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The Worldwide Authority of Amateur and Shortwave Radio

★

March 1939

NUMBER 237

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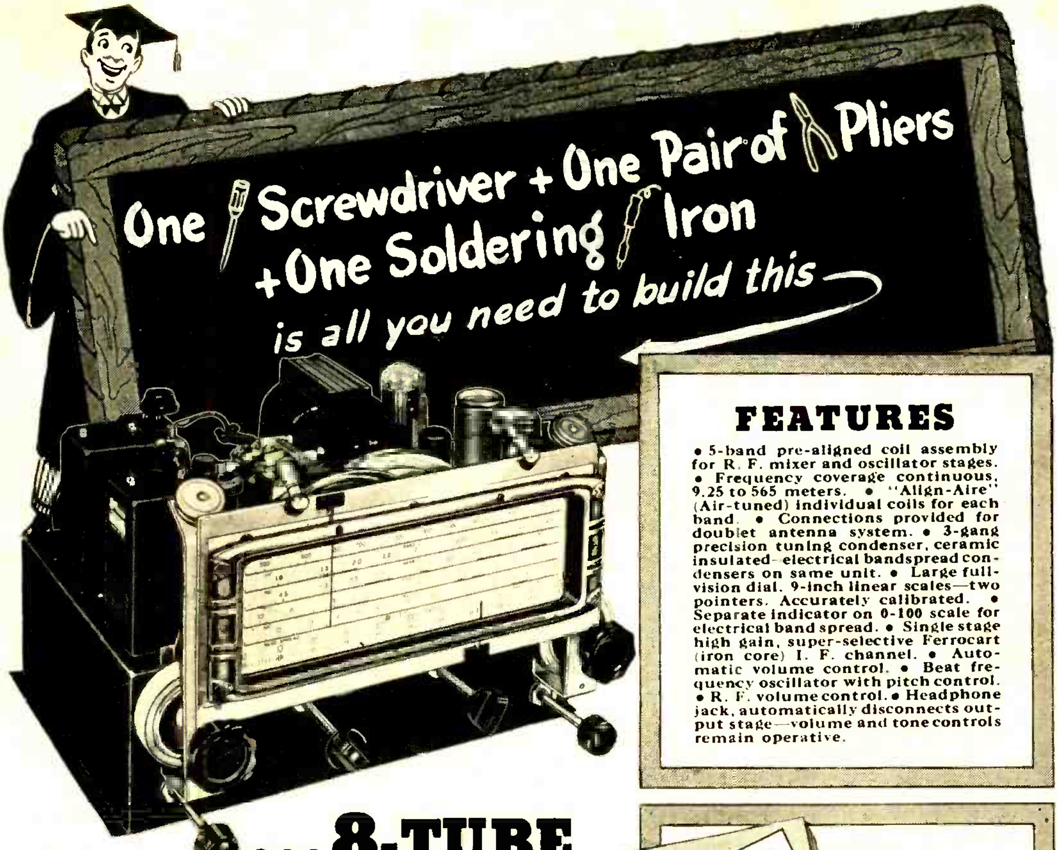

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RFD 2 Box 5
Dead Horse Gulch,
Mar 20, 1939

Deer Sirs,

Pleeze find enclosed $1.50 for one of your new 1939 MODEL HANDBOOKS. Your 1938 book was purty good and full of FB dope but I understand your new book is still better. besides i ain't got my 1938 book no more. The old woman she got sore and burns it up!!!

You see after I got my Handbook and rebilt my rig according to the dope in it, I got out so well that it kept me me busy answering foreners who wanted Nevada for W.A.S. The old woman she didn't kick only mildly when she had to drain the cows while i kept an ear peeled for DX that comes around milking time — but when i suggests she start the plowing on the lower 40 while i put up one of them slick flap top beems on Asia and try for Zone 23 - she is fit to be tied.

Pleeze send it care of General delivery on acc of if it comes to our mail box Sadie might see it furst and there goes another $1.50!! Im going to keep it hid out in the tool shed along with my whiz Bangs and my Antenna Handbook and that purty picher of the movie acter girl I won at the County fair

Yrs Truly
Zeb Willits

P.S.

Pleeze rush becuse I need the book bad on account of i give the widder Jones b.c.l. trouble and i got to make a wave trap and mail it to her afore she sics the R.I. on me. Sadie wont let me go over to the widders place since the time I went over to put up a antenna for her and didn't get home till 3 A.M.

1939 "RADIO" HANDBOOK:

$1.50 in continental U. S. A.; $1.65, elsewhere

From the PRIVATE LIFE of RADIO

As the spirit moves, we present in this column from time to time a bit of gossip about RADIO, its affiliated publications, and those who produce and distribute them.

"—From the private life of RADIO."

Only One for Sale

Our technical and laboratory staff is not permitted to build you a duplicate of some piece of apparatus which has been described in RADIO, even though you may be willing to pay for their time. If the item was built by our staff the original model is often for sale; if so, this will be indicated in a small advertisement in our Market-place section. First come, first served. To construct duplicates would take time which we cannot spare from our program of developmental work, the results of which will appear in future issues; secondarily, it would place us in competition with several manufacturers whose advertising makes it possible for us to serve you with RADIO at $2.50 yearly instead of, say, $10.00!

December Special Annual "Yearbook" Number?

Several have suggested that RADIO's double-size special annual "yearbook" number should be the December issue instead of January. Perhaps the January issue doesn't arrive far enough in advance of Christmas to guide mother, sister, wife, or sweetheart in filling our ham-hero's Christmas stocking. Anyway, we'd appreciate the comments of this column's readers—if any. A postcard will do, thank you.

RADIO on Your Favorite Newsstand

If your favorite newsstand does not carry RADIO please suggest that the owner contact the American News Company, whose branches throughout the United States and Canada are prepared to furnish copies to all who have a demand for it. RADIO's former restricted distribution is now a thing of the past, and we hope that it will continue to be (but note that a 2-year subscription at $4.00 in U. S. A. and contiguous countries still saves $2.40 over newsstand prices.)

Apologies

RADIO's annual Christmas gift offer apparently overloaded our Circulation Department even more than usual this year. Unfortunately it is impractical to train additional help in the complicated routine necessary to enter subscriptions for just a few weeks' work. The Circulation Manager asks that we thank you for your patience. Changes in the system of handling orders will be made if possible to avoid a similar occurrence in the future.

Welcome

A somewhat greater percentage than usual seemed to be subscriptions from new subscribers. Welcome to the fold; this is *your* magazine; if it isn't as you want it, don't hesitate to write in. Our Editors welcome comment, good or bad, and particularly constructive criticism.

Changes of Address

The Circulation Department is located at the home office in Los Angeles and all notices of change of address should be sent only to that office. A few persist in sending such notices to our printers 3000 miles away! Mailing wrappers for each issue are prepared on the tenth of the month preceding the cover date of the issue about to be mailed (e.g., on February tenth for the March issue). Changes received after that date can only become effective with the succeeding issue (that is, the April issue in the foregoing example).

No New "Antenna Book" This Season

It is not planned to issue yearly editions of all books by the Editors of RADIO. While the RADIO HANDBOOK will probably continue to be revised annually, their other books—and particularly the RADIO ANTENNA HANDBOOK about which a number of inquiries have been received—will be revised at irregular intervals, whenever the Editors believe changes or new developments make a new edition advisable. In the meantime, of course, all important developments suited to amateur application appear in RADIO.

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A considerable amount of circulation and miscellaneous correspondence is addressed to our New York office. Please note that our branch offices in New York and Chicago are advertising sales offices only; that at East Stroudsburg, Pennsylvania is concerned only with the mechanics of translating our editors' manuscripts and our advertisers' copy into print. All correspondence other than that relating to advertising sales, copy, or cuts should be directed to Los Angeles.

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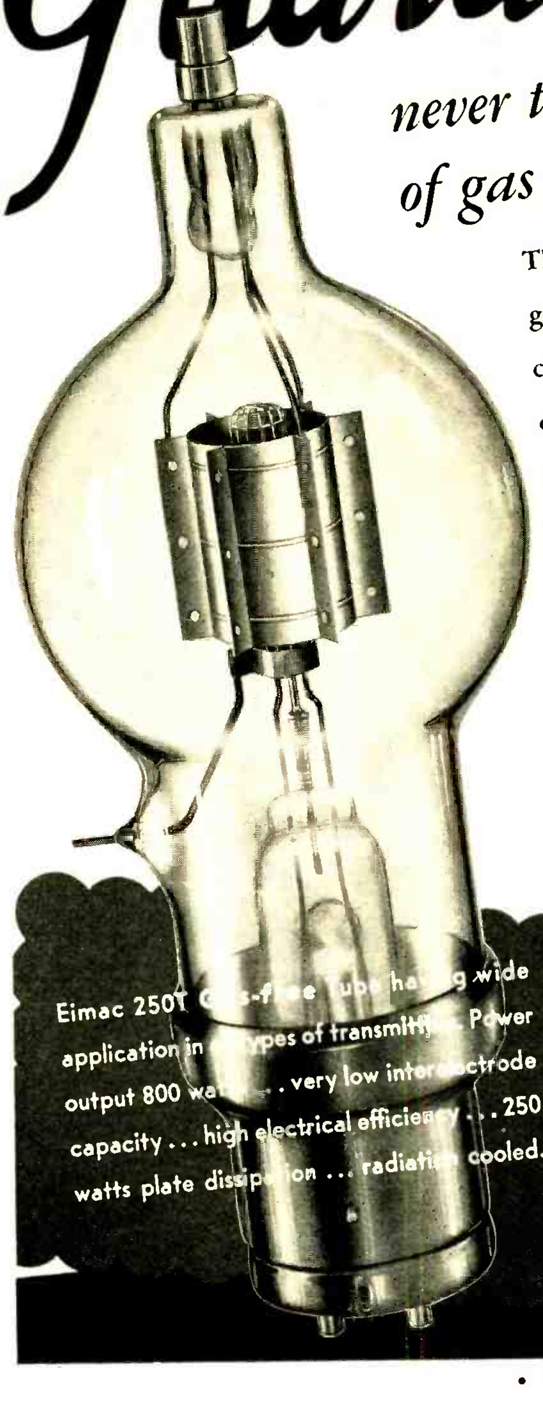

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RADIO

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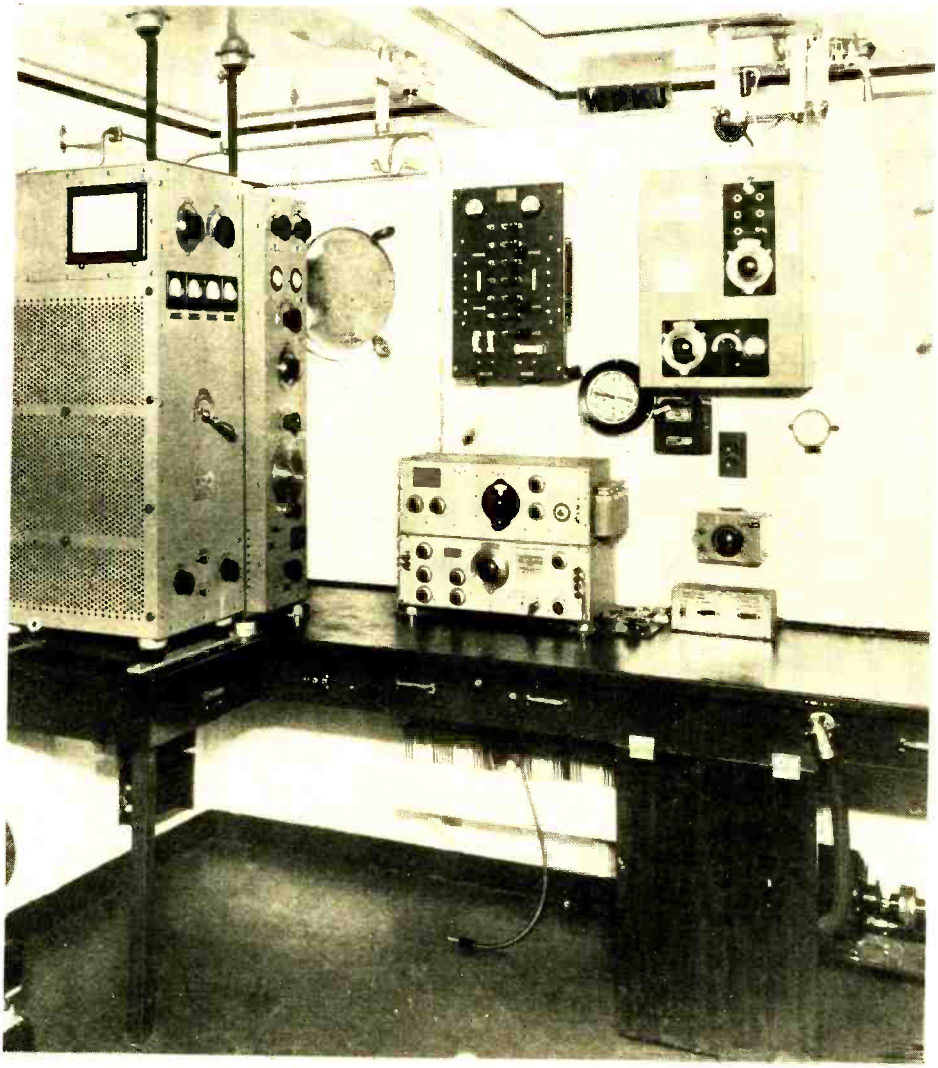
THE WORLDWIDE TECHNICAL AUTHORITY OF AMATEUR, SHORTWAVE, AND EXPERIMENTAL RADIO



● Most amateurs think of the radio installation aboard an oil tanker as sporting a pancake helix the size of an umbrella, various and assorted spark gaps, sliding tuner receivers with the tubes projecting through the panel, 6-inch projection-type meters, and similar gear.

But the radio room of the tanker Esso Baytown, a typical modern RCA installation, looks more like a deluxe amateur station. Excepting possibly for the motor generator, most amateurs would feel right at home around a rig like this.

The Esso Baytown figured prominently in the rescue of passengers from the ill-fated flying boat, Cavalier.

Supporting the ROTARY BEAM

While much has appeared on the subject of rotary arrays and rotating mechanisms, detailed data on the construction of the supporting structure have been lacking. The structure described in this article possesses many advantages, and is easily constructed from the accompanying plans.

By F. CLAUDE MOORE,* W9HLF

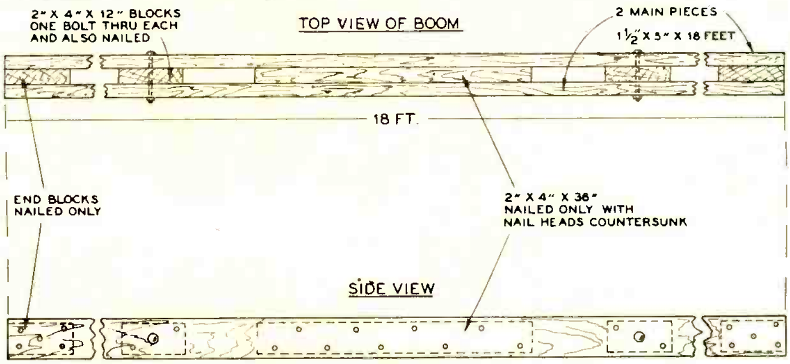


Figure 1.
Top and side views of the boom. Note that the center and end blocks are held in place only by nails. The three blocks between the center and each end of the boom are bolted as well as nailed in place.

Desiring to install a new three-element 14-Mc. array that would be easy to rotate and easy to adjust, the writer spent several sleepless nights before coming up with what he believes to be a new idea in rotatable antenna construction. Since rotatable antennas of the close-spaced variety are becoming increasingly popular among the amateur fraternity, the following constructional data should be of some interest.

Exact dimensions for the various elements that go to make up the antenna supporting structure will not be given here as a majority of the amateurs building such an affair will be interested principally in the basic idea and would alter any dimensions given to suit their own particular requirements.

The antenna to be used at W9HLF was a three-element array using a well-known factory-built kit which consisted of copper-plated steel tubing elements. The necessary wooden cross members and mounting insulators were supplied in the kit along with an 8-ohm concentric cable to feed the array.

With all these components supplied, all that was needed was some sort of a supporting structure to hold the array in the air and separate the three antenna elements. Since 0.1-wave spacing was needed between the radiator and reflector and 0.15-wave spacing between the radiator and director, an 18-foot supporting framework was required. Quite a large order.

A large cross-braced framework was out of the question in the writer's case because he (probably in common with a great number of other amateurs) was a notoriously poor carpenter. In addition, such a framework is difficult to mount on a rotating head and keep in the air.

The first plan was to use an 18-foot length of 3-inch x 4-inch lumber. But such a piece was not easily obtainable at lumber yards, and

* 512 Catherine St., Pekin, Ill.

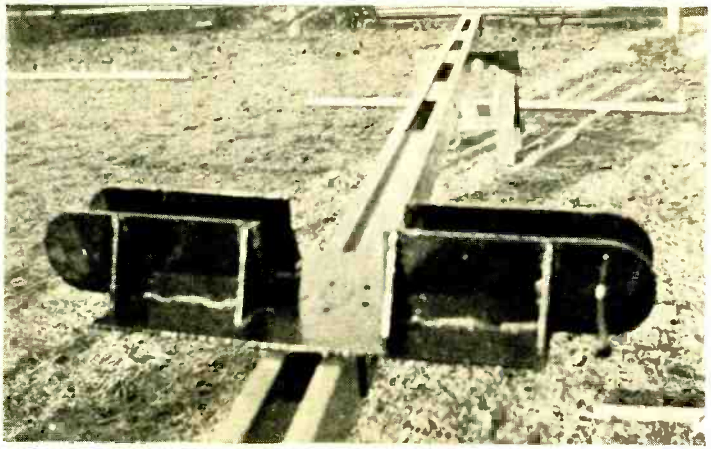


Figure 2.
The completed boom resting on sawhorses. The center supporting plate is in the foreground. This plate does not mount in the position shown, but is merely resting on the boom to show its construction.

when one was located the price was found to be so high as to be somewhere in the vicinity of this "free space" we hear so much about nowadays.

A single piece of lumber being out of the question, it was decided to build the "boom" out of two pieces of clear straight spruce 18 feet long, 5 inches wide and 1¼ inches thick. A solid assembly was formed by standing these pieces on edge and placing 2-inch x 4-inch x 12-inch pieces of spruce between them and bolting and nailing the whole together. In the center of the boom, however, the 2-inch x 4-inch piece was 3 feet long rather than 12 inches since, as will be shown later, solid construction was advisable at this point.

Assembling the Boom

The boom was assembled by standing the long pieces of spruce on edge on two sawhorses and then placing the blocks between them and clamping the assembly together with several C-clamps. Next, a ¼-inch hole was drilled through the boom at about the center of each block. Then a 5-inch carriage bolt was run through each hole and tightened to hold the assembly snugly together. A few nails driven through the outside members and into the blocks completed the job. The 3-foot center block could not be bolted in place because the bolts would prevent the boom from resting evenly on its supporting plate atop the mast. Therefore, nails alone were used to hold the center block in position. The blocks at each end of the boom were also held in place by nails, rather than by bolts. These nail heads were driven down flush with the wood. Figure 1 shows how the boom appears from top and side views. Figure 2 is a top view of a section of the completed boom.

The Mounting Plate

Although the particular rotating head, bearings, etc., used with this boom are of no great interest, it is advisable to use a mounting plate similar to that shown in figure 3. A photograph of this mounting plate is shown in figure 4. The plate (A) is of ¼-inch thick steel and is 12 inches wide and 24 inches long. The center of this plate was drilled to match holes in the rotating plate on the mast. The four upright pieces (B) were next set up on the main plate (A) and welded to this plate so that the space between the uprights (B) was just large enough to allow the boom to lie between them. One-eighth

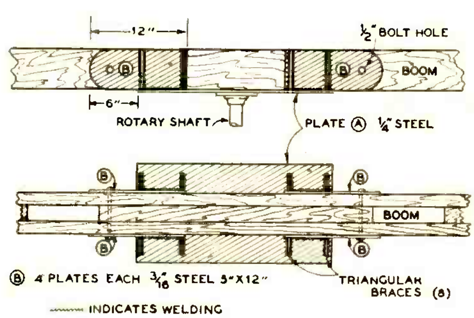


Figure 3.
Top and side views of the main mounting plate showing how it is bolted to the boom.

to three-sixteenths of an inch clearance was allowed to permit the boom to be easily slid in and out of the mounting. For added strength, two triangular braces were welded to the outside of each upright, supporting it from the mounting plate (A). These braces

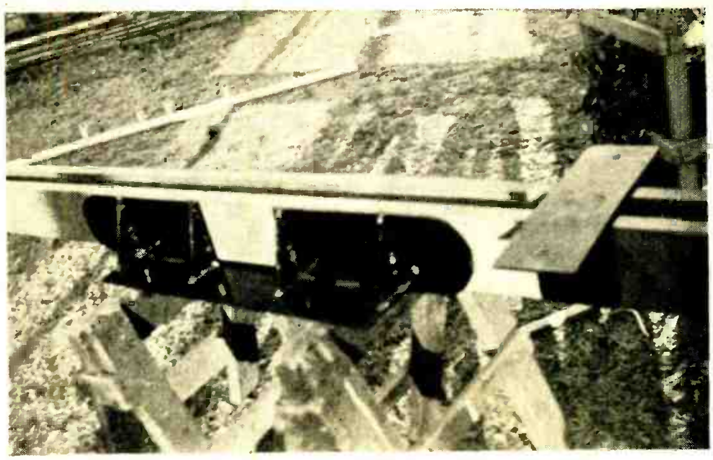


Figure 4. Close-up view of the main mounting plate in position on the boom. The plate which holds the radiator cross member may be seen straddling the boom to the right of the main plate.

are shown clearly in figure 4. The welding needed can be done by any machine or blacksmith shop and should not cost much.

