

●

Yarn of the Month

[*Continued from Page 70*]

kilowatts at the Hawaiian station, too. The rotary spark gaps were attached to the axles of giant steam turbines. The power houses had their own steam-brewing boilers and oil burners to mix the soup for the turbines. The rotary spark gap disc and electrodes were enclosed in a heavy concrete vault. Yet the roar from this tremendous spark discharge was so loud that you could plainly hear it, through the concrete walls, at a long distance from the power house proper.

And this was only 20 years ago.

500 k.w. rotary spark transmitters, 2000 meter communication, antennas a mile long, and more. And all the static you'd want to hear in one minute to last you for the rest of your life.

When wavelength changes were to be made, it was necessary for the electrician in the power house to get on a step-ladder, and with the aid of block-and-tackle he'd move a connecting lead as thick as a rattle-snake from one portion of the loading coil to another.

But there was romance in wireless in those days, 20 years ago. There was romance even in the static. We didn't have to work when the static got so bad you couldn't work through it.

And on Christmas Eve, just 20 years ago, the static was wild with joy, perhaps imbued with the holiday spirit. Suffice it to say that the station at Bolinas had something like 300 messages and 30 bottles of holiday cheer hanging on the hook, the former destined for people who resided in the Hawaiian Islands, and the latter for the operators' gullets.

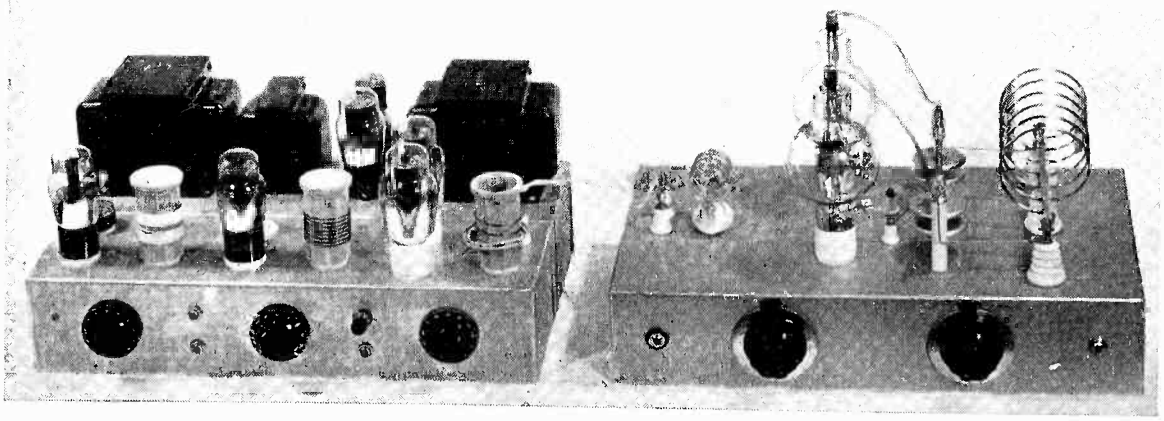
300 on the hook, a few hours before sunset in the Hawaiian Islands. We could hardly distinguish the spark signal from Bolinas. And what's worse than getting a message of Christmas cheer on Washington's Birthday, for example? We couldn't make a total flop of it; we had to get the stuff through, *somehow*. Two of us were on watch on the day trick. One of us handled the wire, the other the wireless. We'd get the stuff by wireless from Bolinas and send it by wire to the main office of the Naval Radio in Honolulu, about 75 miles away.

Static permitting!

I was working the wire. Bob Carlisle, perspiration rolling from his manly brow, sleeves rolled-up to his ears, static rolling into the old "Baldy" headphones that Bob had wound 'round his neck, making sure they'd be a foot or more from his ears.

Bob wasn't getting anything through from Bolinas that Christmas Eve. And the less traffic he caught on that mile-long antenna, the less telegraphing I had to do with Honolulu.

Before the static became intolerable, we learned from Bolinas that they had the aforementioned 300 Christmas messages on the hook, ready to hand us in lots of 20 at a time, or as many as we wanted to take before the typewriter ribbon wore out. But the static storm came up from nowhere, and no sooner had we learned of the total number of messages we were to be presented with, when the static came down on our heads. We couldn't get a complete word from Bolinas through that static.