The Element Mounting Plates

The three element supports, or mounting plates, are all alike and are made from one-eighth-inch steel plate. One piece of plate 4 x 10 inches and two pieces 4 inches square were required for each mounting plate. The two 4 x 4 inch pieces were welded to the 4 x 12 inch piece at right angles to its longer

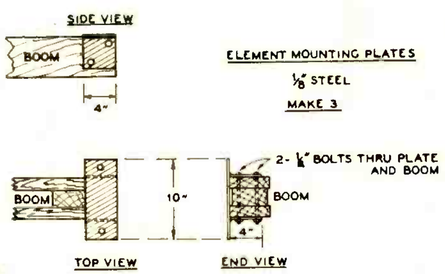


Figure 5. Top, end and side views of the element mounting plates. Three of these are required.

dimension and just far enough apart to allow them to slip snugly over the boom. Each of the 4 x 4 inch pieces had two holes drilled in it to allow it to be bolted to the boom and the large 4 x 12 inch plate had holes drilled near each end to allow bolting the element-supporting cross members to it. A detailed drawing of one of the element mounting plates is shown in figure 5. One of them may also be seen in figure 4 straddling the boom to the right of the main mounting bracket.

Securing the Mounting Plates

With the various mounting plates completed, the boom was mounted on the main mounting plate. This was done by putting the boom in place on the support, first making sure that the boom was exactly centered on the plate, and then drilling a ½-inch hole through the upright pieces (B) and the boom and out through the upright on the opposite side. One of these holes was drilled at each end of the center supporting assembly. The boom was next removed from the mounting and the holes in the boom drilled out to accommodate pieces of ½-inch inside diameter brass pipe, which serve as bearings to keep the supporting bolts from chewing up the wood.

Tipping the Boom for Adjustments

Since the tower upon which the array was mounted is sufficiently strong to be easily climbed, it is relatively simple to make antenna adjustments by removing one of the bolts at the center support and allowing the boom to swing down until either one of the elements is close enough to the mast to allow it to be reached easily. The boom is shown tipped down on one end in figure 6. To facilitate the lowering process, a pair of wooden handles about 5 feet long fitted with hooks in one end is used. These are hooked through large screweyes on the boom about 6 feet out on each side of its center. Each handle has a rope long enough to reach the ground tied through a hole in the opposite end from the hook, thus allowing the boom to be manipulated from the ground. When the tuning

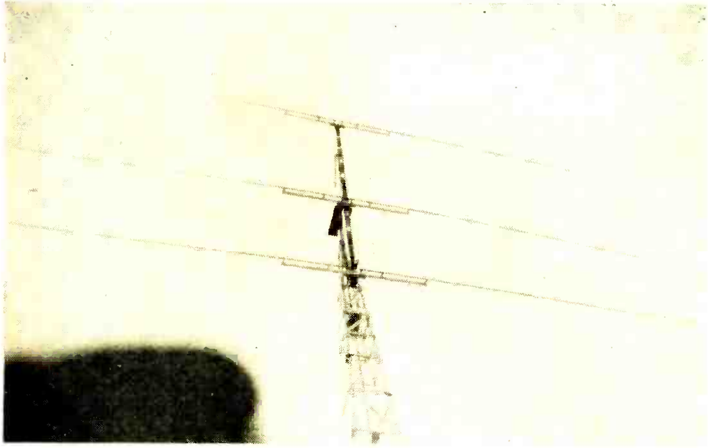


Figure 6. The boom tipped down on one end to allow adjustments to be made in one of the elements. The boom may be tipped in either direction by simply removing one of the bolts in the center mounting plate.

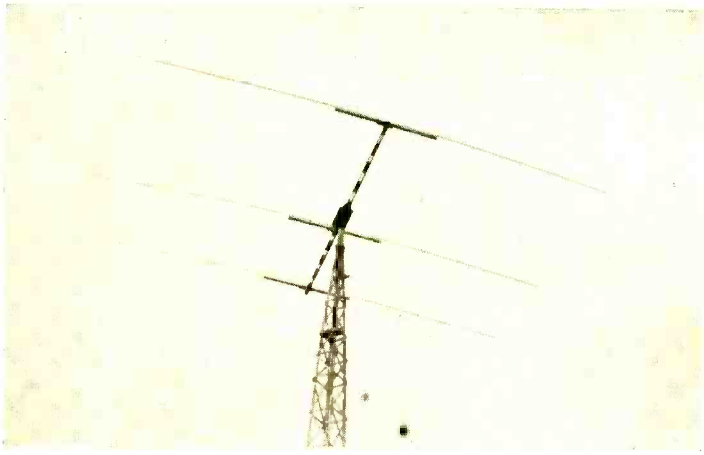


Figure 7. The beam in normal operating position — all set to push an R9 signal into Zone 23.

process was completed, the handles were unhooked by climbing the pole. Details of these handles and their application may be seen in figure 8.

The element-supporting cross members and elements were put in place on their mounting plates after the boom was placed atop the mast by the simple expedient of lowering the boom first on one side of the mast and attaching the director assembly and then repeating the process by lowering the other end and attaching the reflector.

Adjusting the Element Lengths

If desired, the element lengths may be adjusted by loosening one of the bolts holding the element cross member and swinging the whole element assembly around until one end may be reached from the ground or from the mast. Thus, all adjustments may be made without actually lowering the rotating assembly.

To give an idea of the ease with which the array may be adjusted, when first placed into service it was found to tune to a frequency about 100 kc. lower than the writer's pet spot of 14,398. With the help of W9ROQ the elements were taken off, their length adjusted and the array reassembled in just over 30 minutes!

Since this article deals principally with the construction of the element-supporting assembly, little will be said about the performance of the array. It has, however, outperformed in every respect the rotatable close-spaced bidirectional array which it replaced. Field

[*Continued on page 75*]

An Improved U.H.F.

R-C SUPERHETERODYNE

By FRANK C. JONES,* W6AJF

Thousands of resistance-coupled u.h.f. superheterodynes have been built since the original model was described by Mr. Jones several years ago. The improved version described here is more selective, and works well on 2.5 meters. Older receivers of this type can easily be modified to use the new circuit.

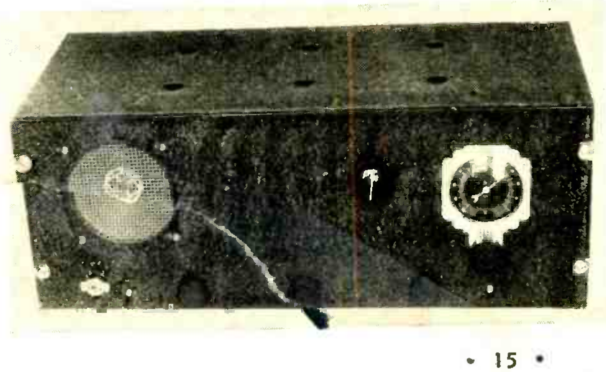
A great number of the resistance-coupled five-meter superheterodyne receivers have been constructed since the original model was described by the writer several years ago. These receivers in various forms, incorporating from four to eight tubes, were designed to receive five-meter phone signals which were extremely broad due to the popularity of frequency modulated oscillators. The new regulations prohibit use of these transmitters on five meters; so there is no logical reason for unselective receivers. The RC superhet can be improved greatly in several ways. The resistances and capacities can be chosen to give a more narrow band in the intermediate frequency amplifier and an LC circuit can be added to increase the selectivity further. The circuit shown has several other modifications so that the receiver can be used in the 2½-, 5- and 10-meter bands. For 2½ meters, the receiver can be broadened when necessary by reducing the Q of the i.f. tuned circuit by opening switch SW. The tuned circuit contributes negligible selectivity when the switch is open, because of the series resistance inserted in the tank.

The modified receiver in the photographs was originally the seven-tube RC super illustrated in several editions of the "RADIO Handbook."

If an old RC super is to be used only in the five- and ten-meter bands, the only changes really necessary are in the coupling circuits between the autodyne first detector and the first i.f. stage. The new values of resistors and condensers shown between each i.f. stage add somewhat to the selectivity. The selectivity of the modified receiver is ample for the five-meter band, but could advantageously be improved somewhat for ten-meter reception.

The LC circuit added to the first detector plate circuit consists of an old Hammarlund

* Associate Editor, RADIO.



1939 version of the popular Jones u.h.f. RC coupled superhet. The model illustrated is the original receiver built several years ago, modified as discussed in the text to include 2.5-meter operation and to give optional increased selectivity.

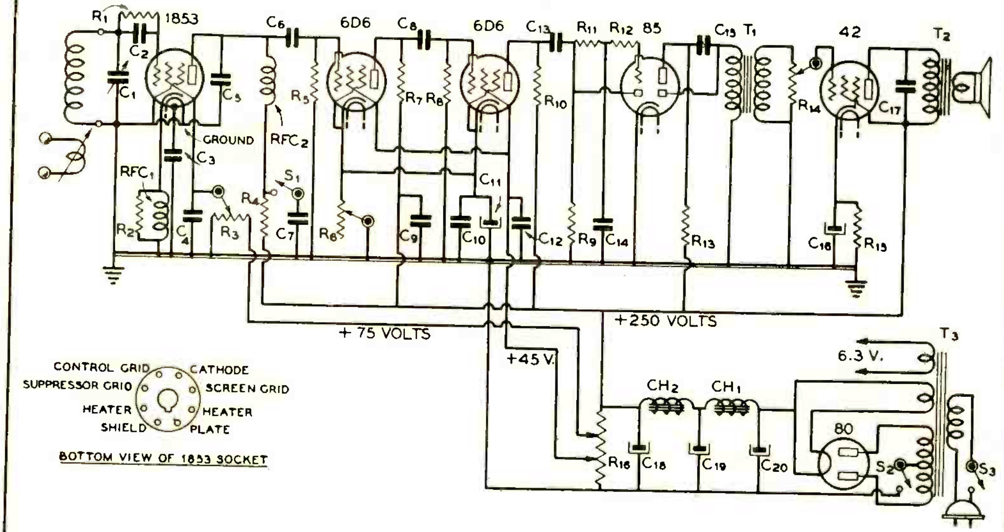


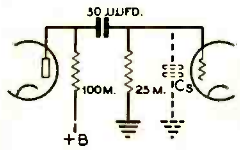
Figure 1. General wiring diagram of the improved RC superhet.

C_1—10-µµfd. midget variable, ceramic insulation
C_2—25-µµfd. midget mica
C_3—.001-µfd. midget mica
C_4—.005-µfd. midget mica
C_5—100-µµfd. midget mica (accurate)
C_6—50-µµfd. midget mica
C_7—0.1-µfd. tubular
C_8—50-µµfd. midget mica
C_9—0.1-µfd. tubular
C_{10}—1-µfd. paper, 200 v.
C_{11}—10-µfd. 25 v. electrolytic
C_{12}—0.5-µfd. tubular
C_{13}—50-µµfd. midget mica
C_{14}—.002-µfd. midget mica
C_{15}—0.1-µfd. tubular
C_{16}—10-µfd. 25 v. electrolytic
C_{17}—.01-µfd. paper tubular
C_{18}, C_{19}—8-µfd. 450 v. electrolytics in single can
C_{20}—8-µfd. 600 v. electrolytic
R_1—100,000 ohms, ½ watt
R_2—500 ohm carbon, ½ watt (try higher value if only 2.5-meter operation is desired)
R_3—50,000-ohm potentiometer, regeneration control
R_4—25,000 ohms, 1 watt carbon
R_5—0.5 meg., ½ watt
R_6—50,000-ohm tapered potentiometer, i.f. gain control
R_7—100,000 ohms, 1 watt
R_8—0.5 meg., ½ watt
R_9—100,000 ohms, ½ watt
R_{10}—100,000 ohms, 1 watt
R_{11}, R_{12}—100,000 ohms ½ watt
R_{13}—100,000 ohms, 1 watt
R_{14}—0.5-meg. pot., a.f. gain control
R_{15}—500 ohms, 2 watts
R_{16}—25,000 ohms, 50 watts
RFC_1—U.h.f. choke, see text
RFC_2—R.f. choke, 80 mh. (accurate)
T_1—Interstage a.f. trans.
T_2—Speaker output trans.
T_3—375 v. ea. side c.t. at 85 ma., and fil. windings
S_1—Selectivity control
S_2—Standby switch
S_3—On-off line switch
CH_1—15 hy. 85 ma.
CH_2—2000 ohm speaker field
Coils—See text

80-millihenry broadcast type of radio frequency choke shunted by a .0001-µfd. mica condenser. It was found that fixed values would resonate in the RC filter frequency range provided the condenser was within 10% of its rated value. The resonance curve of the i.f. amplifier with the values of resistors in figure 2 had a 0.7 amplitude per RC coupling unit at 10,000 and 66,000 cycles per second for a total shunt capacity of 30 µµfd. The LC resonance including all miscellaneous shunt capacities will be at about 50,000 cycles per second. If the 6D6 tubes have a mutual conductance of 450 under these operating conditions, working into an equivalent load of 70,000 ohms the gain in the middle of the RC "resonance" range would be 31.5 per stage. In the actual circuit the values of grid leak are modified somewhat, being 0.5 megohm in the i.f. stages and equivalent to less than 0.1 megohm across the second detector. The 0.5-megohm resistor in the first stage provides a sharp resonant peak of higher amplitude from the first detector LC plate circuit than would be obtained with 0.25 megohm.

2.5 Meters

An 1853 tube provides greater gain as a first detector on very short waves and oscillates easily on 2½ meters. It tends to oscillate so hard on 5 and 10 meters with a cathode r.f. choke for f[illegible]back that superregeneration



Fugure 2.

C_s is equal to the total shunt capacity, including shielded grid lead.

takes place unless this r.f. choke is shunted by a carbon resistor of about 500 ohms. An 1852 can be used to better advantage in the 2½-meter band if the proper shunt cathode resistor can be found to prevent superregeneration on 5 and 10 meters. These high gain television type pentodes oscillate much more readily than the 6C6 tube used in the original version of the RC superheterodyne receiver.

The sensitivity of this receiver is very good, especially in the 5-meter band, and the noise level from tube hiss is quite low, practically negligible in comparison with the usual superregenerative receiver. If there is a loud hiss in the output of this receiver, it usually indicates a superregenerative condition in the first detector. This can be prevented by using tighter coupling to the antenna or backing off on the screen potentiometer.

The antenna is coupled to the first detector tuned circuit by means of a variable link controlled from the front panel. This consists of two turns of no. 16 insulated push back wire about one inch in diameter which swings through an arc near the grounded end of the detector tuned circuit. A quarter-inch bakelite rod was drilled with two holes through which the wire was pushed and then wrapped around the rod as a support. A pair of flexible insulated leads connect to these ends of the variable link and run out to a two-wire feeder (or antenna and ground if desired). The bakelite rod rotates in an ordinary midget telephone jack as a bearing. The jack spring holds the link in any desired position yet allows the front panel knob to be turned easily.

Variable antenna coupling is a great aid in tuning for weak signals and is almost a necessity for multi-band operation since antenna resonance might pull the first detector out of oscillation if the coupling were tight enough for average reception over a wide band of frequencies. The first detector must oscillate weakly at all times in order to heterodyne the incoming u.h.f. signals into the i.f. amplifier. Screen grid voltage control by means of the potentiometer provides an easy method of oscillation control.

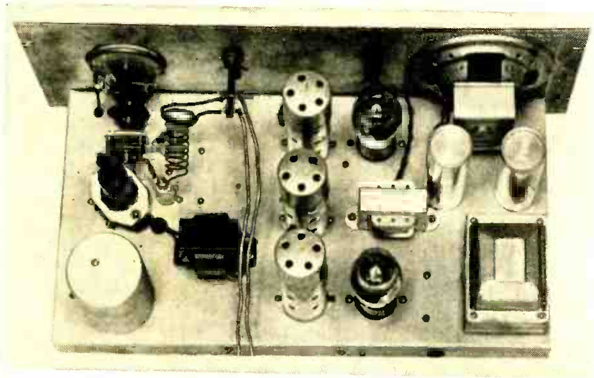
A type 85 duo-diode and triode tube serves as a second detector and audio amplifier which is transformer coupled to a 42 pentode for loudspeaker output. Only one diode is needed as the second detector and this linear rectifier is much less responsive to ignition noise QRM than a square-law grid leak detector. The triode section is diode-biased and should be connected to the plus B supply through a resistor as shown in order to prevent excessive plate current to the 85 triode plate when no signal input is present in the diode circuit.

If the transformer were connected in the usual way to plate and plus B, the full 250 volts would be applied to the 85 plate without any automatic voltage drop as in the case with resistance feed. The connection as shown also allows a very simple and fairly effective noise limiter circuit to be applied to the audio amplifier to reduce auto ignition QRM.

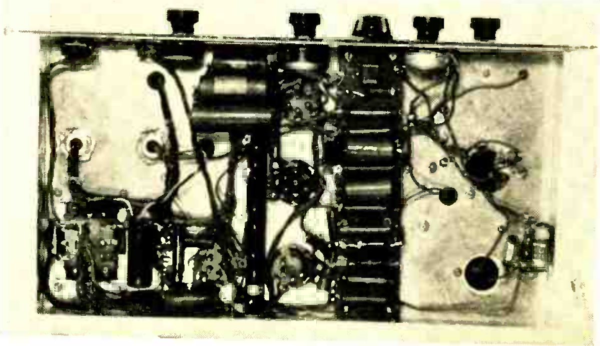
The second diode plate connects to the primary of the audio transformer and acts as a low impedance shunt for strong signals such as auto ignition voltage peaks. The noise suppression starts even on voice signals but does not cause a great deal of distortion for moderate loudspeaker volume output. If desired, a 1½ to 4½ volt C battery can be connected in series with this diode plate or a.f. transformer primary with the negative terminal towards the diode plate to provide a delay bias. This allows voice signals of moderate intensity to pass through without any distortion and still attenuates the very strong noise peaks.

The i.f. amplifier gain control is in the cathode circuit of the two i.f. stages. This acts as a sensitivity control for the receiver and must be shunted by a 1-μfd. paper condenser and a 10- or 25-μfd. electrolytic condenser in order to prevent i.f. oscillation or motorboating. The i.f. amplifier should not have over 45 volts applied to the screens for maximum gain. The second detector audio signal is fed to the triode grid through a pair of 100,000-ohm resistors with the mid-point connected to ground through a .002-μfd. condenser. This RC filter tends to prevent the i.f. signals from getting into the audio amplifying portion of the receiver.

The power supply should be capable of delivering 250 volts, 75 volts, and 45 volts through the bleeder resistor taps. The first detector screen potentiometer can be connected to any supply voltage of from 67½ to 90 volts in case batteries are employed. The receiver will work quite well with 180 volts as the plate supply for portable operation.



Top view of the improved RC superhet. The can in the lower left corner shields the tuned r.f. choke which is incorporated to increase the i.f. selectivity.



Bottom view of the RC superhet. Most resistors and condensers of the i.f. amplifier are mounted neatly together on one strip.

Coils

The 10-meter coil has 14 turns of no. 14 e. wire 7/8" diameter and 1½" long. The 5-meter coil has 7 turns no. 14 e. 5/8" diameter and 1¼" long. The 2½-meter coil has nearly two turns, about 3/8" diameter and 1¼" long. Two 1" jack-type standoff insulators were mounted 1¼" apart near the tuning condenser and isolantite tube socket. The coils are fitted with small banana type plugs for quick band change. The 1853 tube socket was mounted above the chassis and all r.f. leads are very short. The four small mica condensers are mounted by their leads directly to the tube socket terminals. The cathode r.f. choke consists of about 75 turns of no. 34 d.s.c. closely wound on a piece of 3/8" bakelite rod. Probably any u.h.f. r.f. choke would serve the purpose, though the value of shunt resistance might have to be altered. The 80-mh. r.f. choke is mounted inside an aluminum coil shield on top of the chassis. The chassis measures 1½" x 9" x 17" and the front panel, 19" x 7".

While this receiver is highly sensitive and possesses several advantages over a superregenerator, it should be pointed out for the benefit of those not familiar with RC superhets that all stations appear at two spots on the dial, the spots being quite close together. However, this is no disadvantage except when the band is "packed" with signals, in which case the QRM will be increased by the two-spot tuning. It should also be pointed out that the receiver is only suitable for the reception of phone or i.c.w. signals; it does not work on c.w.

Antenna

The performance of the receiver can be greatly improved by the use of a resonant antenna system, the simplest being a half-wave doublet fed by any of the common two-wire line methods. Probably the best method of feeding a doublet to the receiver is by a delta match and open wire line. While 72-ohm twisted cable can be used, the losses in such a line will be rather high, especially on 2.5 meters, unless the line is quite short.

A very effective vertical antenna for use with the antenna is the "J" type, placed as high as possible. If a transmitting antenna or array is in use, it may be used with excellent results on the receiver on the same band.

The "SQUARE-CORNER" Reflector

By JOHN D. KRAUS,* W8JK

The use of parabolic reflectors in directional antenna systems is well known. The antenna is placed at the focus, and it has been customary to construct the parabolic reflector so that the distance from the focus to the vertex is about one-quarter wavelength. This is indicated in figure 1-A, which is an end view of a long sheet reflector of parabolic cross section with a half-wave antenna at the focus. The reflector of figure 1-A has an aperture of one wavelength. The gain of a perfectly conducting parabolic sheet of this aperture is approximately 9 db over a single half-wave antenna. Improvements of this order can also be obtained readily by rather simple configurations of half-wave elements. These are more practical on the lower frequencies but on the ultra-high frequencies the dimensions of a parabolic reflector become small enough to make it practical also.

Other types of sheet reflectors are likewise possible. For example, figure 1-B shows a half-wave antenna in end view located at a distance, D, from a large flat perfectly conducting sheet. This arrangement has been treated by Brown[1] and was shown to be capable of a gain of about 7 db when the sheet is considered to be infinite in extent.

The Corner Reflector

Another possible configuration, which has not been previously discussed, consists of two flat perfectly conducting sheets which intersect at some angle, forming a corner. Let us first consider the case when the corner angle is 90°. The antenna is located parallel to the corner and at a distance, S, from it. This arrangement is illustrated in figure 2. The antenna is equi-distant from both planes or sheets. The maximum radiation is in the direction of a line bisecting the angle between the planes as indicated. This is taken as the direction for which $\phi = 0°$.

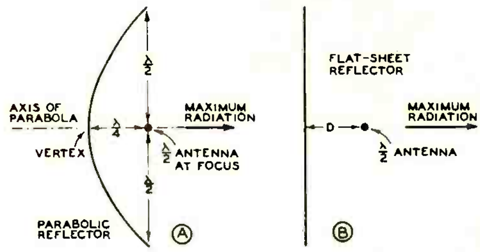


Figure 1.
Cylindrical parabolic and flat sheet reflectors.

When the two planes are considered to be infinite in extent the gain of the system over a single half-wave antenna for various values of S is given by figure 3. The analysis and equations for obtaining these gain-spacing curves are treated in the appendix. The upper curve of figure 3 shows the gain of the beam system when zero loss resistance is assumed. This case is of theoretical interest only, since in all practical cases some loss resistance is present. The lower curve gives the gain when a loss resistance of 1 ohm is assumed for the half-wave radiator. It is apparent in this case that the gain decreases rapidly for antenna-to-corner spacings of less than about 0.15 wavelength. A suitable range of spacings is from about 0.15 to 0.30 wavelength. The gain over this range is about 10 db. Larger spacings can be used but to no particular advantage.

Flat sheets which are infinite in extent are a fiction which is helpful in the analysis. In practice it is desirable to make the planes as small as possible without involving much sacrifice in gain. Thus, the width and length of the sides should be such that the performance approaches as nearly as is practical to that with infinite planes. As a first trial, it was decided to use a side width of about 0.35 and a corner or side length of about 0.6 wavelength, and a spacing, S, of 0.15 wavelength.

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* Arlington Blvd., Ann Arbor, Mich.

[1] G. H. Brown, "Directional Antennas," *Proc. I.R.E.*, Jan., 1937, p. 122.

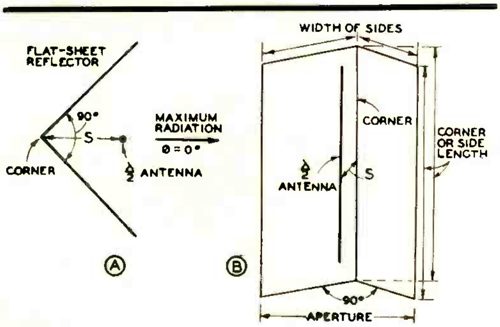


Figure 2.
Square-corner reflector.

Five-Meter Square-Corner Reflector

To test this type of antenna, construction of a 56-Mc. square-corner reflector with these dimensions was undertaken. The problem of the material for the reflector at once presented itself. The ideal material is, of course, a perfect conductor. Copper sheets approach closely to this ideal. Such sheets are economical to use with microwaves. However, a 56-Mc. reflector requires about 12 square yards of sheet and the cost of this amount is very high. Copper screen is a possibility but this is also quite expensive. A practical and economical solution to the reflector problem for a 56-Mc. antenna appears to be a curtain consisting of a large number of parallel copper wires. This construction is light, of moderate cost, and has very little wind resistance. Accordingly, this type of reflector was built. The completed 56-Mc. antenna with square-corner reflector as tested at W8JK is shown in the photograph of figure 4.

The dimensions used are given in figures 5-A and 5-B. The corner length is 10 feet 6 inches and the side width is 6 feet. The wires are supported on a light framework of white pine (1" x 1" pieces) as shown in the photograph. Coating the frame with spar varnish or lacquer is desirable. The reflector is made from a continuous piece of copper wire woven back and forth over the frame. The wire is hooked over small nails on the top and bottom side members. Wire jumpers connect the parallel reflector wires together at the top and bottom. A jumper at the center of the reflector is also used. This is especially helpful in keeping the reflector wires lined up. The "wiring diagram" for the reflector is given in figure 5-A. A spacing of 6 inches between the wires can be employed. On this basis a total of 24 reflector wires is required, 12 on each side. The reflector in the photograph was designed to use an antenna-to-corner spacing of 0.15 wavelength and the reflector wires were spaced 3 inches apart for a distance of 3 feet out either side and 6 inches for the remaining distance. See figure 5-B. This closer spacing is probably not essential, especially if larger values of S are used. No. 12 wire or larger should be satisfactory for the reflector and antenna. It is an advantage to use bare or tinned copper wire in the reflector. With enameled wire much effort must be expended in removing the insulation for the large number of connections necessary along the top, bottom and middle of the reflector.

The antenna in the photograph is fed from the lower end, the transmitter being supported on the bottom cross members of the reflector structure. Other feed arrangements are shown in figures 6-A and 6-B. In figure 6-A the antenna is series tuned at the middle and coupled to the transmitter situated at this point. Probably the most practical arrangement is shown in figure 6-B, the antenna being fed by means of a half-wave stub and 600-ohm transmission line. Zepp feeders could also be used. In adjusting this arrangement, the antenna is shock excited and the shorting wire located for maximum current or antenna resonance. The 600-ohm line is then connected at the point which gives minimum standing waves on the transmission line.

Tuning up the antenna with square-corner reflector consists only in making feeder and transmitter adjustments to get maximum power in the driven half-wave radiator. No adjustments are made on the reflector. During the tune-up, a current indicating device at the center of the half-wave antenna is useful in determining when the antenna current is maximum. The length of the half-wave radiator can be determined from the usual antenna

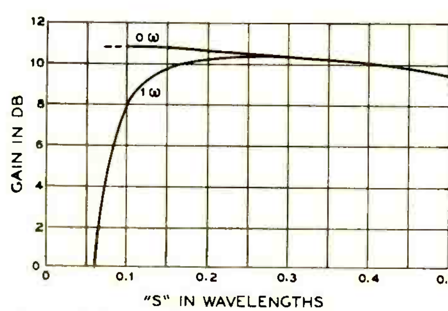


Figure 3.
Variation of gain with a square-corner reflector as a function of the antenna-to-corner spacing, S.

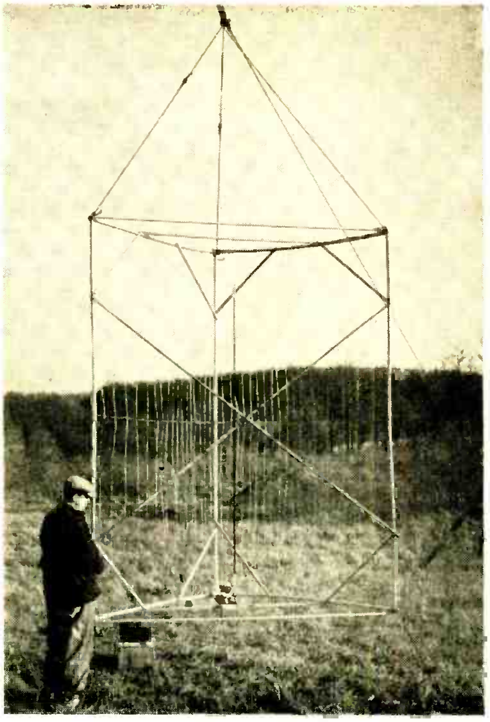


Figure 4. The 56-Mc antenna with square-corner reflector at W8JK. The half-wave radiator has been retouched to show its position more clearly. The transmitter is at the lower end of the half wave. The power supply is on the box under the reflector. The sides of the reflector curtain are substantially flat and meet at a right angle although due to an illusion it appears in the photograph that the reflector is slightly curved.

formulas. A length of about 8 feet was used for the antenna in the photograph.

Nothing in the antenna appears to be critical. The dimensions of the reflector, spacing of the wires, and the value of S all can be varied slightly with little change in performance. The angle of the corner is also not at all critical. It is not known if the corner length of 10 feet 6 inches, used in the tests, is the optimum value. However, satisfactory results were obtained with this length.

Figure 6-C shows a single-section flat-top beam[2] with square-corner reflector. Although such an arrangement might appear promising, each element of the flat-top must be tuned individually. This results from the fact that the inner flat-top element is closer to the reflector and has a considerably lower radiation resistance and a different reactance than the outer element. By spacing both flat-top elements sufficiently far from the corner this differential can be reduced, but a reflector with wider sides is then necessary.

Field Tests

The results of a field test on the antenna in the photograph are shown by the solid curve in figure 7. The dashed curve is computed for the case of a square-corner reflector with infinite sides. Both curves are adjusted to the same maximum. The small circles indicate experimental points. A calibrated field intensity meter was used and was located about 4 wavelengths from the antenna. The antenna was then rotated through 180°.

The beam has a measured front-to-back power ratio of about 60 to 1 or about 18 db. The measured pattern is not as sharp as the computed one. This is due to a number of causes. First, the sides of the antenna are not infinitely large; second, the reflector is not a solid perfectly conducting sheet so that some radiation may "filter" through; and third, some of the radiation picked up with the beam turned in the 180° position may have come from the leads to the power supply. The gain of the actual reflector is probably a couple of db less than the value computed for infinite sides.

A spacing, S, of 0.15 wavelength was used in this test. With this spacing, the radiation resistance of the half-wave radiator is quite

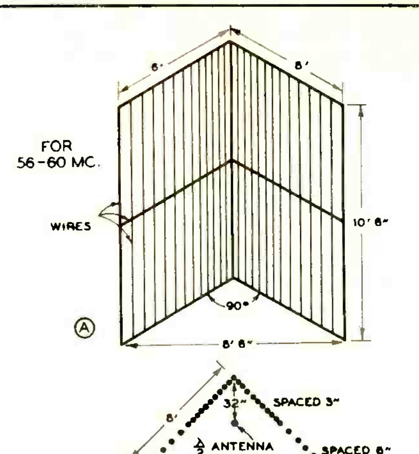


Figure 5. Dimensions and wiring of the 56-Mc. square-corner reflector.

[2] J. D. Kraus, "New Design Data on the Flat Top Beam," RADIO, June, 1938, p. 15.

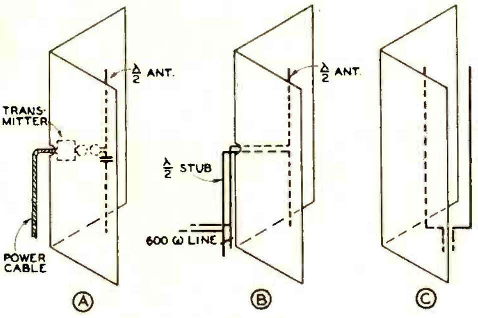


Figure 6.
Methods of feeding the driven radiator. The arrangement at C is a single-section flat-top beam with square-corner reflector.

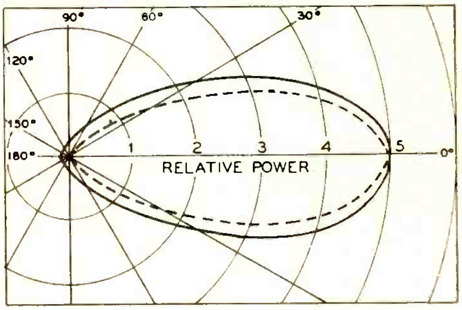


Figure 7.
Measured radiation pattern of the 56-Mc. square-corner reflector (solid curve). The antenna-to-corner spacing is 0.15 wavelength. The dashed curve is computed for a square-corner reflector with infinitely large sides.

small, and any loss resistance present tends to have a marked effect on the gain (see figure 3). More spacing is therefore desirable if it can be used conveniently. Spacings of 0.2 to 0.3 are recommended. Table I gives dimensions for the reflector according to the value of S chosen. In each case, a range of side widths is given. The largest value which is convenient should be employed. The smallest values of side width listed result in a slight sacrifice in gain. If directivity and not gain is desired, as with an antenna used exclusively for receiving, a value of S of 0.15 wavelength or somewhat less could be employed to advantage.

In another test with the reflector shown in the photograph, an antenna-to-corner spacing of 0.3 wavelength was tried. This arrangement gave a measured gain of about 7.5 db over a single half-wave antenna. This gain was somewhat more than when S was 0.15 wavelength.

The square-corner reflector described is used with the corner and half-wave antenna oriented vertically, giving vertically polarized radiation. If desired, the corner and antenna can, of course, be turned horizontal to produce horizontally polarized radiation.

Another possibility is to make the reflector twice as long and use a double zepp antenna as the radiator. This would give slightly more gain.

TABLE I

Dimensions of Square-Corner Reflector

For 56 to 60 Mc.

"S" in wavelengths	"S" in feet	Width of sides
0.15	2′ 7″	4′ to 6′
0.20	3′ 5″	5′ to 8′
0.25	4′ 3″	6′ to 10′
0.30	5′ 1″	7′ to 12′

Corner or side length = 10′ 6″
Aperture = Width of side x 1.41
Reflector wire spacing = 6″
For 112 Mc. (2½ meters) divide the above dimensions by 2.

Corners of Less Than 90°

Two flat sheets intersecting at angles of less than 90° are also possible. Figure 8-A shows a reflector with an angle of 60° and 8-B shows one with an angle of 45°. Assuming infinite planes, the gain of the 60° corner reflector is over 12 db and the gain of the 45° corner even more. Intermediate angles can also be used but these are not as simple to analyze by means of the method used in the appendix. As the angle between the planes is decreased, the gain of the system can theoretically be increased to any desired amount. There is, however, a real objection to the use of corners of less than 90° unless the value of S is at least about 0.5 wavelength. This is so because the radiation resistance of the half-wave radiator becomes very small as the angle between the planes is decreased, when small values of S are employed. If the value of S is about 0.5 wavelength, corners of less than 90° can be used advantageously. For example, a 60° corner reflector with S equal to 0.5 wavelength gives a computed gain of about 12.5 db even with considerable loss-resistance present. This is for infinite sides. If the sides are of such width that the aperture of the 60° corner reflector is about one wavelength, the gain should still approach 12 db.

Corners of more than 90° can also be used if desired. The limiting case would be a 180° "corner" or flat sheet.

Conclusion

The corner reflector is a type which appears to have excellent possibilities. The simplicity of its construction when compared with a parabolic reflector is of considerable advantage. The corner reflector produces a highly directional beam system with a relatively small structure. The gain is substantial. For example, a square-corner reflector with an aperture of one-half wavelength can give a gain of about 8 db. An aperture of twice this value, or one wavelength, is necessary with a conventional parabolic reflector to obtain a gain of this order. This applies to parabolas with a focus-to-vertex spacing of about one-quarter wavelength. Smaller spacings with

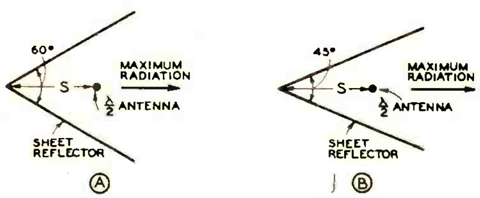


Figure 8.
Reflectors with 60° and 45° corners.

correspondingly smaller apertures could be used with the parabola, but for a given size of aperture the corner reflector would still compare very favorably in performance.

Acknowledgment

The writer greatly appreciates the interest and criticism of Dr. Robert M. Whitmer of the Department of Physics at Purdue University.

APPENDIX

The method of images is used in the analysis of the corner reflector. This method can be applied in all cases where the angle between the planes is 180°/n, where n is any positive integer. Thus, corners of 180° (flat sheet), 90°, 60°, 45°, and so forth, can be treated. This fact is well known in electrostatics.[3] It

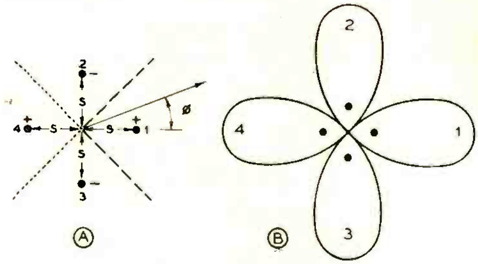


Figure 9.
Image antenna configuration and pattern for analysis of the square-corner reflector.

is assumed that the planes are infinite in extent.

In the case of the square-corner reflector, there are three images, 2, 3, and 4, as indicated in figure 9-A. At first glance, only two images, 2 and 3, would seem to be required, but actually the planes forming the corner must be extended as indicated by the dotted lines. Element 4 is then the image of 2 and 3. The plus and minus signs show the relative phases of the currents in the elements. The currents in the four elements are equal in magnitude.

The gain of the beam over a half-wave antenna at a distant point is the product of the vector sum of the fields from the four elements and the current in each element expressed in terms of the current in a half-wave antenna having the same power input.

The voltage, V_1, at the terminals of element 1 is by Kirchhoff's law,

$V_1 = I_1Z_{11} + I_1Z_{1L} + I_1Z_{14} - 2I_1Z_{12}$, where,
Z_{11} = the self-impedance of element 1,
Z_{1L} = the loss impedance of element 1,
Z_{14} = the mutual impedance of elements 1 and 4, etc.

There are three similar expressions for the image elements. The power in each element

[*Continued on Page* 75]

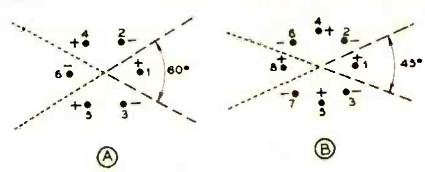
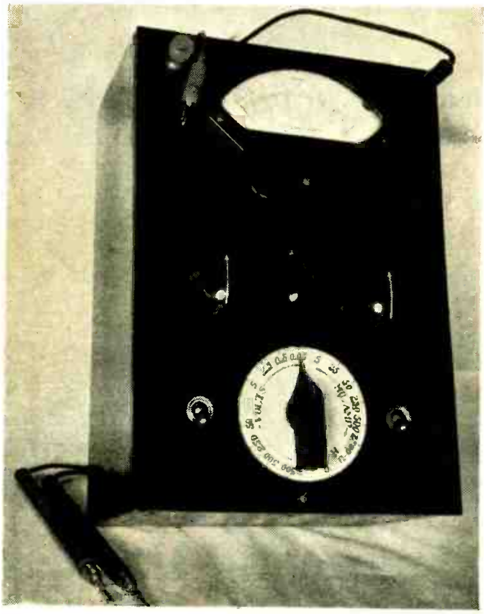
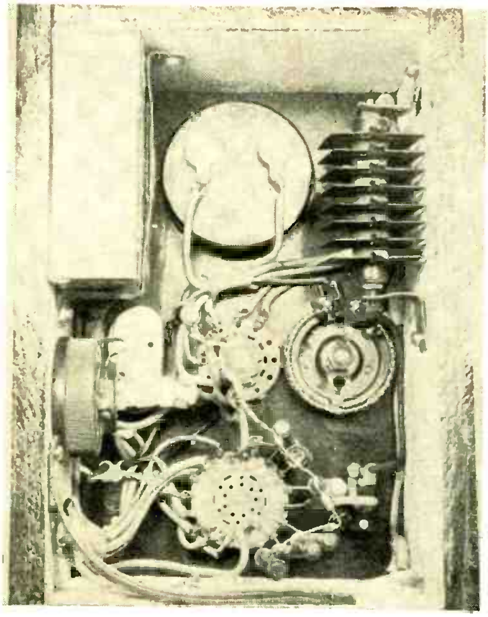


Figure 10.
Arrangement of images for analysis of 60° and 45° corners.