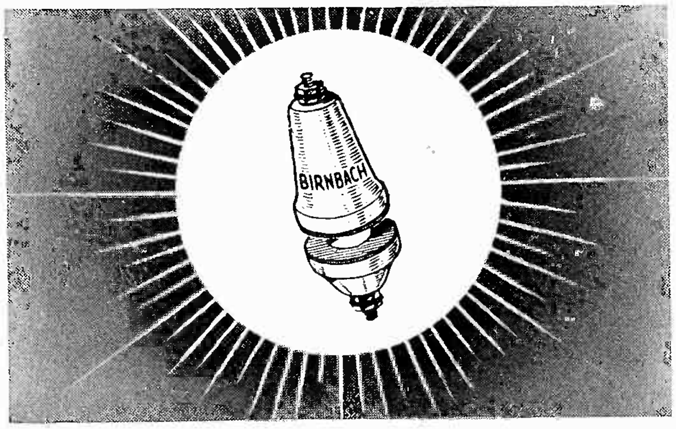


Not *one* complete word.

So the two of us got together, Bob Carlisle and myself, and we figured out a scheme. Something had to be done. The navy usually doesn't fire an enlisted man in wartime, but we figured it would look sort-of bad for us if we didn't get something into Honolulu during an 8-hour trick. Our chances of becoming Rear-Admirals would be remote if we failed.

The "bright idea" was to tell Bolinas (he wasn't bothered with static there) to continue sending one single letter at a time, repeat this letter over and over again until we gave him an OK in the form of a dash from our own transmitter. The body text of all the Christmas messages was identical: "M X H N Y" (Merry Christmas Happy New Year) ; so all we needed was the address and the signature. The station at Bolinas started the grind. The op. would sent one letter, perhaps a hundred times, before we were able to identify it correctly through the static. Then the laborious task of receiving the next letter, and the next.

Believe it or not, we cleared exactly *three* messages of Christmas cheer during that 8-hour



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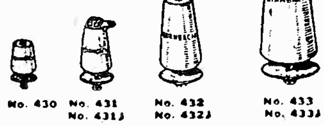
433J	2¾"	50c



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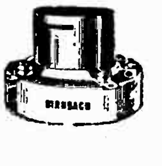

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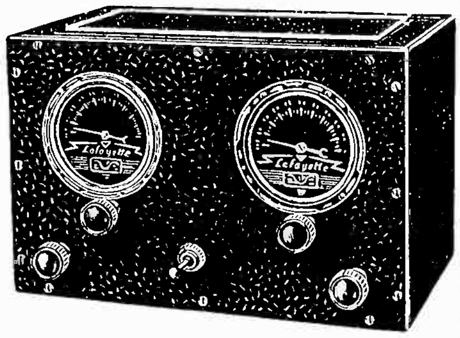

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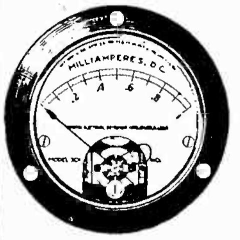

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day trick, and the record will bear me out.

Perhaps a thousand dollars or more per message was consumed in crude oil and wages and overhead and steam for the turbines that drove the rotary spark gap. Perhaps twice that sum was spent, considering the fact that it required a force of land-wire operators, wireless operators, engineers in the power house, cooks who prepared grub for the hungry mob, wear-and-tear on the miles of antenna wire, and black paint for the roof of the hotel at Bolinas where the sea-gulls chose to paint it white.

So, brother amateur, when I hear you fellows complain about the static you get on 20 and 40 meters, it always takes me back to 20 years ago, 'way down there in Hawaii, and 'way up there on 2,000 meters . . . where static is born, not made!

56 Megacycles

[*Continued from Page 72*]

We don't expect much morning-and-evening five meter dx during the winter over 500-1100 mile paths, but somewhat longer dx should be possible from late morning to mid-afternoon when the F_2 layer virtual height and critical frequency are favorable. Let's try to get all the dx we can during the next several years of favorable sun-spot conditions so things won't all die out as ten meter work did from 1929 to 1934!

DX

[*Continued from Page 68*]

all, that's where the fun is—going after them and working as many as possible. So, everytime you hear of a new one which is more or less rare, let us know. Of course, the frequencies listed will not have to be guaranteed as to accuracy, but get them as close as possible.

Well gang, that's about it for this time. CUH just popped in with word that a few of the boys in our locality have just hooked this UT3AC in Mongolia. His frequency centers about 7028 and spreads out each side with about a T6 note. CUH is all worked up now and can't figure out how he is going to get on 40 tomorrow a.m. with only a 20 meter antenna up in the air. Charlie has a new super-final using a couple of W.E. 251A's in p.p. This should spur you "guys" a bit to get on the roaring 40 again. And you can bet I'll be after that UT3 tomorrow myself. Even the W9's will have to wait.

●

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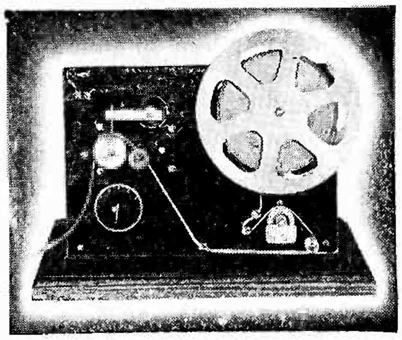

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INDEX TO ADVERTISERS

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BUYER'S GUIDE

Where to Buy It

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics usually may be substituted without materially affecting the performance of the unit.

●

500-WATT PHONE-C.W. TRANSMITTER

Final Amplifier

C_1—Cardwell XG50KD
C_2—Cardwell MT70GD
Meters—Hoyt 579
RFC—Ohmite 1000 ma. 10-20 choke
T_1—Inca J5
T_2—Inca C32
Coils—Decker

Bi-Push Exciter

C_2, C_6—Bud 911
Coupling condensers—Aerovox mica
C_{14}—Aerovox 608
M—Hoyt 573
T_1—Inca J8 and J11
T_2—Inca B15
CH—Inca D42
Coils—Decker Bi-Push
SW_1—Bud 1010 toggle
SW_2—Yaxley 1325
SW_3—Yaxley 1316
Sockets—Amphenol

Class-B Modulator

T_1—Thordarson T6414
T_2—Thordarson 11M77
M—Hoyt 573
Tubes—Taylor 203Z
Sockets—Johnson 211

Speech Amplifier

All condensers—Aerovox
C_1—Aerovox EM25 10 μfd.
C_3, C_6—PBS5 8-8 μfd.
C_5—PR25 10 μfd.
C_{12}, C_{13}—G6 8 μfd.
Resistors—IRC Insulated
R_{21}—Centralab 72-115
T_1—Inca C66
T_2—Inca G9
T_3—Thordarson 15D79
CH_1—Inca D40
CH_2—Inca D4

Final Power Supply

C_1, C_2—Aerovox 2005 condensers
R_1, R_2—Ohmite Brown Devils
R—Eagle 415A resistor
T_1—Inca J3

Modulator Power Supply

C—General Electric 9CE5A41
R—Ohmite Brown Devil
CH—Inca D42
T_1—Inca J3
T_2—Inca B24
Tubes for both power supplies—Taylor 866

PORTABLE A.C. SUPPLIES

Wire, wedges, paper, collector ring, brushes and brush holders obtainable from S. W. Duncan, 408 S. Hoyne Ave., Chicago, Ill.

Motor base obtainable from above source @ $1.15. Also obtainable from W. W. Grainger, 311 S. San Pedro St., Los Angeles, Calif.

Motor rails (adjustable) obtainable from Grainger, or the one illustrated was obtained from Montgomery Ward & Co. Cat. No. 84A9831 @ 89c.

Engines obtainable from following manufacturers, all of whom have distributors throughout the country:

Briggs and Stratton Corp., Milwaukee, Wis. (So. Calif. Distributor: Electric Equip. Co., 1601 S. Hope St., Los Angeles, Calif.)

Lauson Motor Corp., New Holstein, Wis.

Wisconsin Motor Corp., Milwaukee, Wis. (1 HP and up only)