[3] Sir James Jeans, "Mathematical Theory of Electricity and Magnetism," 5th edition, Cambridge University Press (London), p. 188.



Top view of the completed multi-meter showing the indicating instrument, ohmmeter adjusting rheostats, and the selector switch.



Interior view of the multi-meter. The rebuilt rectifier can be seen on the right-hand wall of the box.

Electrical MULTI-MEASUREMENTS

By JAMES SILVERMAN*

Radio amateurs and experimenters are constantly investigating the many types of electrical magnitudes and relationships existing in power and radio circuits. In the course of their work they must be able to measure direct and alternating currents ranging from 0.0001 to 100 amperes; d.c. and a.c. voltages from less than a volt to several thousand; and in rare cases their measurements may exceed these limits. They must determine values of resistance, capacitance, inductance and power. And these measurements must be secured simply and with a fair degree of accuracy.

The cost of a multitude of single meters capable of covering such vast ranges of values is quite high. A complete assortment of meters, therefore, is beyond the reach of the average individual.

To correct this deficiency, and to secure compactness and flexibility, the universal meter has been developed. A number of more or less satisfactory units are now on the market. But few of these exhibit a universality which would make the possession of other types of meters unnecessary, and these few are exceedingly expensive.

The universal meter described here has an exceptionally low construction cost. Through a series of ranges this instrument has continuous d.c. coverage from 20 microamperes minimum to 2.5 amperes maximum, from one millivolt minimum to 2500 volts maximum.

The sensitivity of the alternating current ranges is lower but still quite good. With the application of either 0.4 volts or 2.5 milliamperes, a.c., on the most sensitive scale, the meter will provide full scale deflec ion. Maximum values of alternating currents and voltages readable on the meter are even higher than for the d.c. ranges. All ranges, of course, may be extended by means of external shunts and resistors.

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* 167 Johnson Ave., Newark, N. J.

Amateurs and experimenters who can't afford an array of meters can make one meter do for all common measurements such as inductance, resistance, capacity, and a.c. and d.c. voltages and currents. The necessary shunts and rectifier can be salvaged from the junk box, the multipliers purchased for a few cents each.

Besides these current and voltage scales the meter is also provided with two resistance ranges, which have maximum values of 2000 and 200,000 ohms respectively. Here again, by a simple external circuit (see figure 1), resistance values of an even higher order may be easily determined. Finally, this instrument is ideally adapted for the simple measurement of inductance and capacitance, especially in those cases where extreme accuracy is quite unnecessary.

In spite of the multiplicity of functions performed by this instrument, the construction of the universal meter is not difficult, and the circuit diagram can easily be followed.

Great care has been taken in the design of the meter to make it practically foolproof.

The Indicating Instrument

The constructor, of course, is not constrained to use any particular type of indicating instrument. He may employ any make having the same rating as the one shown: 0-1 ma. movement and 50 ohms internal resistance. Many excellent instruments are commercially available.

The Selector Switch

An essential feature of the universal meter is the seventeen-contact rotary switch. All ranges are chosen simply and swiftly by a turn of this selector device. Because this switch is of the shorting type, the circuit remains unbroken when changes are made from one current range to another.

If additional ranges are desired on the universal meter a rotary switch may be selected having a greater number of contacts. Or a second such switch may be installed. The circuit diagram is very flexible, and permits the inclusion of additional voltage and current ranges with great facility.

D. C. Voltage Ranges

For the d.c. voltage ranges the simplest but also the most expensive procedure is to buy resistors accurately calibrated. However, for those persons whose financial resources are slim, a small amount of labor will accomplish excellent results.

Secure the cheapest resistors possible (say, of the five-cent variety). Because of the low price several of these may be secured for each range. Some of these resistors when connected into the voltage circuit will give results accurate enough to require no further adjustment. However, to secure the correct value where the resistor choice has not been so fortunate, the following procedure may be resorted to:

Select a resistor whose value is somewhat under that required. The cross section is then slowly filed away so as to raise its resistance to the required amount. The resistor is then protected from moisture by rubber tape and a coat of shellac or by a coat of lacquer.

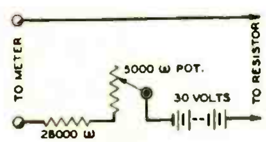

Figure 1. External circuit for extending ohms range to two megohms. With terminals shorted, the 5000-ohm potentiometer is adjusted so that the meter reads full scale. The terminals are then placed across the resistor and the meter will indicate its resistance.

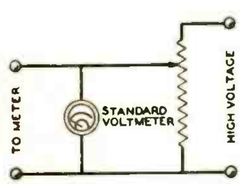

Figure 2. Voltage calibration circuit. General circuit for obtaining any voltage desired. The potentiometer or divider resistor should have a rating of ample wattage when voltages above 1000 are being used.

In all cases the resistor unit is of the correct value when a known voltage is indicated correctly on the upper reaches of the meter scale. The circuit shown in figure 2 will be found quite useful for voltage calibration.

The following table gives the values and ratings of resistors for the various voltage ranges. For those persons who desire additional ranges the value of resistor required by any particular range is given by the formula, $R = 1000\,E - 50$ ohms, where E is the maximum voltage readable on the scale. The (— 50 ohms) term may be dropped for voltages above 25 volts.

Range in Volts	Resistor Value, Ohms	Power Rating, Watts
0.5	450	1
2.5	2,450	1
5.0	4,950	1
25	25,000	1
50	50,000	1
250	250,000	2
500	500,000	5
2500	2,500,000	20

If difficulty is encountered in securing any particular value of resistance, two resistor units may be connected in series to give the required value. For example, 2450 ohms may be secured by connecting resistors of 2000 and 450 ohms in series.

The power ratings shown in the column at the right are necessary only when the meter is to be connected for long periods of time across live a.c. circuits. If measurements are to be intermittent, which is usually the case, no resistor need have a power rating greater than two watts.

D. C. Current Ranges

One continuous shunt is used to obtain the current ranges. The wire-wound section of a filament rheostat usually found present in old battery sets forms an easily obtainable yet effective shunt resistor for this purpose. Inasmuch as one end of the shunt is to carry 2.5 amperes, heating of the wire, with a consequent change of resistance, will occur. This action is highly undesirable, and the means indicated in figure 3 is suggested to overcome it.

It is noticed in this sketch that the shunt is in two sections, one of which is the wire-wound insulator strip of a 30-ohm filament rheostat, the other of which has a resistance element composed of six strands of rheostat wire. Only this latter section of the shunt

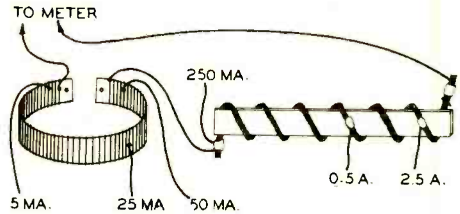

Figure 3. Schematic diagram of the method of connection of the various elements comprising the series shunt for current readings.

is permitted to carry currents from 0.25 to 2.5 amperes. Heating effects are greatly minimized in this manner.

The resistance of the total shunt is not critical, but it should be in the neighborhood of 30 ohms. The entire shunt is connected across the indicating instrument, and the calibration procedure is as follows:

A current maintained at exactly 2.5 amperes is secured by the circuit of figure 4 through the adjustment of the variable resistor there. This current is permitted to enter to the right of the shunt (see figure 3). The return wire for this current is attached to a point on the shunt which will make the meter read exactly 2.5 amperes. By moving the return wire along the shunt this point can be easily found. A connection is then carefully soldered to this spot on the shunt. If it is found that the meter now reads a trifle low, the section of the shunt between the soldered wire and where the current enters is carefully filed until the needle again indicates exactly 2.5 amperes. This procedure gives a 2.5-ampere tap.

Next, a current of exactly 500 milliamperes is permitted to enter at the same point on the end of the shunt. As before, the return wire is moved along the shunt away from this point till the meter indicates exactly 500 ma.

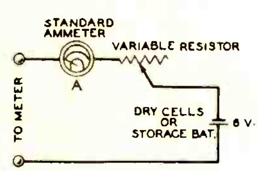

Figure 4. Current calibration circuit. The variable resistor should be 10 ohms for the high-current calibration, 60 ohms for intermediate currents, and as high as 500 ohms for the low-current calibration. Replacement of the d.c. source by an a.c. one and of the d.c. instrument by an a.c. one will provide an a.c. calibration circuit.

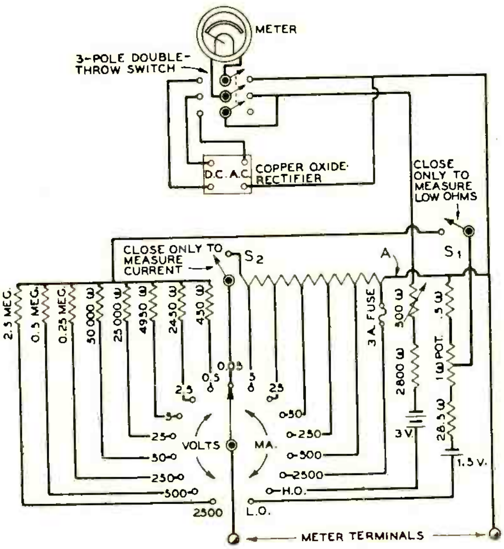

Figure 5.
Complete wiring diagram of the multi-meter.

At this point another connection is made. If the indicating instrument reads low after the soldering, the section of the shunt between the 2.5-ampere tap and the 500-milliampere tap may be filed till the needle indicates full scale.

Proceeding in this manner, a shunt is obtained fully calibrated for ranges of 5, 25, 50, 250, 500 and 2500 milliamperes.

Measurement of Resistance

Now that the voltage and current ranges have been made workable, resistances of any order may be easily evaluated. First a measured voltage is placed across the resistor, and the value of current which flows is determined. The voltage reading is then divided by the current reading. This calculation will supply the value of the resistor in ohms.*

In order to read values of resistance up to 2000 ohms directly on the meter, the range selector is set on "L. O." (Low Ohms), the switch S_1 in figure 5 is closed, the terminals of the universal meter are shorted, and the one-ohm potentiometer, R_p, is adjusted so that the pointer shows full-scale deflection. The terminals are then placed across the resistor whose value is to be determined, and the meter will indicate its resistance.

Though the individual resistances in the "L. O." circuit are not critical, it is essential that the entire resistance of this circuit total exactly 20 ohms. Because of its low internal resistance, the use of an "A" cell in a circuit of this type is distinctly advantageous.

Values of resistance up to 200,000 ohms may be read directly on the second resistance range of the meter. The range selector is set on "H. O." (High Ohms), the terminals of the universal meter are again shorted, and this time the 500-ohm variable resistor is adjusted until the needle indicates zero ohms. The test prongs are then placed across the unknown resistor and the meter reading will give its value in ohms.

Figure 1 illustrates the circuit required to extend the range of the meter to 2 megohms.

The Rectifier

In the design of the meter it was at first thought possible to use a commercial copper oxide instrument rectifier. To read a.c. voltages this type of rectifier is quite effective. But its resistance is so high that it becomes extremely insensitive to normal voltage drops found across meter shunts. Because of its unsuitable characteristics for current measurements, the search for a rectifier of low resistance was begun.

Copper sulfide rectifiers gave disappointing results, seemingly doing little rectifying on the low currents employed. Strangely enough, copper oxide cells from a trickle charger, which happened to have undergone hundreds of hours of charging duty previously, were found to be the solution to the problem.

The cells used were from a Kuprox 0.25-ampere trickle charger. This rectifier contained two eight-unit banks of copper oxide cells. These two sections were removed from their case, and connections between adjacent cells were severed.

The ohms range of the universal meter was used to determine the ratio of forward to backward resistance of each cell. Those units whose ratios gave the greatest departure from unity were determined on each bank of cells. The inferior of the two banks was discarded, and the four best units on the remaining group of cells were used in the rectifier circuit. Because of possible injury and maladjustment to the rectifier cell units, it was thought inadvisable to remove the four spare copper oxide cells from the bank.

Like terminals of each of the four copper oxide cells used were determined by noting the connection of the + terminal of the uni-

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* This calculation exemplifies the fundamental form of Ohm's Law, which is usually expressed algebraically as $I = E/R$ where I is the current in amperes, E is the potential in volts, and R is the resistance in ohms.

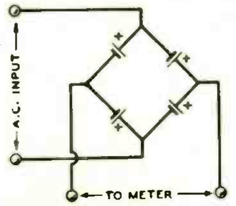


Figure 6.
Rectifier bridge circuit. The plus signs indicate a given terminal of each rectiter cell unit. The text explains the method of finding each proper terminal.

versal meter when each cell was connected in so as to show its higher resistance. The four cells were then connected in the bridge rectifier circuit as shown in figure 6.

If, under measurement, the meter reads backward, the connections to the d.c. leads of the bridge must be reversed.

The use of the trickle charger rectifier for the meter offers several pleasing results. First, the flow of two or three milliamperes through units designed to operate continuously on 250 ma. will produce inappreciable temperature effects. Second, the units have been aged over such a long period that a state approaching equilibrium has been reached. Third, overloads sufficient even to destroy the meter will not damage the rectifier. Qualities such as these insure the continued correctness of all alternating-current calibrations of the universal meter. Commercial meter rectifiers are still inferior in these respects.

The most pleasing point of all, however, is the fact that the meter, because of the curved rectifier characteristic apparent in figure 7, provides readings which are very nearly effective values. This condition means that a.c. readings are indicated correctly regardless of the wave form present.

In order for the a.c. circuit of the meter to indicate effective values, it is essential that the static rectifier characteristic should be representable as either a quadratic or a cubic equation. If, in the circuit, the rectifier has such a characteristic, then the meter will indicate r.m.s. values whether the voltage has a peaked, square, or sinusoidal shape, or any other intermediate form.

It is extremely probable that most rectifier characteristics will only approach a parabolic shape. A simple test, however, will determine this condition. If, throughout the range of the meter, like values of d.c. and a.c. voltage give equal deflections, then it is practically certain that the instrument indicates r.m.s values.

There seems to be little doubt that most copper oxide trickle charger units can be converted very simply into a meter rectifier.

Calibration Charts

By means of calibration charts all readings of a.c. values on the meter can be converted easily into actual volts, amperes, henries, and microfarads. The fundamental basis of these charts is the simple plotting of actual a.c. values against meter readings.

The same ranges used for d.c. voltage measurements may now be used for a.c. voltages by the inclusion of the rectifier into the circuit. Since the meter no longer indicates real readings, the essential procedure for the construction and use of an a.c. voltage calibration chart will now be undertaken.

For this purpose the 50-volt range was selected. Various known voltages were placed across the meter and a list of readings were obtained. Typical values are shown in the following table:

Meter Readings	Applied Voltage	Meter Readings	Applied Voltage
0.00	0.00	1.84	74.1
0.17	12.2	2.57	87.0
0.46	30.0	3.31	98.5
0.81	47.0	3.98	107.5
1.29	62.5	4.46	114.0
		5.00	121.5

In plotting these data it will be noticed that the applied voltage values have been divided by 10, and for additional convenience, the chart has another set of coordinates placed outside those used for plotting. These outer scales are half the value of the inner coordinates.

An inspection of figure 7 will indicate the construction and use of the chart. The decimal point for any values read from the chart is determined by inspection.

On the 0.5-volt range the resistance of the non-linear rectifier will have a noticeable effect on the current flowing with any given impressed voltage. For this reason the calibration chart will be in error by a small amount, the magnitude of this error depending upon the characteristics of the rectifier employed. A separate calibration chart for this low voltage range, however, will supply accurate measurements.

Alternating Current Ranges

With the insertion of the rectifier into the circuit, the direct current ranges will register alternating currents. Known values of alter-

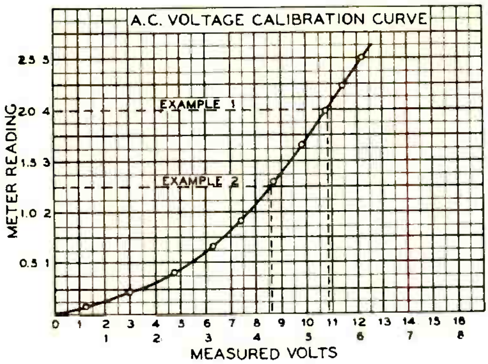


Figure 7.
A.c. voltage sample calibration chart. After the chart has been made up for the individual meter it is used as follows: Example 1—meter range, 2500; meter reading, 2000; curve gives actual voltage as 5400. Example 2—meter range, 500; meter reading, 250; actual voltage from curve, 860.

nating current are sent through the meter and tabulated against meter readings. This procedure will permit the construction of a calibration chart similar to the one drawn for a.c. voltages.

It is probable that the lowest current range will give values which are not in strict agreement with the current calibration curve. In that case a separate calibration curve should be constructed for this range, and accurate measurements of small currents will result.

Measurement of Capacitance and Inductance

Once the a.c. voltage and current ranges have been calibrated, the determination of inductance and capacitance becomes a simple matter. If the resistance of a choke or winding is small in comparison with the reactance, the inductance in henries may be determined as follows:

Place a convenient known a.c. voltage across the unit. Measure the current through the device. Divide the voltage by the current and multiply the result by 0.00265. This type of test, when made with 60-cycle current of approximately sinusoidal form, will supply the inductance of the coil in henries. The resistance of the winding may be as high as 30% of the value of the reactance, yet the preceding computation will give results which will be in error by less than 5%.

Under a similar type of test the capacitance of a condenser may be found. Measure the voltage across the condenser and the current through it. Divide the *current* by the *voltage* and multiply the result by 2650. This type of test, when made with 60-cycle current of approximately sinusoidal form, will supply the capacitance of the condenser in microfarads.

If the experimenter or amateur is an ambitious sort of person, he may construct calibration charts to be used in conjunction with the alternating current ranges—these charts to be a plot of inductance and capacitance against meter readings under a constant voltage. The house line voltage is kept by the power companies at a surprisingly stable value, and so may be used in this connection to supply inductance and capacitance readings with a reasonably fair degree of accuracy.

Since the current flow through a coil under a constant voltage is a measure of its impedance, its inductance may be determined from:

$$L = \sqrt{\frac{E^2 - I^2R^2}{(2\pi fI)^2}},$$

where L is the inductance in henries, E is the voltage across the coil, I is the current in the coil, R is its resistance, and f is the line frequency.

If the resistance of the coil is neglected the equation becomes:

$$L = \frac{E}{2\pi fI}$$

which, under a constant voltage of 120, and a line frequency of 60 cycles per sec., reduces to:

$$L = \frac{0.388}{I}$$

This latter equation shows that if the current scales of the calibration curve are divided into 0.388, a plot of meter readings against inductance will result.

In a similar manner the capacitance in microfarads is found to be:

$$C = 26.6\ I.$$

If the current scales of the calibration curve are multiplied by 26.6, a plot of capacitance against meter readings will result.

To sum up, for a coil or choke, divide the current which flows into 0.388 to secure the inductance. For a condenser multiply the current which flows by 26.6 to secure its capacitance.

If use is made of all alternating current ranges, capacity measurements from 0.01 to 100 microfarads, and inductance measurements from 0.1 to 500 henries are possible.

Precautionary Measures

The indicating instrument itself has not been fused, because such action would mean the insertion into the meter circuit of a high resistance whose value would vary with the current through it. This state of affairs is highly objectionable, resulting in poor accuracy and sensitivity.

However, the highest current range is fused. All current measurements, to be on the side of safety, should start with the rotary switch on the 2.5-ampere range, and from there descend to a range where a reasonable deflection is obtained.

Voltage measurements should start on the 2500-volt scale and descend the voltage ranges until a scale is reached where the maximum readable deflection is obtained.

When not in use the universal meter should be left with the rotary switch on the 2500-volt range.

If procedures of this type are always followed, and made a condition to the use of the meter, the safety of the instrument can be assured.

AUXILIARY MEASUREMENTS

Shunts

To measure currents higher than 2.5 amperes external shunts may be employed. These shunts may be easily built for currents as high as 100 amperes. The only rule which one must carefully observe in the construction is that temperature effects must not be excessive when the shunt is in operation. The more metal and exposed surface used in the shunt proper, the less will be temperature and resistance variations with any given current.

Any type of resistance element may be used. Even tinned steel plate (such as may be found composing "tin" cans in the pantry) has been used effectively as the shunt element.