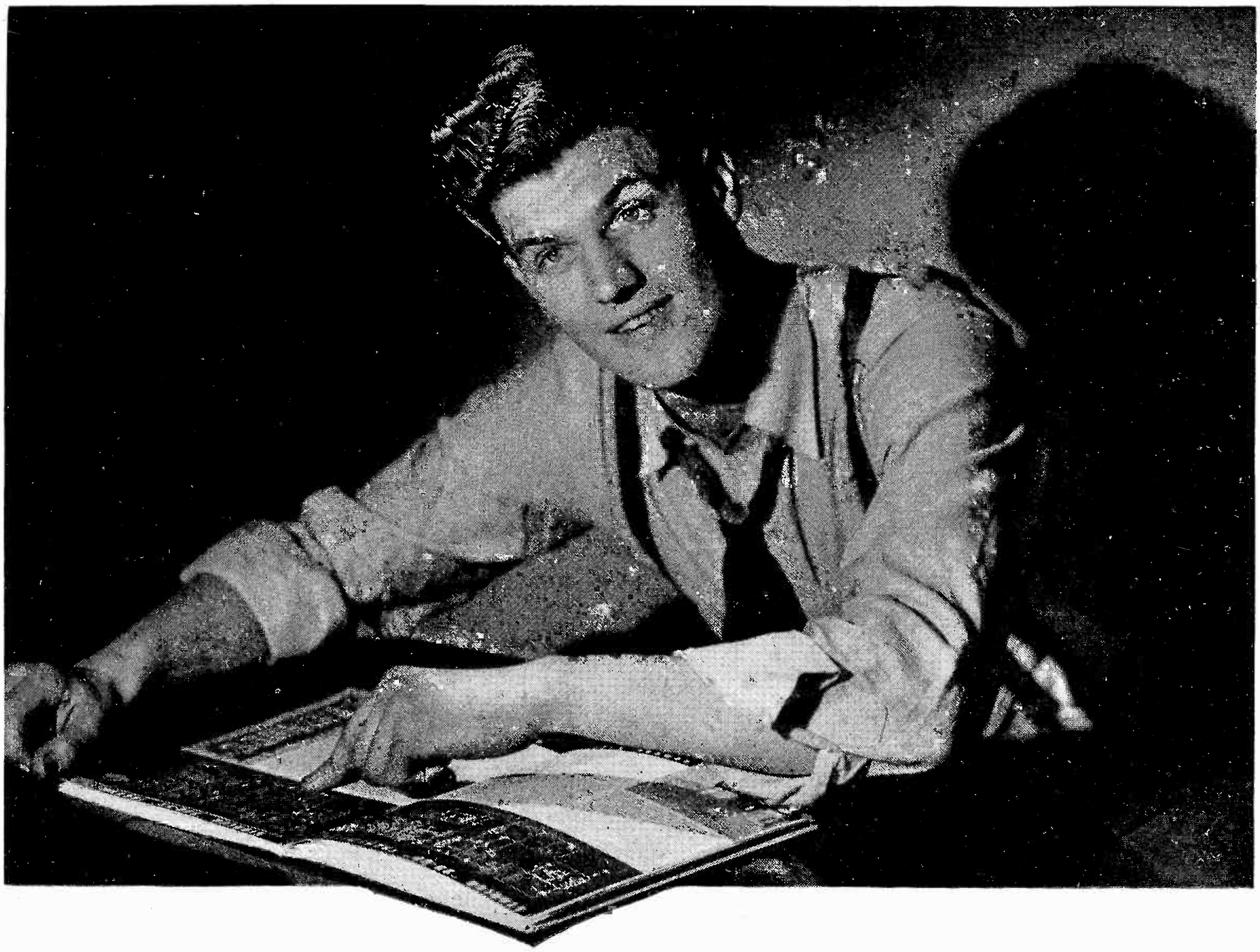
Johnson Motors, Waukegan, Ill. (So. Calif. Distributor, B. H. Hebgen, 1361 S. Flower, Los Angeles)

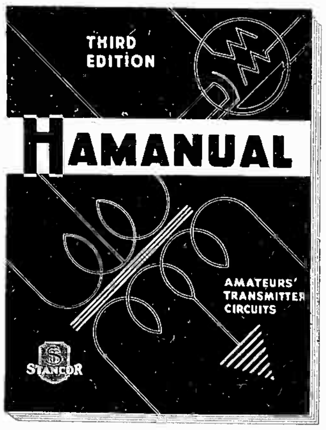
Notes on Motors

In ½ HP type, Briggs and Stratton, use model H. For 1 HP use, model A.

Briggs & Stratton washing machine motor (½ HP @ 2300 r.p.m.) good for light jobs. Obtainable from Sears Roebuck (Cat. No. 23FM7110) for $27.95. A one-to-one pulley ratio should then be used. This is a very reliable and efficient engine. (B & S model No. WM.)

Wisconsin Motors sold by Montgomery Ward on time. Briggs and Stratton sold by Sears Roebuck on time. Johnson motors make only a 5/8 HP (30 degree). (This type is used on Pioneer 300 watt a.c. jobs.)