The construction of two types of shunts are illustrated in figures 8 and 9. Whether the shunt be made fnr 25, 50, or 100 amperes, its resistance must be such as to produce a voltage drnp between meter terminals sufficient to deflect the meter exactly full scale at rated current. For resistances of the order encountered in these shunts—0.0005 ohms for the 100-ampere shunt—the best procedure to secure the correct values is by trial and error. Enough resistance elements are placed in parallel to produce a value somewhat less than the required voltage drop. Judicious filing is then resorted to, until the exact potential is produced between shunt terminals.

If good accuracy is required the same set of leads used in the calibration of the shunt should be employed in actual measurements.

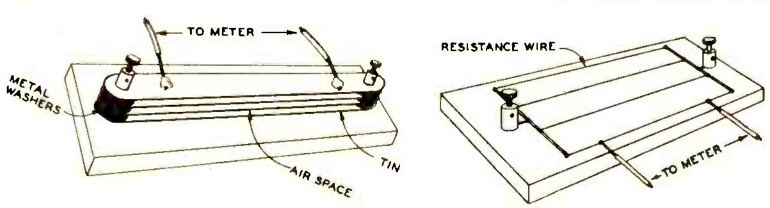
External Voltage Resistors

For the measurement of d.c. voltages above 2500 volts, external resistors may be employed. The 2500-volt range of the meter should always act in series with the external circuit. Because of the high voltages involved a careful check should be made in order to have adequate insulation at all possible points of the circuit.

An external resistor of 2.5 megohms will extend the 2500-volt range to 5000 volts d.c. and 12,000 volts a.c. A resistor of 5 megohms in series with this range will permit readings up to 7500 volts d.c. and 17,000 volts a.c. These external resistors should be oversized, so that temperature changes should not be excessive under more than occasional use, and should be of the special, high-voltage multiplier type. As large a radiating surface as possible is desired, for as much as thirty watts will have to be dissipated when continuous measurements of voltages as high as 17,000 volts a.c. are being undertaken. Also, the resistors must be designed to handle the voltage gradient.

Power and Power Factor Determination

In all measurements of power factor either a power factor meter or three separate instruments—a wattmeter, voltmeter, and ammeter—are employed. Ordinarily the universal meter cannot be used for this type of measurement. However, by the use of a simple external cir-



Figures 8 and 9.
Two types of high-amperage shunts for extending the current ranges of the multimeter. These shunts are ordinarily used externally with connecting leads from the shunt to the meter.

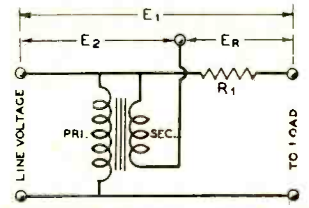


Figure 10. External circuit for power-factor determination. See text for method of interpretation of indications.

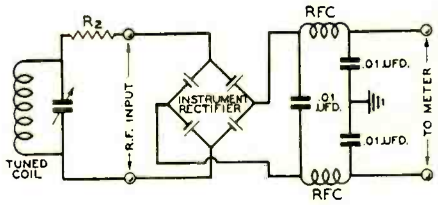


Figure 11. External circuit for measurements at high frequencies. It must, of course, be calibrated for the desired frequency of measurement.

cuit, the writer has developed a method for the determination of power factor which involves only the measurement of voltages. Figure 10 illustrates the circuit diagram.

The transformer used in the circuit is of the low-power bell-ringing type. Enough wire is removed from the secondary of this transformer to produce a potential of one or two per cent of that of the primary. The transformer is then connected into the circuit, first with the secondary polarity one way, then with the polarity reversed. If the load is reactive, E_r will read a maximum only under one set of conditions, and at that time correct connections will exist.

The value of R_1 is not critical, and will, in general, depend upon the order of current required by the load. Whatever the current, the drop across R_1 should not be permitted to exceed 2% of the line voltage, nor should it fall below 0.5% of the line voltage; otherwise decreased accuracy will result in the determination of power factor. With the limits specified here kept in mind, R_1 may assume any convenient value, such as one ohm for currents up to 2 amperes, or 0.01 ohm for currents as high as 200 amperes.

Measurements of E_1, E_2, and E_r are made under any load. To secure the power factor of the circuit these values are substituted in the power factor formula:

$$\text{Power factor} = \frac{E_r^2 - E_1^2 - E_2^2}{2\,E_1\,E_2}$$

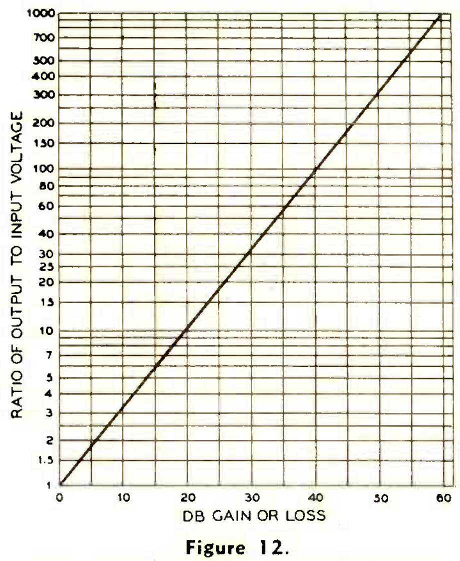


Figure 12.

Chart showing ratio of output to input voltage (assuming the same input and output impedances) plotted against decibels gain or loss.

Because power factor determinations are now possible, the power taken by alternating current devices, such as transformers, motors, and transmitters, can be computed by the use of the formula:

Power (in watts) = E × I × Power Factor, in which E is the voltage across the circuit and I is the current which flows.

It must be remembered that, except for heating and lighting purposes, practically all alternating current devices take reactive power. The multiplication of only the voltage and current to get the true power taken becomes, then, invalid. The power factor is an integral element in the power determination, and must be included, as has been done in the preceding formula.

Measurements at High Frequencies

The rectifier contained in the universal meter is useless for measurements at frequencies much in excess of 10,000 cycles per second. However, using copper oxide meter rectifiers of small size (5 ma. capacity) together with

[*Continued on Page 76*]

Figure 2.
The city of Lhasa has no street cars, only one amateur, and is a "long ways from anywhere."

Figure 3.
The Mission Residence, actually the summer residence of the Incarnation God at the Kunderling Monastery.

Figure 4.
A huge prayer Ghortin. This might be called the western gate to the city of Lhasa.

Figure 5.
The Sera Monastery, second largest in Tibet, is occupied by 5000 Lamas.

Figure 1. Reg Fox, AC4YN, (right) decked out in silk costume while talking to Sikkimese doctor.

Hams Across the Sea

By HERB BECKER,* W6QD

To most people Tibet is a fascinating and romantic country, principally because they know so little about it. To a great extent the people, customs, and cities of Tibet have been shrouded in mystery.

In this far off country, "a long ways from anywhere," there is at present but one active amateur, who is also the only amateur in Zone 23. This makes R. N. (Reg) Fox probably the most sought-after ham today. Not only does working AC4YN mean a new and hard-to-work Zone, but a new country as well. And the only way to get this elusive Zone and country is to work AC4YN.

While Reg has certainly done his bit towards putting AC4YN on the map by working stations in many parts of the world, at the time of this writing he has not worked a single station in the United States or Canada. AC4YN has been pirated rather consistently, and Reg is in receipt of dozens of letters from W stations who claim to have worked him. Unfortunately Reg is pretty well shut off from North America, and to an extent from South America too, though he did manage to contact a few LU stations over a year ago. He has heard a few W stations in certain parts of the U.S.A., but W stations in those locations have been unable to hear him. And while a few W stations in other parts of the U.S.A. seem to have heard the "legitimate" AC4YN, he cannot hear them.

At the time he wrote us his last letter, Reg was using a zepp antenna directional towards Europe, which permits him to lay down a good signal in Great Britain. Reg expects to be in Tibet for some time yet, rumors that he was leaving soon to the contrary, and he says for W amateurs not to give up hope as he intends to erect a rotary beam, which should greatly assist his low power in putting a signal into this country. Reg uses a 35T in a fundamental crystal oscillator working on 14,106 kc., running about 35 watts input.

* Contributing Editor, RADIO.

Figure 6. (left) Lamas of the lowest order at the Sera Monastery. They know nothing about their religion.

Figure 7.
Looking south from the Mission Residence, giving an idea of the country in the winter.

Figure 8.
Tibetan nomads, typical of the peasant found throughout the wild country of Tibet.

Figure 9.
South or front face of the "Potala Palace," the Lhasa Monastery and home of Dalai Lamas.

Figure 10.
Another view of "Potala Palace," with the Ghortin Gate of figure 4 in the distance.

Reg gives some interesting information regarding Tibetan "phonies." He says that AC4YR is definitely a pirate and not in Tibet. At one time a station signing AC4AA was operating in Tibet, but without permission of the Tibetan Government. He is not in Tibet now, however. AC4YN is the only amateur station authorized by both the Tibetan and British authorities.

Now let's take a peek at some interesting photographs that Reg sent us and get a better idea of Tibet.

Figure 1 shows Reg Fox (right) dressed in the silk costume of the lay official class, and their Sikkimese doctor. This style garb is worn when "stepping out," and the natives seem to appreciate the gesture. On most occasions, however, Reg wears his European clothes.

The romantic and picturesque city of Lhasa, shown in figure 2, lies at an elevation of about 12,000 feet. Reg is with the British Political Mission, whose headquarters are in Lhasa. It is from here that they take various trips into other parts of Tibet.

The Mission Residence, figure 3, actually is the summer residence of the Incarnation God at the Kunderling Monastery, situated in what is called "Dekyi Lingka." The meaning of "Lingka" is *garden*. The huge Prayer Ghortin in figure 4 might be called the western gate to Lhasa. The Sera Monastery, occupied by 5000 Lamas and second largest in Tibet, is shown in figure 5. In figure 6 are seen Lamas of the lowest order at this monastery. They know absolutely nothing about the religion they profess, Buddhism.

Figure 7 is a view looking south from the Mission Residence, showing their environment during the winter months. The Tibetan nomads of figure 8 are typical of the peasant found in the wilds throughout Tibet. They have just arrived with a supply of wood for Reg's party, at the moment a ten days' march from Lhasa. Note in all of these pictures the barren nature of the country and lack of

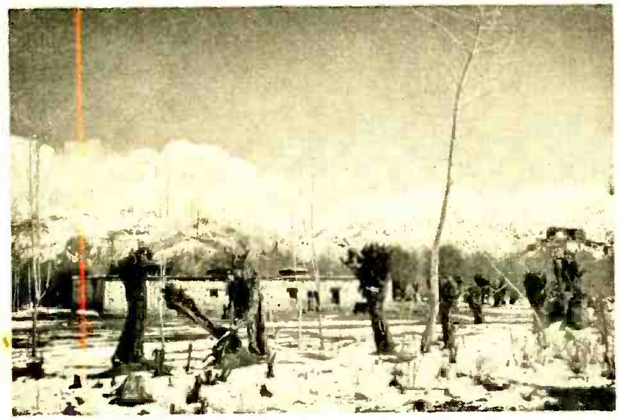


Figure 11.
Tibetans receive free treatment in this hospital, which is run by the Mission.

Figure 12.
River craft made from animal skins on the Kychi River, a tributary of the Bramaputra.

timber. The reason for this is apparent when one remembers that all of these mountains range from 12,000 to 20,000 feet above sea level.

The south or front face of the "Potala Palace" is shown in figure 9. This is the Lhasa Monastery and home of the Dalai Lamas. Tibet now has a Lama Regent. The new incarnation of the late Dalai-Lama is still being sought. Figure 10 is another view of the Potala Palace. To the right may be seen the Ghortin Gate, also shown in figure 4.

In the Mission's Hospital, figure 11, Tibetans receive free treatment. While the Tibetans are a hardy lot, social diseases are prevalent and require treatment. "Potala Palace" can be seen again in the distance on the right.

The Kychi River, a tributary of the Bramaputra (Tsang-po) is shown in figure 12 in flood stage. Most small Tibetan river craft are fabricated of animal skins. This point of the river is near Lhasa.

As many W amateurs should be able to work AC4YN when he gets his new beam antenna erected, a word regarding the sending of QSL's and letters to Lhasa might be in order. Tibet is not a member of the International Postal Union. They have their own stamps, which can be used only within their own country. All foreign mail is handled by the Indian Post and Telegraph Department at Gyantse, where they have a trade agency under treaty. Getting mail into Lhasa requires eight days, as ponies and runners have to cover 400 miles across the formidable Himalaya mountains from Kalimpong.

Reg says he will try to send us a story on his station and his activities as a ham in Tibet. We hope to be able to present this story in an early issue; in the meantime we leave with you these pictorial impressions of Tibet, the land of the missing (zone).

MOBILE
Tuning Hint

W6DJZ has a 10-meter crystal-controlled rig installed in the rear of his Oldsmobile coupe. The radiator is a quarter-wave "fish pole" supported from the left rear bumper bracket. He suspected that raising and lowering the large door to this compartment affected the tuning, due to its proximity to the radiator. So, like the man who was curious as to whether the light in a refrigerator went out when the door was closed, he took a flashlight and got inside, closing the door behind him. He discovered that lowering the door after tuning the transmitter resulted in a plate current change of 30 per cent, indicating the desirability of tuning the transmitter with the compartment door *closed*.

Needless to say, it is very important that you fix the latch on the door so that it cannot catch, or you will begin to wish you had a can opener about the time the air begins to get a little stale. Better have someone else on hand "just in case."

Correction

In the article "Radio with the Airlines" in the January, 1939 issue, it was stated that copies of the Department of Commerce weather codes could be obtained by writing to Washington for Circular N.

This circular is issued by the U. S. Weather Bureau, a unit of the Department of Agriculture, and requests for copies should be addressed accordingly.

Equipment for PORTABLE MOBILE

By F. R. GONSETT,* W6VR

What is this thing called "mobile"; what can I work; what is the installation cost? And so on into an endless chain of questions. This, the latest amateur craze, is on the minds of many amateurs today. Having spent some time working with this type of equipment, the author would like to pass on various bits of information gathered from personal experience and from the experience of others who have been working with this type of equipment.

Before going directly into a discussion of what to use and why, let's size up the problems at hand. The subject may be divided into three major topics: receivers, transmitters, and installation. During the past few years there have been many excellent articles written dealing with various phases of these subjects. This article is intended as a general correlation of this previous material, coupled with the practical experience of the author.

Receivers

What to use for a receiver? Today we have two possible solutions: the superheterodyne and the superregenerator.

Perhaps the thought of building a superheterodyne for mobile use will cause an undue amount of worry due to the complications involved. Many amateurs have, in the past, been discouraged from building a superhet and have finally wound up with the simplest form of receiver for ultra-high-frequency work, the superregenerator. But recently, with the introduction of a highly efficient superhet converter,[1] the superregenerator has fallen into discard in favor of the much more satisfactory superheterodyne.

There are two ways of securing superheterodyne results: the first is to construct an entire receiver for ultra-high-frequency reception; the second is to construct only the front end, detector and high-frequency oscillator, and to operate this into a good automobile b.c.l. set. Of course the second method is the easiest and simplest and by far the most satisfactory for amateur use, but under certain conditions a complete assembly will be warranted.

In designing any u.h.f. superhet (converter or complete unit) perhaps the biggest problem to contend with will be images from other signals appearing in the amateur bands. An i.f. system of a frequency that will reduce the trouble is the most important consideration. Images are received on the "other" side of the high-frequency oscillator by an amount equal to i.f. Therefore, if we have a 1500-kc. i.f. channel, the images will be 3000 kc. away from the frequency to which the detector is tuned. As an example, suppose the first detector is tuned to receive a signal at 28,500 kc. With 1500-kc. i.f.'s the high-frequency oscillator will have to operate on either 30,000 or 27,000 kc. The image received will be 1500 kc. further on from the oscillator frequency or a total of 3000 kc. from the received signal. So, in choosing the side on which to work the oscillator, thought must be given to what stations may be received as images. The high-frequency side of the ten-meter band contains many police stations, while the low side holds many u.h.f. broadcast stations. As far as choice is concerned, it is a toss up. With an i.f. lower than 1500 kc. trouble will be experienced with images from amateurs within the band and sometimes it will be hard to determine if the signal being "fished" for is dx or a local.

There is one disadvantage to the use of 1500-kc. i.f. in a superheterodyne, the loss of gain at this frequency in comparison with the gain at a lower frequency. The answer is either to add more stages of 1500 kc. to make up for the loss, or to use a double i.f. system entailing both 1500 kc. and a lower frequency such as 465 or 262 kc. With the double system we have both the advantage of no images from amateurs and the gain and selectivity of the lower frequency system. This is the very worth-while result of using a converter to feed an auto set tuned to 1500 kc.

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* Technical Assistant, RADIO.

[1] R. L. Dawley, "A Five- and Ten-Meter Converter," RADIO, Dec., 1938, p. 22, F. R. Gonsett, "Ten-Meter Auto-Radio Converter," RADIO, Jan., 1939, p. 52.

R. F. Stages

The question of whether or not to use an r.f. stage ahead of the mixer tube will have to be left up to the individual. Our reasoning has been this: most of the signals worked when operating mobile will of necessity be of good volume to overcome car noise and local ignition interference. Therefore, if the signals must be coming in strongly in the first place, why bother with an r.f. stage? However, when parked in a really good location, the r.f. stage will be a real help. With this simple discussion, we leave the decision up to the individual.

Many amateurs have made simple one-tube converters (see January issue of RADIO) for use with their already installed auto radios. Since an auto radio already has the necessary audio system, power supply, i.f. system, etc., the addition of the converter will permit a complete installation at very little expense and with little work. By tuning the receiver to 1500 kc. and leaving it there we have the combination just mentioned, that of a double i.f. system (1500 kc.-262 kc.). The auto radio must have an r.f. stage in order to give enough gain at the 1500-kc. frequency. If the receiver used does not have an r.f. stage, just add a simple one-tube 1500-kc. amplifier to the output of the converter.

A simple one-tube converter may be constructed for around ten to twelve dollars, while a good ultra-high-frequency receiver will cost about thirty-five to fifty dollars in parts alone and will entail quite a bit of work. Another nice feature of the converter arrangement is that the receiver may be used for broadcast reception or high-frequency work at will by merely turning a switch.

Noise Reduction

A few words here on noise attenuation will be in order. The greatest source of noise in mobile operation is ignition both in your own car and from other cars in the immediate proximity. Be sure to ground everything on the body of your own car to reduce the possibility of high-resistance connections. Bonding body joints will help greatly. The use of spark plug suppressors sometimes will help and at other times it will have no effect. In any event the use of a single suppressor in the high tension lead to the distributor will be of assistance.

A noise silencer of the diode type in the receiver is of great help, though it entails considerable extra equipment. The author has found that a simple though effective silencer may be made of a single quarter-watt neon bulb. Most neon bulbs come with a small resistor in the base, so this must be removed before the bulb may be used. A soldering iron and a little careful work will assist in the removal. Place the bulb (minus resistor) from the plate of the audio tube to the high voltage lead. A switch should be placed in series with the bulb so that the silencer may be cut in and out when desired. The neon bulb functions as a limiter to knock off the high peaks of interference that are caused by the ignition. When strong signals are being received, either b.c.l. or u.h.f., the silencer may be cut out of the circuit. When the volume is at a low level the circuit will not function properly and when it is at too high a level the silencer will tend to distort the signal, so an in-between level will have to be maintained. However, the silencer will work very satisfactorily at the proper adjustment of the a.f. gain control.

Bandspread

The correct amount of bandspread is important to enjoyable operation of the receiver. Different amounts of bandspread have been tried and it is suggested that anywhere from thirty to fifty degrees of spread will be best. While driving down the street it is rather hard to tune the receiver and drive at the same time, so by having less spread the band may be "looked over" much quicker and more easily.

Another point worthy of careful consideration is the physical construction and mounting of the oscillator coil in the receiver. Be sure to mount the coil rigidly on some type of ceramic form and then cement it in place with low-loss coil dope. Due to the selectivity of the receiver it is quite important that the oscillator coil be insensitive to vibration.

Some car owners will experience interference from the generator of the car in the form of a high-frequency steady whine in the output of the receiver. To eliminate this trouble construct a choke coil of about twenty turns of very heavy wire about two inches in diameter. This coil should be of wire capable of carrying the entire output of the generator. No. 6 house wire with the necessary insulation is suggested for the coil. This coil is installed in series with the generator lead to the battery. Mounting the coil upon the generator may be somewhat of a problem but it can be worked out in each particular case.

Transmitter Power Supply

There are three general ways of securing the coveted high voltage for use with mobile equipment. The first is the gasoline-driven generator to produce 110 volts a.c. Then the transmitter proper may be run in the conventional manner from an a.c. power pack. This system has both advantages and disadvantages. Perhaps the most severe disadvantage is the cost of the equipment. Also, the audible noise of this type of supply is almost prohibitive for work in a city. However, special mufflers may be obtained which will reduce the noise somewhat.

Now the other side of the story may be summed up. The a.c. combination makes a splendid source of power for the use of the same equipment both in the main station and in the car in that the transmitter from the home station may be taken out and just plugged into the car for use without any changes other than connecting an antenna. This also holds true with the receiver; the home station receiver makes a good mobile receiver when 110 volts a.c. is available if properly installed.

A note here on the ignition noise encountered with this type of supply: The author used a generator of this type at a fixed location while on vacation, but found that it was impossible to use the supply without some type of shielding in so far as ignition noise was concerned. All types of filters, chokes, grounding, etc., were tried, but the only way the noise could be entirely eliminated was to shield very heavily the ignition wire leading to the spark plug (one cylinder) and the spark plug itself. A tin can was placed over the plug but was found to be insufficient shielding. Something with a good heavy wall and tight fittings must be used for this purpose. Cast aluminum shields for the spark plug are available from the manufacturers of these supplies.

Now that the plug has been taken care of, the wire leading to it must also be heavily shielded. Shielding as purchased in the radio stores is not enough to remove all the noise; so if possible use some type of copper pipe around the wire itself. Lead foil may be wrapped around the wire but vibration will shake it loose after a time. When the type of shielding has been chosen, before placing it into service be sure to wrap plenty of additional insulation around the high tension lead. It is suggested that an additional thickness of insulation the size of the original wire be added.

Generator Supplies

The second type of power source is a dynamotor driven by the battery included in the car. Perhaps this is the most general type of transmitter power equipment used today due to ease of installation and operation. But do not forget that the battery in the car is far from an endless source of energy; you must give back to the battery what you have taken or it will not be long before a step on the starter will result in only a very R1 grunt.

The usual generator included in the car as standard equipment is capable of putting out from 20 to 30 amperes depending on the size of the car. It has been found that a total drain of 20 amperes will be about the maximum that we dare pull from the battery for the transmitter. About 15 amperes of the drain can be allotted to the generator and the remaining 3 to 5 amperes will take care of relay and filament drain.

Be sure to get every possible amount of voltage to the generator primary, for any drop in primary voltage will cause a much larger drop from the secondary. It has been the practice of the author to run battery cable right up to the transmitter to prevent voltage drop. In some cases the transmitter may be placed very near the battery, thus making the leads very short and eliminating the requirement for battery cable. But in any case be sure to use the heaviest wire possible.

Vibrapack Supplies

The third source of power is the "vibrapack" type of vibrator supply. For a medium or low powered transmitter the 300-volt 100-ma. vibrapack power source cannot be surpassed. Since supplies of this type draw but about 7 amperes at full load, it will be seen that they are comparatively easy on the car's battery. The filament and power drain of the single vibrator supplied transmitter is in the neighborhood of 8 to 10 amperes, thus making the consumption just above that of a large auto radio. With the vibrapack in use the modulated amplifier can run at about 8 watts input. More than one vibrapack may be used for higher powered operation.

The power supply discussion may be summed up thusly: A motor generator putting out 350 volts at 150 ma. will consume 15 amperes from the battery. Two vibrator packs producing approximately the same actual power output will draw about the same. Cost of two vibrator packs is about $24, while the cost of the generator will be around $20. Since both supplies deliver about the same output, cost and future upkeep must be taken into consideration. The generator will in most cases require only an occasional replacement of brushes, while the vibrator power supply will need a new vibrator after many hours of operation. For less than 300 volts at 100 ma. the vibrapack seems to be the answer; for higher power a dynamotor appears more economical.

[*Continued on Page* 79]

Figure 1. This neat appearing amplifier operates with high efficiency on all bands from 5 to 40 meters, with inputs up to 500 watts.

An Efficient "SEMI-SKELETON AMPLIFIER"

Here's a very neat, compact, half-kilowatt final amplifier that really "does its stuff" even on 5 meters.

By LEWIS VAN ARSDALE,* W8QZR and JOHN MORAN,* W8IOB

In many push-pull radio-frequency amplifiers, especially those intended for use above 14 megacycles, it is too often found that innumerable "bugs" are present upon completing the unit, these appearing in the form of parasitics, inability to neutralize completely, or some other such difficulty. These demons of grief often crop up in spite of all the care and trouble one puts into the design of the amplifier to avoid them.

After having a number of such experiences in building amplifiers for five and ten meters, the authors decided that a different approach to the subject was necessary before an amplifier could be constructed with the full assurance that it would "perk" properly in all respects on frequencies as high as 60 megacycles the *first* time the juice was applied. This seemed a tremendous problem at the time in view of the inconsistent results standard layouts had been affording, but the solution proved to be quite simple.

In analyzing the situation, several facts were noted in the usual balanced amplifier layout that were not desirable but usually unavoidable. It was observed that, in spite of all precautions taken to make all leads exactly symmetrical and equal in length, the rotor of the split-stator plate condenser was, of necessity, grounded either at one end or the other or both. The former upset the circuit balance due to unequal voltage distribution along the rotor (especially noticeable at 5 meters) and the latter created a closed loop through the rotor rod, end pieces, and common ground. This frequently caused unwanted circulating currents to be present in the tank circuit. Then too, the majority of transmitting condensers have closed loops within themselves, formed through the rotor rod, end pieces, and tie rods which likewise gave rise to these undesirable currents.

Following these lines of thought, it was felt that if a circuit design could be conceived which eliminated (1) the unequal voltage distribution along the plate condenser rotor, (2) closed loops in the plate condenser mounting, and (3) closed loops in the condenser itself, the amplifier could hardly help but perform properly. And sure enough if we weren't right!!

Figures 3 and 4 give a clear picture of the manner in which this was accomplished. The heart of the amplifier is a split-stator condenser (recently placed on the market) designed especially for the purpose just described. This condenser has a special rotor connection

* Engineering Dept., Bud Radio, Inc.

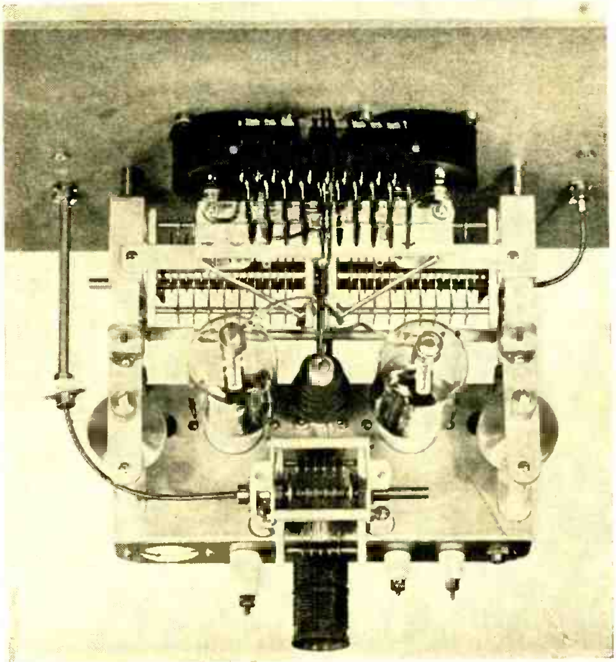

Figure 3.

Looking down on the "works." This layout, in conjunction with a new, balanced, special u.h.f. tank condenser permits exact electrical balance and short r.f. leads.

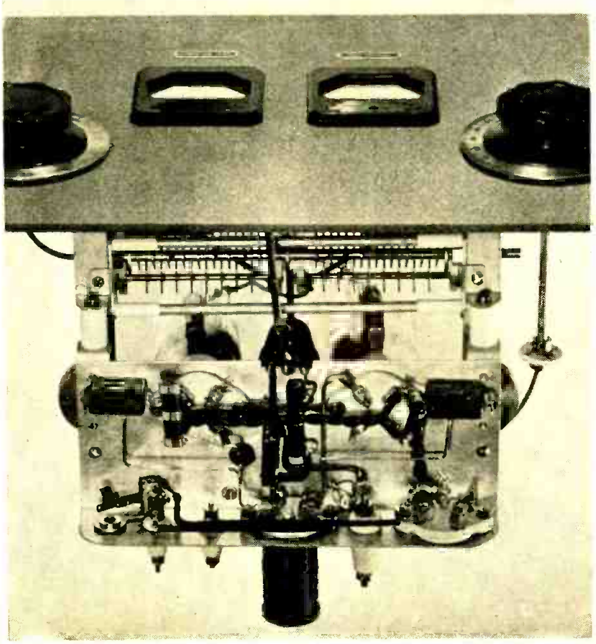

Figure 4.

A "skeleton chassis" is sufficient for mounting of the components. The grid leak, by-pass condensers, and center tap resistor are mounted underneath.

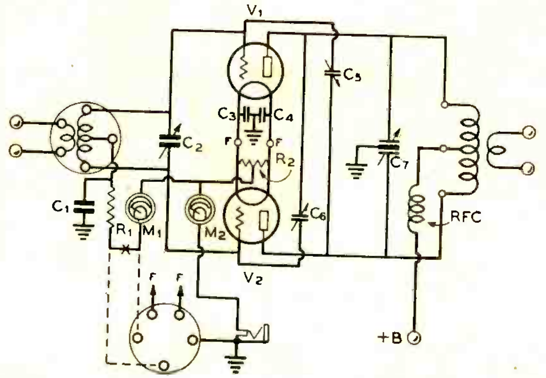

Figure 2. General wiring diagram

C_1—.001-µfd. 600-volt mica
C_2—55-µµfd. 3500 volt peak
C_3, C_4—.001-µfd. 600-volt mica
C_5, C_6—Disc neutralizing condensers
C_7—55-55 µµfd. 5000 volt peak per section, balanced special u.h.f. condenser
R_1—To suit tubes used; refer to manufacturer's data sheet
R_2—100 ohms, center tapped
M_1—0-100 ma.
M_2—0-300 ma.
RFC—4.3 mh. 600 ma.
V_1, V_2—T40

at the center of the rotor rod to which the ground lead is attached, assuring an equal r.f. voltage distribution along each half of the rotor. In addition the tie rods of the condenser are insulated with ceramic bushings to eliminate the "closed frame" condition.

External closed loops are eliminated by attaching the whole assembly to one of the increasingly popular Masonite panels and by attaching the plate tank circuit components to the two neutralizing condensers through heavy ceramic pillars. These two condensers in turn support the semi-chassis which holds the tubes, power supply leads, grid circuit components, etc. Upon completion, it was gratifying to note that not only did this make an electrically efficient unit, but it likewise made a pleasing appearance both from the rear and front of the panel.

The circuit, it will be noted, differs little from the conventional push-pull amplifier hookup. By connecting the meters as shown, the plate meter does not read grid current even though it is in the ground lead as the grid return is made to the cathode instead of to ground. The break (x) and dotted lines shown indicate changes necessary to insert fixed bias in the amplifier.

In construction, one precaution must be observed. The plate leads are crossed in this amplifier to facilitate neutralization and care must be taken in soldering these leads to eliminate the possibility of shorting. One lead is attached so it loops down *under* the wire connecting the r.f. choke to the coil jack bar, and the other plate lead is arched up *over* this same wire, as can be seen in the photograph. If this method is followed, no difficulty will result from these connections. The lead from the r.f. choke to the coil bar must, of course, be a good grade of high-voltage wire. The couplers used for flexible shaft connections to the grid tuning condenser must be of the insulated type to prevent unbalance, as the rotor of the grid tank condenser is "hot" with r.f. voltage.

Any desired pair of medium-power low-C triodes such as the T40, T55, 808, 54, 35T, etc., may be used in this layout at inputs up to 500 watts as long as the voltage does not exceed 1750 volts (which is well on the safe side). If tubes having their grid lead out the side are used, the grid wiring may be altered slightly as necessary.

As a final comment concerning this unit, it is interesting to note that since the original idea was conceived, the authors have completed nine amplifiers exactly like the one shown for operation on 40, 20, 10 and 5 meters, and each one performed perfectly the first time the power was applied, even on 5 meters, and that's something!

See Buyer's Guide, page 98, for parts list.

●

It seems that "ballast tubes" are now "plug in resistors." Reason? So purchasers of b.c.l. sets won't think an a.c.-d.c. set is better than an equivalent a.c. set because it "has one more tube."

●

While 56-Mc. amateurs curse self-excited "wobbulators," servicemen pay good $$$ for "wobbulators" for use in their work. The signals generated by the latter, however, do not sound like someone with a mouth full of hot mush attempting to say "Hello CQ."

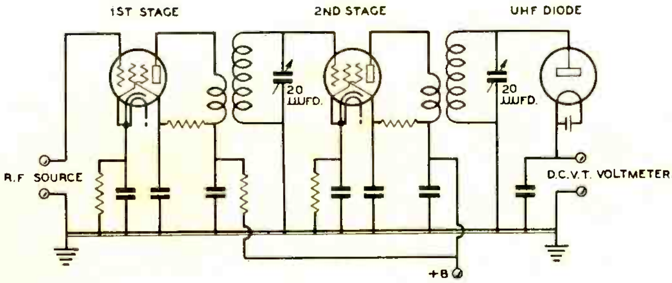

Figure 1. Experimental setup for measuring gain of different tubes at ultra-high frequencies.

GAIN IN R. F. STAGES

By E. H. CONKLIN,* W9BNX

Having heard a large number of statements about the gain per stage obtained—or not obtained—at 28 and 56 megacycles, we decided to collect a little information on the subject. One tube laboratory impressed upon us the fact that the individual setup will be such an important factor that such data could be relied upon only to a minor extent and that the theoretical considerations probably give the best comparisons. A second manufacturer, however, made some comparative measurements on high mutual conductance tubes which, while the study was not extensive, are of interest.

The Measuring Setup

The diagram of the circuit employed in making the measurements is shown in figure 1. The tuning condensers were mounted on a wide strip of heavy copper with as short a lead as possible, but the amplifier was not entirely free of chassis currents, and the point of grounding of the signal generator at 51 Mc. caused some variation in gain. Plug-in coils were used to reach 28 and 51 Mc., with tuning condensers having a maximum capacity of 20 µµfd. The tuned circuit of the first stage was loaded by the input resistance of the second tube's grid.

A two-stage amplifier was used to illustrate better the effect of grid loading, and to obtain sufficient u.h.f. voltage to give a useful deflection on the output meter. The latter consisted of a u.h.f. diode which, in turn, actuated a laboratory type d.c. vacuum tube voltmeter. This combination produced practically no loading on the tuned circuit of the second stage.

Stage gains were determined by successively feeding the signal generator into the grid of the first and second tubes and adjusting the input to give two volts at the plate of the diode. To obtain consistent readings, it was necessary to disconnect the grid of the second tube from the tuned circuit when the signal generator was applied at this point.

Regeneration and Gain

Considerable difficulty was encountered with regeneration and oscillation in the first

[*Continued on Page 81*]

* Ex-W9FM, Associate Editor, RADIO, 512 N. Main St., Wheaton, Ill.

Table I

Type	Freq. Mc.	Input 2nd Grid µv.	Input 1st Grid µv.	Gain 2nd Stage	Gain 1st Stage	Overall Gain
1231	28.	38,000	1,800	52.5	21.	1110.
	51.	42,000	12,000	47.5	3.5	167.
1851	28.	23,000	360	87.	64.	5560.
	51.	24,000	4,000	83.	6.0	500.
1852	28.	20,000	900	100.	22.	2220.
	51.	19,000	5,500	105.	3.5	365.
1853	28.	40,000	1,800	50.	22.2	1110.
	51.	46,000	9,700	43.5	4.7	208.

A TUNING INDICATOR

• for Plate Detectors

By VERNON H. VOGEL,* W9HMS

Many receivers designed for maximum weak-signal response employ cathode-biased second detectors. In such receivers there is usually no source of a.v.c. voltage suitable for operating a tuning indicator of the "magic eye" type. The circuit of figure 1 shows how an indicator of the 6E5 cathode-ray type may be added to any receiver using such a second detector.

Circuit Operation

The current flowing through resistors R_3 and R_4 places a practically fixed bias on the 6E5. When a signal is received the second detector cathode current flowing through R_1 and R_2 increases. This action increases the voltage across R_2. The increased voltage across R_2 is applied to the 6E5 triode section grid and balances out the fixed bias, allowing the eye to open. This action is the reverse of that obtained when the eye is operated from the a.v.c. line; the eye opens on signals and closes when no signal is being received.

Resistor Values

R_1 can be the regular cathode resistor since the addition of the comparatively small resistance, R_2, will have little effect on the operation of the detector. The 6E5 has a fairly linear relation between shadow angle and grid bias when the bias is varied from 0 to 6 volts, so R_2 should be of such a value that the *change* in voltage developed across it is 6 volts when going from no signal to the loudest signal received.

On 56, 6C5 and 6J7 tubes used as bias detectors the variation in cathode current when going from no-signal to full-signal conditions will be one milliampere or less. Assuming a variation of 0.8 milliampere, and a voltage change of 6 volts, the value of R_2 is 7500 ohms.

The value of R_3 is such that it will develop across its terminals a voltage of 6 volts plus the no-signal voltage developed across R_2. Assuming a no-signal current of 0.2 milliampere through R_2 and R_1, the no-signal voltage across R_2 is 1.5 volts. The total voltage that must be developed across R_3 is thus 6 plus 1.5, or 7.5 volts. Since the voltage across R_3 and R_4 is 250 volts, the voltage across R_4 must be 250 minus 7.5, or 242.5 volts. The current through R_3 and R_4 (neglecting the 6E5 cathode current flowing through R_3 only, which is negligible) is therefore 242.5 divided by 50,000 or 4.9 milliamperes. R_3 must be of a value to cause a drop of 7.5 volts with 4.9 milliamperes (0.0049 amperes) flowing through it. 7.5 divided by 0.0049 is approximately 1550. A 1500-ohm resistor will be satisfactory.

It must be emphasized that tubes such as the 6G5 and the 6U5 will not work satisfactorily in this circuit as they are of the remote cutoff type and their shadow angle does not vary linearly with bias voltage.

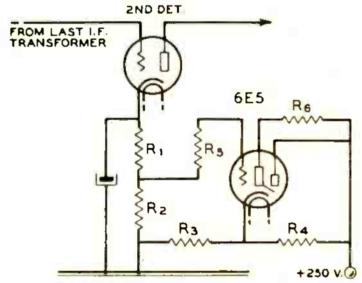

Figure 1.

R_1—Usual cathode resistor
R_2, R_3, R_4—See text
R_5—50,000 ohms ½ watt
R_6—1 megohm, ½ watt

* 425 East Pacific St., Appleton, Wisc.

Rear view of the 35T grid-modulated phone transmitter. The power suppies are on the right-hand side of the chassis and the speech stages are on the left. The extension shaft coming from the panel down to the chassis drives the gain control.

A COMPACT PHONE TRANSMITTER

Using High-Efficiency Grid Modulation

By J. T. GOODE,* W6LVT

Transmitter efficiency cannot be determined simply by measuring the power input and power output of a final amplifier. Efficiency must be measured by the ratio of the a.c. wattage input to the entire transmitter—all filament and power supplies included—to the actual r.f. wattage output of the final amplifier. If efficiency is determined in this manner, a grid-modulated transmitter may actually be more economical and efficient than a plate-modulated transmitter, both having the same power output, if the plate efficiency of the grid-modulated stage can be made at least 50 per cent.