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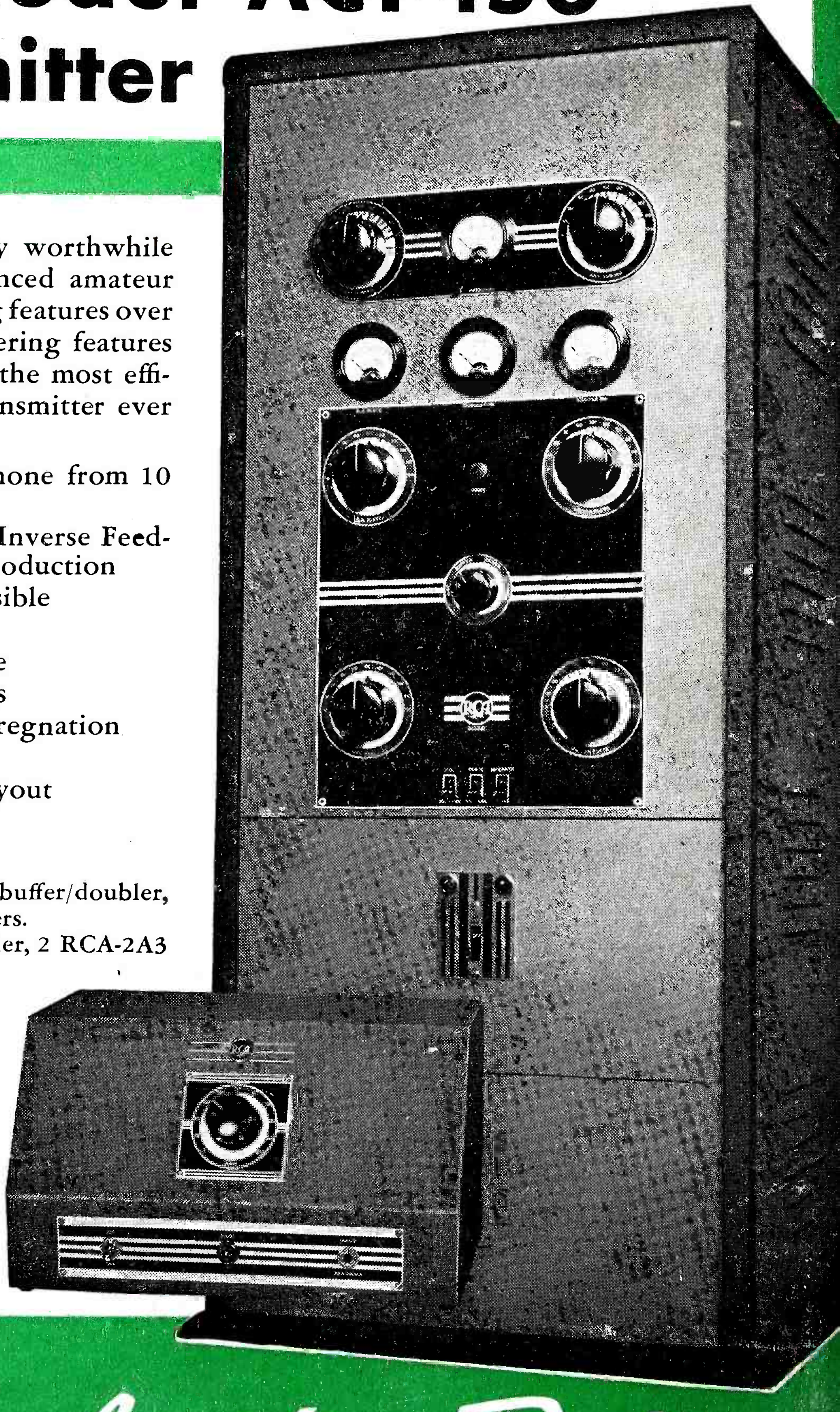
AMATEURS' TRANSMITTER CIRCUITS
STANCOR

Get "Broadcast Quality"

WITH THE NEW RCA Model ACT-150 Transmitter



RCA offers in this new design many worthwhile features that will appeal to the advanced amateur radio operator. Look these outstanding features over and carefully consider all the engineering features RCA Engineers have put into this—the most efficient—most economical 150-watt transmitter ever offered by anyone.

- 150 watts output C.W. and Phone from 10 to 160 meters
- Special Speech Amplifier with Inverse Feedback for high quality voice reproduction
- R.F. feedback practically impossible
- Modulation indicator
- Coils and crystal easily accessible
- Conservative ratings on all parts
- Transformers given special impregnation
- Circuits fully metered
- Attractive cabinets and panel layout
- "Tune-up" protection
- Low tube and accessory cost.

R-F—RCA-807 crystal oscillator, RCA-802 buffer/doubler, 2 RCA-807 drivers, 2 RCA-808 final amplifiers.

Audio—RCA-6J7 input, RCA-6C5 amplifier, 2 RCA-2A3 drivers, 2 RCA-808 modulators.

Power Supply—RCA-80 for speech amplifier, RCA-83 for exciter, RCA-5Z3 for bias and driver plate, 2 RCA-866 for high voltage.

AMATEUR'S NET PRICE

f.o.b. factory with speech amplifier and one set of coils but less tubes, microphone, crystal and other minor accessories. **$625.00**

See your supplier or write for descriptive literature

RCA

for Amateur Radio

AMATEUR RADIO SECTION

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