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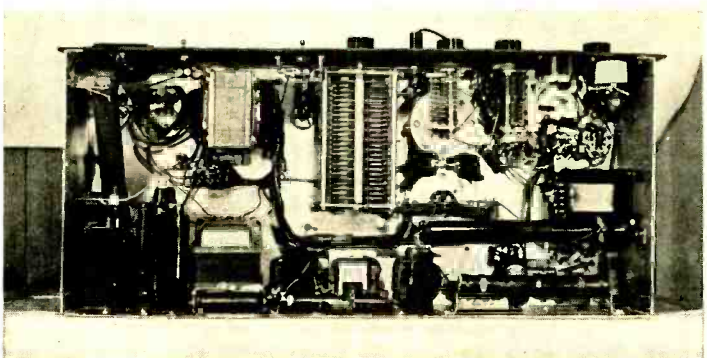
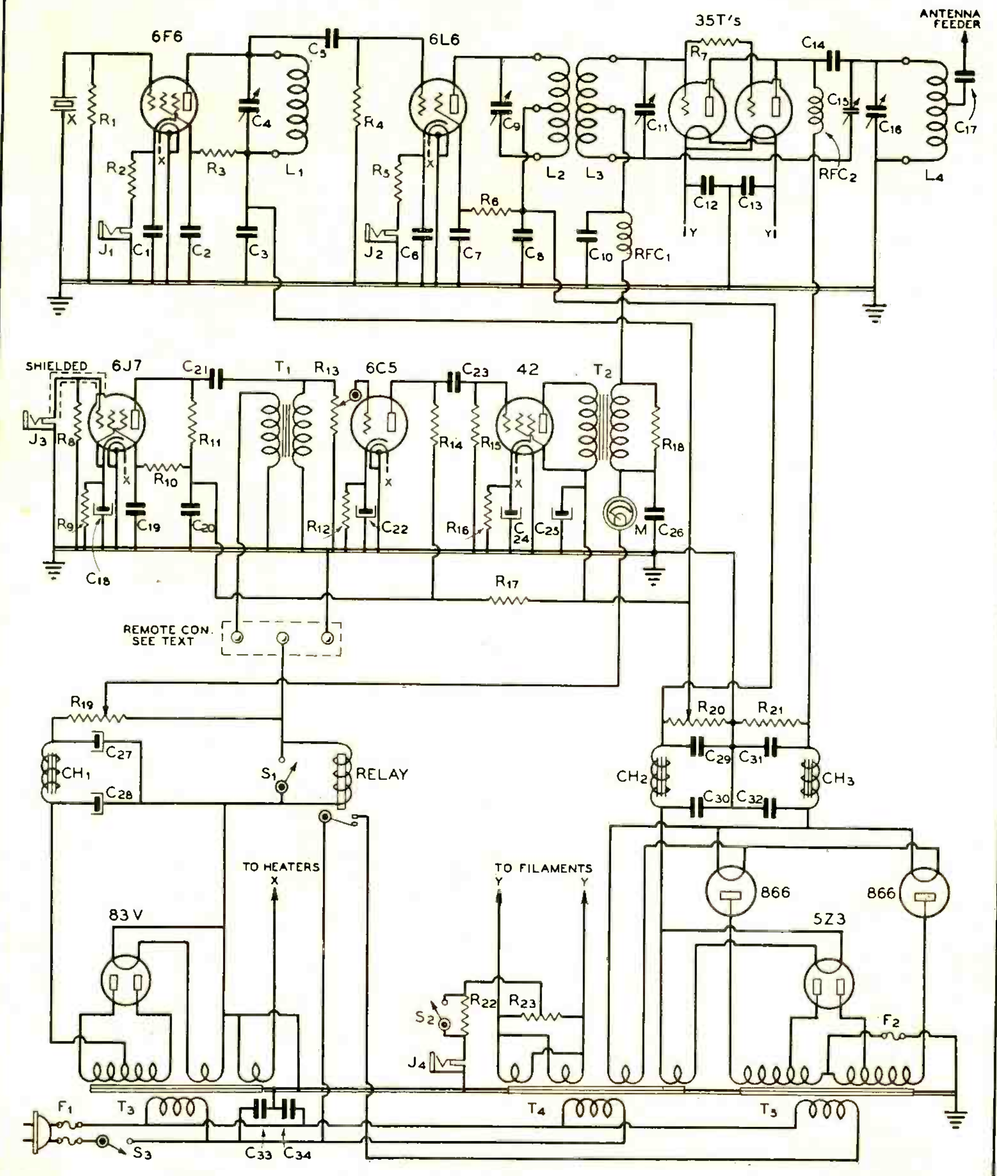
Parts Requirements

First to be considered in the construction of a grid-modulated transmitter are the necessary components. Three watts of good, clean audio will modulate 100 per cent any input up to 1000 watts, and twenty-five watts of driving power will furnish sufficient excitation for any input up to 1000 watts. Power supplies for this type of modulation offer no problems, since the one high-voltage supply requires little filter, and the low-voltage supplies may be



Bottom view of the transmitter. All tank condensers are mounted below chassis; the final tank condenser is the large single-section affair mounted in the center.



General wiring diagram of the complete transmitter.

C_1, C_2, C_3—.002-µfd. mica
C_4—100-µµfd. midget
C_5—.00005-µfd. mica
C_6, C_7, C_8—.002-µfd. mica
C_9—100-µµfd. variable, double spaced
C_{10}—.00025-µfd. mica
C_{11}—100-µµfd. double spaced variable
C_{12}, C_{13}—.005-µfd. mica
C_{14}—.001-µfd. 5000-volt mica
C_{15}—Homemade neut. condenser
C_{16}—100-µµfd. variable, 7000-volt spacing
C_{17}—.001-µfd. 5000-volt mica
C_{18}—5-µfd. 25-volt elect.
C_{19}—0.1-µfd. 400-volt tubular
C_{20}—0.5-µfd. 400-volt tubular
C_{21}—.01-µfd. 400-volt tubular
C_{22}—5-µfd. 25-volt elect.
C_{23}—.05-µfd. 400-volt tubular

constructed from heavy-duty receiver parts. All the transmitter, with the exception of the final amplifier and its power supply, may be constructed with low-voltage receiver parts, making compact and economical construction possible.

Final-Amplifier Considerations

The final amplifier is the heart of any grid-modulated transmitter. The type circuit used is not critical, and push-pull is recommended when operating on frequencies higher than the 14-Mc. band. The transmitter to be described has the final tubes in parallel, as it was not to be used above 14.25 Mc. Shunt feed keeps the plate voltage out of the final tank coil and reduces possible contact with the high voltage.

When operating tubes at their maximum dissipation ratings, as is desirable with grid modulation, considerable heat must be dissipated by the glass envelope; this necessitates adequate ventilation. Transmitting tubes are so designed as to furnish their own ventilation if properly located in a transmitter.

When cigarette smoke is blown into the side of the transmitter, the smoke travels slowly across the top of the chassis to the base of the 35T tubes, then rapidly shoots upwards. Placing a case over this transmitter without adequate holes on the sides and top for ventilation would seriously impair cooling of the tubes. If tubes are to be overloaded, an electric fan is desirable to help dissipate the added heat.

The transmitter illustrated was originally designed for 900 watts input to a pair of 250TH tubes. As a gesture, adapters were made for the 50-watt sockets and 35T tubes placed in the transmitter. The results obtained from these tubes warranted this article. Anyone building this transmitter for 35T's should omit the 50-watt sockets and use a smaller high-voltage transformer than that illustrated in the photographs, which would make possible even more compact construction of the entire transmitter. The dimensions are 12" x 14" x 27". The equipment weighs less than 100 pounds and comes under the heading of "portable." The time required to QSY from one band to another is one minute, thirty seconds. The transmitter may be remotely controlled by a shielded two-conductor cable.

Speech and Modulator

The speech amplifier consists of a 6J7 driving a 6C5. It is well to remember that complete shielding of the 6J7 grid lead, including mike jack and plug, is necessary. The modulator is a 42, and is coupled to the grid circuit of the final amplifier through a one-to-one ratio transformer. The secondary of this transformer is shunted by a 10,000-ohm, 10-watt resistor. This acts as a stabilizing load for the grid-modulation tube.

The Exciter Circuit

A 6F6 crystal oscillator was chosen because of its simplicity and foolproof operation. The buffer-doubler tube is a 6L6, and the simplicity of this circuit makes it sure-fire. The 6L6, when used as a buffer, showed a tendency to oscillate; so it was necessary to center-tap the buffer plate coil. No neutralizing condenser was employed since the compact construction of the transmitter placed the buffer tuning condenser over the bottom of the socket of the 6L6, and thus furnished sufficient

Circuit constants of figure 3, continued.

C_{24}—5-µfd. 25-volt elect.
C_{25}—4-µfd. 450-volt elect.
C_{26}—0.5-µfd. 400-volt tubular
C_{27}, C_{28}—8-µfd. 450-volt elect.
C_{29}, C_{30}—4-µfd. 600-volt oil-filled
C_{31}, C_{32}—2-µfd. 2000-volt oil-filled
C_{33}, C_{34}—0.1-µfd. 600-volt tubular
R_1—50,000 ohms, 1 watt
R_2—500 ohms, 10 watts
R_3—20,000 ohms, 10 watts
R_4—15,000 ohms, 1 watt
R_5—500 ohms, 10 watts
R_6—20,000 ohms, 10 watts
R_7—100 ohms, 1 watt carbon
R_8—500,000 ohms, ½ watt
R_9—1250 ohms, ½ watt
R_{10}—1.0 megohm, ½ watt
R_{11}—250,000 ohms, ½ watt
R_{12}—1250 ohms, ½ watt
R_{13}—500,000-ohm potentiometer
R_{14}—250,000 ohms, ½ watt
R_{15}—500,000 ohms, ½ watt
R_{16}—400 ohms, 3 watts
R_{17}—10,000 ohms, 3 watts
R_{18}—10,000 ohms, 10 watts
R_{19}—5000-ohm 50-watt slider type
R_{20}—25,000-ohm 75-watt slider type
R_{21}—100,000 ohms, 100 watts
R_{22}—1000 ohms, 100 watts
R_{23}—100 ohms, c.t., 20 watts
T_1—Line-to-grid transformer
T_2—1-to-1 grid-modulation trans.
T_3—700 v., 100 ma., c.t.; 5 v., 3 a.; 6.3 v., 3 a.
T_4—2.5 v., 10 a.; 5 v., 3 a.; two 5 v. 10 a.
T_5—First 500 volts each side of c.t., 300 ma.; winding above 500 volts, 200 ma.; total winding, 3500 volts c.t. Two separate transformers can be used.
CH_1—30-hy. 100-ma. choke
CH_2—30-hy. 150-ma. choke
CH_3—15 hy. 200-ma. choke
F_1—10-ampere line fuses
F_2—3/8-ampere 5000-volt fuse
M—0-25 d.c. milliammeter
J_1—Closed-circuit crystal plate current jack
J_2—Closed-circuit doubler plate current jack
J_3—Crystal mike jack
J_4—Closed-circuit final plate current jack
S_1—Transmitter on-off switch
S_2—Final catbode resistor shorting switch
S_3—Main power on-off switch

capacity to neutralize this stage. A different location of parts might necessitate the use of a neutralizing condenser when the stage is used as a buffer.

Final Stage

The circuit for the final amplifier is conventional and employs shunt feed and grid neutralization. A 100-ohm carbon resistor is placed between the grids of the two tubes, as well as a 12-turn choke between the plates. This resistor and choke were found necessary to stop parasitic oscillations. The choke consists of 12 turns of no. 14 wire wound around a pencil. When once the final is neutralized, it will remain so on all bands.

Power Supplies

The power supplies are composed of three transformers—the dual-purpose high-voltage transformer, the grid-bias transformer, and a filament transformer.

The high-voltage transformer supplies plate voltage for the entire transmitter. The first 500 volts each side of center tap is wound for 300 ma. From these taps on out to the end of the high voltage, the winding is designed to carry 200 ma. The high-voltage filter consists of a 15-henry 200-ma. choke and two 2-μfd., 2000-volt oil filled condensers. The low-voltage rectifier is a 5Z3, and the filter is a 150-ma. choke with two 4-μfd., 600-volt condensers. The bleeder on the high-voltage supply is a 100-watt 100,000-ohm resistor. The bleeder on the low-voltage supply is a 100-watt 20,000-ohm adjustable resistor. The tap from this resistor furnishes plate voltage for both oscillator and modulator.

The bias supply uses a midget receiver power transformer. The 6.3-volt filament winding on this transformer furnishes voltage for the oscillator, buffer, and modulator tubes; and the 5-volt winding heats the 83v rectifier. The filter for this supply consists of a 30-henry 50-ma. choke and a double 8-μfd. condenser. The bleeder is a 50-watt 5000-ohm resistor, with the coil of the control relay in series with the ground end of the bleeder.

When the filaments of the transmitter are turned on, the bias transformer supplies bias to the grids of the final stage, eliminating the possibility of tunable hum.

Transmitter Controls

The main switch opens one side of the a.c. line, thus making it impossible to cut the filaments and leave the high voltage on the plates. The switch for turning the carrier on and off simply shorts out the relay coil. Any small toggle switch is capable of breaking the current across the relay coil and can be operated from a remote point.

The switch controlling the power relay is of the double-pole, single-throw variety. All four contacts of this switch are brought through the panel by means of pin jacks. By setting the switch in "open" position, the transmitter power supplies will turn on. A remote line shunted across the relay side of the switch will turn the carrier on and off from a remote point. Shorting the two wires that come from the relay will, in turn, short out the relay coil and operate the power relay. The other two contacts of this switch are connected to the negative return of a receiver.

When the contacts of the switch are closed, the relay opens, turning the transmitter off and turning the receiver on. With the switch contacts open, the action is reversed: The receiver is turned off and the transmitter on. A switch may be employed at the receiver, giving the same action through a remote line to the transmitter.

One side of the remote line is grounded. You will also notice that one side of the 500-ohm audio line is grounded. Through the use of a two-conductor shielded cable and line amplifier, the transmitter can be turned on and off and modulated from a remote point. To do this, the shield is used as the ground conductor, with one wire connecting to the relay and the other wire connecting to the primary of the 500-ohm line transformer. An amplifier consisting of a 6J7 driving a 6C5, feeding a 500-ohm line transformer, will be adequate to feed this line from a remote point. It is not advisable to use over 20 feet of microphone cable with the speech amplifier placed right at the transmitter. Longer lengths of mike cable might result in r.f. feedback. A 500-ohm line is preferable.

Controls and Indicators

The gain control was the last part to be mounted on the chassis. At this point limited space resulted in mounting it above the chassis. Flexible cable gives access to the gain control from the panel.

The four dials constitute the final plate tank, final grid tank, buffer-doubler plate tank, and oscillator tank. A 500-ma. meter is plugged into the various stages through jacks and a 50-ma. grid meter is wired in permanently. The panel light is coupled by means of a loop of wire to the final tank. This indicates that the carrier is on, and registers modulation. This light proves very useful for tuning.

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Exterminating "PARASITICS"

By J. E. JENNINGS,* W6EI

Whenever the subject of parasitic oscillations is brought up the general attitude of the amateur is that his transmitter is quite free from these oscillations in any of the forms in which they appear. Then, on the other hand, the same operator describes his troubles and states that he is quite unable to get the results he desires and is unable to find the cause of the trouble. The purpose of this article is not to give a scientific dissertation on the subject of parasitic oscillations but rather to point out how to detect and eliminate parasitics.

Needless to say, there is a great deal of power wasted when these oscillations are present and I feel safe in stating that over 80% of all amateur transmitters have at least one of the various types of parasitics. Under certain conditions all of these oscillations may even appear at the same time. The result of systematic parasitic suppression is a cleaner signal, lower minimum plate current and less drop in grid current when the amplifier is loaded, and less arcing across of neutralizing, antenna, plate, grid and driver circuit tank condensers.

Determining the Presence of Parasitics

Before parasitics can be detected, it is necessary to have indicators to show the magnitude and location of the undesired oscillations. Meters in the grid and plate circuits are the most important and can be used in the preliminary tests. Then the station receiver, which is used on all bands including the broadcast band, is used as a monitor in making the final tests. A pencil or a neon bulb also can be used but the pencil is the more effective. A 60-ma. flashlight globe connected to one turn of wire is also good.

Types of Parasitics

I will divide these oscillations into three groups as follows: The first are low-frequency oscillations which occur considerably lower in frequency than the operating frequency. The second class of parasitics are of nearly the same frequency as the operating frequency of the stage. The third type is resonant at a frequency between a few centimeters and nine or ten meters.

It must be remembered that if parasitics are present the circuit is fairly low loss; otherwise these oscillations would have been suppressed. It has been found that receivers quite commonly have parasitics and a few of the methods described apply, although the article deals more strictly with transmitters. Rough notes in self-excited oscillators can also be attributed to parasitics, and one of the methods suggested may apply. It is generally true that the high-frequency parasitics are the cause of breakdown of equipment supposedly being worked within its rating.

Checking the Amplifier

First disconnect all plate power leads except those going to the stage being tested. Generally, this is the final amplifier. If a high-μ tube is in use, the best procedure is to use grid-leak bias. Care must be taken, however, to watch the plate current meter when the voltage is applied to see that it does not climb. If it does, the tube is subject to gaseous discharge and a small battery must be connected

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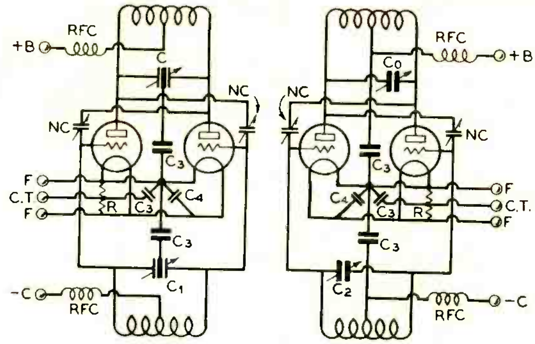

C—Split-stator tank condenser
C_0—Single-ended final tank condenser
C_1—Split-stator grid condenser
C_2—Single-ended grid condenser
C_3—.002 to .005-μfd. mica
C_4—Optional, .002 to .005-μfd. mica
NC—Neutralizing condensers for tubes in use
R—Center-tap resistors
RFC—R.f. chokes suitable for band in use. Grid r.f. choke may be replaced by inductively wound resistor of appropriate value for grid leak.

Alternate methods of connection for a push-pull amplifier.

in series with the grid leak to prevent this condition.

When the plate voltage is applied to the tubes, if the stage is push-pull, both tubes should heat evenly and show considerable dissipation and plate current, depending upon the plate voltage. The grid current meter should be at 0. No indication of radio frequency should be noted, regardless of whether the flashlight globe or the pencil detector is used.

If an indication is noted by the grid meter or other means, it is necessary to find out if the oscillation is at high, medium or low frequency. If the flashlight globe lights when placed adjacent to the tank coil, or if a smooth r.f. arc can be drawn by the pencil, it is safe to say that medium- or low-frequency parasitics exist. On the other hand, if the globe does not light but grid current is indicated and a rough spark can be drawn either from the grid or plate coil, high-frequency oscillations are present. If the pencil is used, the peaks of radio frequency voltage rarely occur at the plate terminals of the tank circuit. Generally the peaks appear at the center of the tank coil or at some point near the center. It is also possible to have only one peak on the tank circuit. Grid circuit peaks also may appear and sometimes the r.f. voltage is greater on the grid than on the plate.

It is also common to find parasitics in link or capacity-coupled grid circuits and they can be detected by a small spark to the pencil. Link-coupled amplifiers usually offer less resistance toward the suppression of parasitics than capacity-coupled amplifiers. The most accurate way to test for these oscillations when they are not strong is to use a broadcast and short-wave receiver for monitoring purposes. The receiver method is by far the best in making the final tests. It has been found that just before oscillations cease, the meters do not indicate, but weak oscillations can be heard in the receiver. This type of disturbance from the transmitter is not capable of causing interference for any great distance but is received as a hash in the broadcast or short-wave receiver on certain frequencies.

One thing to remember concerning these oscillations: Any amplifier oscillating at these frequencies produces a very rough note, the strength of which is dependent on the grid current. When the amplifier is on the air the oscillations may produce parasitic sum and difference frequencies over the entire amateur bands. Frequently the operator is ignorant that the interference is parasitic in nature and can be cured.

Suppression of Parasitics

It is assumed that all equipment is in perfect condition and the stages under test are neutralized. Low-frequency oscillations are comparatively easy to detect and if the following suggestions are followed they should be eliminated. Two standard push-pull amplifiers using two alternate methods of connection are shown. The sizes of the by-pass condensers are of vital importance, especially when the capacity is too low to offer a low impedance on the lower frequencies. In the low-frequency bands, the size of the condensers must be much larger than when the stage is operated on 10 or 20 meters. In general the low- or medium-frequency oscillations are readily detectable with the flashlight globe and as soon as they are suppressed no indication can be noted. Low- and medium-

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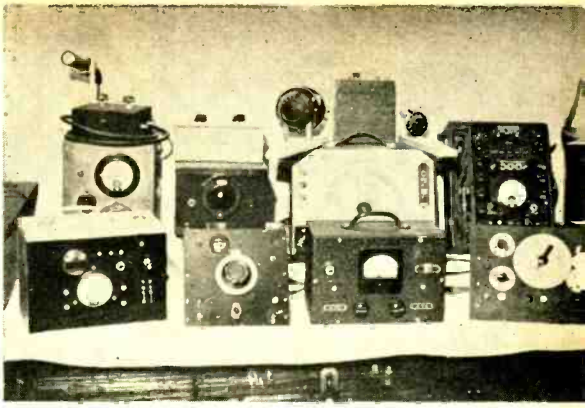


"Ready for the Revised Regulations"

Instruments in use at the shack at W3FPL. They include:

Back Row (bottom) 1. Tuned field strength meter (home built) 2. Heterodyne frequency meter (commercial) 3. Signal generator (commercial) 4. Volt-ohm-milliammeter (commercial).

Back Row (top layer) 1. Basic oscilloscope (built from article in RADIO) 2. Resistance and capacity box for Wheatstone bridge (home built) 3. Absorption wave meter—10 to 80 meters (home built) 4. Tapped inductance for Wheatstone bridge (commercial) 5. Absorption wave meter—60 to 300 megacycles (home built).

Front Row 1. All-wave phone monitor (home built) 2. Vacuum tube voltmeter and percentage modulation meter (home built) 3. Special speech analyzer (home built) 4. Wheatstone bridge — portable type with built-in audio oscillator (home built).

DEPARTMENTS

"WAZ" HONOR ROLL

CW and PHONE

	Zones	Countries
ON4AU	40	148
G2ZQ	40	143
W8CRA	39	151
G6WY	39	151
W6CXW	39	150
W6GRL	39	141
W8BTI	39	141
W6ADP	39	140
W6BAX	39	140
W6CUH	39	140
W4CBY	39	138
W8OSL	39	133
W2GWE	39	129
W6KRI	39	129
W3EVT	39	126
W7BB	39	123
W6HX	39	123
G5BJ	39	120
G5BD	39	118
W2CYS	39	117
G2LB	39	115
W6FZL	39	112
ON4FE	39	110
W6FZY	39	109
W4IO	39	105
XE1BT	39	90
K6AKP	39	67
W2BHW	38	149
W1BUX	38	145
W2GT	38	143
W2GTZ	38	141
W8BKP	38	138
W6KIP	38	137
W2GW	38	137
W5VV	38	132
W6DOB	38	131
VK2EO	38	130
W9FS	38	130
W1ZB	38	129
W2HHF	38	127
W5BB	38	127
W3EMM	38	124
W6QD	38	124
W4CYU	38	123
W3EDP	38	121
W8LEC	38	121
W3EPV	38	121
W3EVW	38	120
W8DFH	38	119
W9PST	38	119
W2GVZ	38	119
W2AAL	38	118
W8DWV	38	118
W1CC	38	116
W3DDM	38	116
W9UQT	38	116
W3GAU	38	115
W5KC	38	115
W6AM	38	115
W8HWE	38	112
W8AU	38	112
W2IYO	38	112
W2BXA	38	111
W6GRX	38	111
LY1J	38	110
W6HZT	38	110
W8KWI	38	108
W8OQF	38	108
W2BMX	38	107
W6VB	38	107
W8MTY	38	107
W8BOX	38	106
W9ADN	38	106
W9KG	38	106
W8LYQ	38	106
LU7AZ	38	103
W8QXT	38	98
W9CWW	38	98
VE4RO	38	95
J2KG	38	95
G6XL	38	89
W8GBF	38	87
W9VDQ	38	79
W4AJX	38	
W9TJ	38	
W8KKG	37	127
W7AMX	37	122
W6GAL	37	121
W8ZY	37	114
W6LYM	37	111
W8EUY	37	110
W9PTC	37	103
G2QT	37	103
VE2EE	37	102
G6GH	37	102
W6FKZ	37	101
W6JBO	37	101
W8KPB	37	100
W4DMB	37	100
W9AJA	37	99
W4EQK	37	99
W3AYS	37	98
W3EXB	37	98
W6ITH	37	97
W1BGC	37	97
ZL2CI	37	97
W3AYS	37	97
W1GDY	37	92
W9UBB	37	77
W2BJ	36	116
W1AQT	36	108
W9AFN	36	105
W1RY	36	104
W6BAM	36	103
W3TR	36	103
W3GHD	36	102
ON4EY	36	101
J2JJ	36	100
W8LZK	36	99
G2QT	36	98
VE1DR	36	98
ON4VU	36	96
ZL1HY	36	95
G2IO	36	94
G6YR	36	94
W7AYO	36	94
W9RBI	36	94
W6KWA	36	92
W9KA	36	92
W9PK	36	92
W5ENE	36	91
W4ADA	36	90
W8JAH	36	89
VK2NS	36	84
G2UX	36	83
W6TI	36	80
W6GCX	36	76
W7DSZ	36	73
W2GXH	36	71
G6CL	36	
W9ARL	36	
W8AQT	35	110
W8OXO	35	107
W6GHU	35	103
W8DOD	35	102
W6MVK	35	100
W8CJJ	35	98
W9RCQ	35	97
OK1AW	35	96
W8AAJ	35	96
W3RT	35	95
W9EF	35	94
ON4FQ	35	92
W6AQJ	35	92
W6DLY	35	92
LU3DH	35	89
W8AAT	35	87
G6QX	35	80
GI6TK	35	80
W6KQK	35	79
W9GNU	35	77
W9QOE	35	66
W6MCG	35	
SU1WM	34	109
W6HEW	34	103
W8BSF	34	100
VK2AS	34	94
W8HGA	34	93
W6HJT	34	92
W3KT	34	92
W9GBJ	34	90
W6CVW	34	84
W8JSU	34	83
W9BCV	34	83
ZS1CN	34	82
VK2TF	34	81
W6MJR	34	81
ON4SS	34	80
W6HIP	34	76
VK2TI	34	75
W7AVL	34	75
W4ELQ	34	74
W6ONQ	34	72
W6LHN	34	71
VK2EG	34	70
VE5MZ	34	69
VK2VN	34	63
W9QOE	34	56
K6JPD	34	
W8ACY	33	97
W5ASG	33	94
W6GK	33	94
W1APA	33	92
W2BMX	33	90
W6KUT	33	90
ON4HC	33	88
W6CEM	33	88
W1APU	33	88
W8QDU	33	86
W2WC	33	83
VE4LX	33	82
W6ANN	33	81
W6GCT	33	79
W6LCF	33	78
W5PJ	33	78
W6MVQ	33	77
W9TJI	33	76
W7AVL	33	71
W2FAW	33	67
OK2HX	33	66
VK2RA	33	65
K6CGK	33	62
W9LBB	33	
VK2VQ	32	99
W6DIO	32	90
G6WB	32	84
W9FLH	32	80
ON4NC	32	79
W9PGS	32	78
W6NLZ	32	76
W1AB	32	76
W3CIC	32	75
W6POZ	32	73
W9GKS	32	71
W3GAP	32	70
W6LPR	32	67
W9DEI	32	66
W6KRM	32	62
W6OAQ	32	56
W4MR	31	92
W6DRE	31	86
W6GNZ	31	85
W8FJN	31	85
W2AOG	31	83
W9LW	31	82
W2FLG	31	80
W6KEV	31	80
W2HVM	31	78
SM6VK	31	76
W2GPF	31	75
W2BZB	31	75
W9YEG	31	75
G5VU	31	73
W6OEG	31	72
W5PJ	31	71
W9VKF	31	68
VK2VA	31	62
W6OFC	31	62
W9VWV	31	60
W9NRB	31	54
VE2GA	30	84
W4DCZ	30	80
W3CDG	30	78
G3BS	30	75
W3GHB	30	73
W3GMS	30	72
W8MFB	30	71
W4DTR	30	68
W8MPD	30	66
W9RXL	30	65
W6PNO	30	63
W9VLQ	30	58
W8PHD	30	57
W6AJN	30	56
W8DPY	30	53
VE5ZM	30	52
W7ENW	30	51

PHONE

	Zones	Countries
W2AZ	37	90
W6OCH	36	89
F8UE	33	95
W3FJU	35	80
KA1ME	35	79
W2IYO	34	88
W6ITH	34	82
W9NLP	33	74
W9TIZ	33	72
W3FAM	33	68
W6NNR	32	73
W6CQI	32	70
W6OI	32	68
W3LE	32	65
VE1DR	32	59
W4CYU	31	88
W6MLG	31	72
W6LLQ	31	68
W2GW	31	65
F8KI	31	53
W6IKQ	31	50
W6AM	31	
W4AH	31	
W2AOG	30	77
W9QI	30	75
G6BW	30	73
VE1CR	30	68
W7BVO	30	64
W2IXY	29	86
W3EMM	29	76
W8LFE	29	67
W6EJC	29	64
W2IKV	28	77
W9BCV	28	68
W8AAJ	28	66
F8VC	28	63
VE2EE	28	62
W9RBL	28	58
W8QXT	28	58
W8LAC	27	72
W6FTU	27	60
W8RL	27	58
G8MX	27	56
W6NLS	27	52
W6GCT	27	52
W9ZTO	27	50
G5ZJ	26	77
W2IUV	26	65
W4EQK	26	61
W5DNV	26	60
VK4JP	26	32
W6GAL	26	45
W7EKA	26	45
W2HCE	25	69
W1AKY	25	65
W1HKK	25	63
W8JK	25	47
W6PDB	25	44
W7AMQ	25	40
W6LYM	25	39
W6MXD	25	38
W6FKK	25	36
YV5AK	24	59
W4TS	24	52
W8QDU	24	51
W1BLO	24	50
W6LPR	24	45
W6MVK	24	36
W6MVQ	24	32
ON4HS	23	51
W5ASG	23	46
W6GRX	23	43
W9ORL	23	38
W7ALZ	23	27
W6NCW	23	27
W7ESK	23	
W1JCX	22	51
W8DBC	22	46
W1KKP	22	40
W9UYB	22	35
G6DT	21	53
W6NEP	21	53
W8KWI	21	50
W5BB	21	42
W6FZL	21	40
W4MS	21	40
W9VYD	21	36
W7BJS	21	37
W6PNO	21	30
W6OJK	20	37
W3AKX	20	32
VE5FO	20	31
W6IWS	20	24
W6LOY	20	29
W6NMI	20	25
K6KMB	20	23

DX AND OVERSEAS NEWS

Herb. Becker, W6QD

Send all contributions to Radio, attention DX Editor, 7460 Beverly Blvd., Los Angeles.

Just think, gang, next month is the DX Contest again. It hardly seems a year since we dove into the depths . . . and depths it really is. One fellow will say he's going to hit the hay early every night from now until the contest rolls around so he can "take it" during the wee small hours. Nine times out of ten this same guy will be so full of rest that he can't get out of the habit and goes right on through the whole "session" with his usual 10 hours sleep. On the other hand you'll run into the fellow who takes the opposite stand, and asserts the way to become used to staying up for long hours is to begin now and practice. I might mention that too much of this practice for the "graveyard watch" could, also, result in a boomerang, and he would never get through the first night. Everyone has his own system of "training" and from what I've seen it consists of a lot of dashing around at the last minute tossing up new antennas, building a new quick-change final, spotting new crystals into favorable places in the band, cleaning up the hay-wire around the shack, shining up the coffee pot, getting in good with the folks and neighbors, and last but not least, sort of easing the news to the y.l or x.y.l., as the case may be. And may luck be with you. Yessir, there will be a lot of "dx widows" around in March.

The "1939 Marathon"

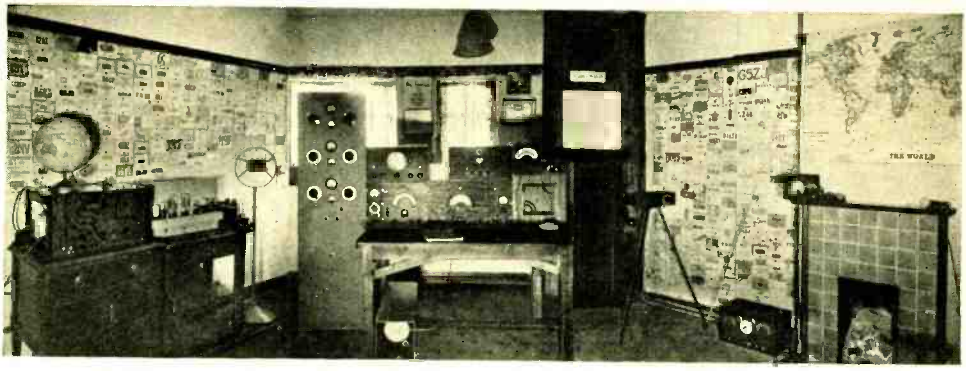
The DX Contest should give everyone a big boost in his "Marathon" score. You'll be after points in the contest and at the same time the zones will automatically increase as will your countries. December RADIO contained complete details, but just so you'll have a general idea I'll go over a few of the high points. The "1939 Marathon" began January 1, 1939, and will continue until December 31, 1939, everyone starting from scratch to work as many zones and countries as possible in one year's time. The present "WAZ" Honor Roll will be continued, representing the "all time" totals. A new list will be run from month to month showing the standings of the highest 50 for combined c.w. and phone (as in the WAZ Honor Roll) and 25 for phone only. This list will be called the "1939 Marathon." To qualify for entry you must send in your list of zones claimed, showing zone, station worked and date, and for the countries, the total number will be sufficient. On succeeding reports it will be only necessary to show the additional ones worked. It is important that you keep "Honor Roll" and "Marathon" totals separate when sending them in. The first results will appear next month. Let's have a report every month, regardless of whether you may think it too small to send in.

ON4HC, owned by S. Van de Wouwer, near Antwerp, Belgium. The rig uses a pair of 10's in the final amplifier with 50 watts input.

From the Phone Men

I must lead off with a W6 this time and I think you will agree with me that W6OCH doesn't seem to know when to stop. A few months ago he moved from Oakland to a little town named San Leandro, which really is just beyond the city limits of Oakland. Anyway, when Larry moved to this new "spot" (remember what I said about "spots" last month) he very carefully saw to it that there was plenty of room for numerous antennas. The country is fairly well in the open and he has taken advantage of this by putting up an excellent batch of antennas. Well, of course it's history now that he hooked AC4AN in zone 23 and has confirmation. But . . . the new ones are K7FST who was at East Cape in Siberia, and that is in zone 19, while the other nice one was SU1RD in zone 34. This makes OCH 36 zones and 89 countries. When he worked SU1RD it was a six-way with W6OI, W6CQS, W6IKQ and W7BVO.

Speaking of K7FST, the only thing I can suggest is to look for him on week-ends (Saturdays and Sundays). He usually goes to East Cape every two weeks but may go every week. The last word from him stated he would go over there as long as he could . . . weather permitting.



G5ZJ at Letchworth, England, operated by Kenneth Jowers primarily on 10- and 20-meter phone. Over 90 countries and 27 zones have been worked on phone. From left to right can be seen the cathode ray equipment, speech amplifier, low-power emergency transmitter, main transmitter using a pair of 100th's, u.h.f. receiver preselector, main receiver, mixer panel, 5-meter transceiver, and three-band exciter having 12 crystal frequencies.

You might look around for him on the second Saturday and Sunday in February and March. He was going to try to maintain this schedule . . . phone CQ at 3-5-7 and 9 p.m. p.s.t. and c.w. CQ at 6 and 8 p.m.

W6OI worked K7FST on December 18 and Charles reported it was 35 below zero with 25 feet of snow around him. W6OI got his wish while W7BVO was visiting him during the holidays. Last month he made mention of wanting to work a nice piece of dx when Rollie was there as he couldn't turn around and hook him himself. Well, it happened and W6OI hooked FB8AH for his 32nd zone while W7BVO chewed his fingernails. I understand that Rollie didn't enjoy a bit of his visit after that.

W1KKP wants to know the address of HR1AT . . . and goes further to say that he worked a guy signing U3BC on 20 phone, about 6 months ago . . . and should he mention it. It's mentioned. W9TIZ adds FI8AC and VQ4ECJ to make 33 zones. Frequencies are 14,410 and 14,006 respectively. W2HCE tackled a couple of new zones and a few countries. The newest for Bill are CN1AF, VQ4KTB, SP2HH, KA1ME, G6IA, VQ5KTF, ZL2JQ. W9RBI never gives up. Just when he thinks conditions are "punk" he bowls over OH2OI, VU2CQ and EA9AH on phone, and U6WB on c.w. making him now 28 and 58 for phone and totals of 36 and 94. Two of those new ones were worked on December 31 and Ross is wondering why in the deuce they couldn't have happened on January 1. It would have given him a nice start in the "Marathon."

F8VC pulled in VP4T and YU7XU for his 62nd and 63rd countries. W3FJU is up to 35 and 80; those helping are XZ2DX and VS7GJ. FJU also says that W5DNV has fallen by the

Beulah B. Tolonen operating her station K7GLL at Kennecott, Alaska. The final stage uses a 100TH with 250 watts input on both phone and c.w.

wayside and is off the air due to a brand new x.y.l. W3LE has been ill but is back on the job now in more ways than one. At least one is to the tune of adding more countries . . . and now Lou has 32 zones and 65 countries. W6GCT worked KF6DHW on Canton Island but this was on c.w. . . . and I suppose I should get a demerit for even mentioning it here. W8QDU is still at it and increases his totals on phone to 24 and 51 with VQ4CRE and CN8BA.

G6BW has been keeping his sked with W7BJS in Wyoming quite regularly. Ben has worked all of the states on 28- and 14-Mc. phone. With the addition of VR6AY and CX2AK he has 30 zones and 73 countries. W2IUV had his call twisted around in the list so we will charge that one up to the printer. He has 26 and 65. W6ITH worked K7FST in zone 19, and also reports CX2CO coming through well along with VK7LZ, VK4HN in Papua, ZL2BE on 28, 420, 14,210 and 3,900 kc. Best time for ZL2BE on 75 meters is around 3 to 4 a.m. P.s.t. OH2OI has been in there around 1600 G.m.t. on 14,120 and 14,150 kc. Reg says he was the fifth North American station to work K7FST while in zone 19. W6IKQ nabbed three nice ones which boosted his zones to 31 and countries to 50. The stations were FB8AH, OH2OI and SU1WM.

The voice of Malcolm Magers, K6OJI, is well known to amateurs throughout the world. He recently amused listeners by carrying on negotiations with a ZS amateur on behalf of a Zulu chieftain who wanted to trade 60 prize cattle for the R9 K6 hula dancer whose photo appears on K6OJI's QSL card. Everyone enjoyed the fun except the Zulu chief, who was in dead earnest. (Pan Pacific Press Photo)

The "WAZ" Honor Roll

When looking over the Honor Roll in this issue you may notice that a great number of calls have been omitted. We have decided to go over the list periodically and take out the inactive stations. Our decision is based entirely upon comments from you fellows who have been good enough to express your desires from time to time. The general consensus of opinion has been to make the "WAZ" Honor Roll a list of the *active* dx men.

To be listed again it is not necessary to send in a complete new list of zones worked. Just become active, making contributions to this column, and requesting us to place the call in the Honor Roll. To keep on the active list you need not work a new zone or a flock of new countries every month, but simply be active on the air and and keeep this department informed of your activities. Pass the word around because there may be quite a number of the boys who are active but just don't contribute anything, possibly thinking it doesn't amount to much. We do not want to omit any of the active dx men, but we are determined to make it exclusively an active list.

Brasspounders Comments

W3EVW tossed a ringer when he got LZ1AA, 14,340, and let's hope he's good. That makes 120 countries for Rog. Other good ones for him include ZD2H, VQ3HJP, CR8AF, CN1AA, PJ1BV, YS2LR and then to top off with ST2CM and ZC6NX. W3TR had his prayers answered when J2JJ came back to him making 36 zones as well as country no. 102. YV2CU gave him no. 103. W2GVZ traveled right along in there and now his QSO with LZ1AA is history . . . country 119. W6BAX had a swell chat with ON4AU the other day and ON4AU told him that he had "worked K7FST with his pajamas on." BAX also passes along info about VQ4RHL coming through from 10 a.m. to 1 p.m. P.s.t. TF3C is on every day from 3 p.m. until 6:30 p.m. P.s.t. BAX thinks something is screwy somewhere when he works VQ8AI on his South American-Orient beam, and didn't show at all on the European antenna. Also the other night about 8 p.m. VU2FX was coming through on the European beam and not at all on the VU antenna. BAX swears that New Year's Eve had nothing to do with it. Another bit from him tells of hearing VP8AD ordering some QSL cards . . . so that should be good news for some of you.

It is encouraging to know that W3KT has received cards from three tough ones . . . LX1AX, FP8PX and VP3TEST. This helps dispel the rumor that LX's are NG and won't QSL. New zones for Jesse are FI8AC and XU4XA in zones 26 and 24. VK2EO is still in the Australian navy and occasionally gets home for a stretch on the air. Latest for Dave are TF2X, VQ2HC, VP8AD, HI6Q, EL2R, K6CKM, VQ3HJP, which gives him 38 and 125. W4DMB started the year out with a bang and got VQ2JC for a new zone and new country. That's a good one for the "Marathon" too.

W6BIL gives the new QRA of J5CX as follows . . . Chikaji S. Ikeda. 260 Yamashita-cho, Kagoshima, Japan. W9WCE has a few new ones that look very good to me . . . YV2CU, HI6Q, PY1DS, PY8AH, CX1NE and finally but by no means least, J2JJ for 9WCE's w.a.c. W4EQK is not laying down on the job and with such dx popping up as the following you'll agree: VQ3HJP, ZB1P, U3DQ, U2NE, UK5KJ, PZ1AB and OH5OD. This makes W4EQK 37 and 99.

K6OJG has returned from Guam and will answer any cards from his new QRA, which is C. R. Spicer, 1332 Geary St., San Francisco, Calif. W3RT is up to 35 and 95 with FI8AC and J2NF furnishing the makings. W6PUZ says he wants to get his two cents worth in so here it is . . . and all done with 40 watts: XU6TL, KA8ED, J5CC, J2NG, J8CG, ZS1CN, CE3AJ, CX2AJ and HH4AS. W9VDX says there are signs of life on 7 Mc. with VK7AB 7178 kc., LU9CK, GM6RV, G6LC and about 30 VK's. 9VDX wants to know who URAK9 is. Whew!!! whata call. J2KG worked 36 zones and 93 countries in 1938, and his all-time total is 38 and 95. I think that is a swell record for him to shoot at in the '39 Marathon. Like many others he needs zones 2 and 23.

W1APU says when the 20-meter band does the "enfoldo" he QSY's to 40 and works a little stuff up there. He says the band sounds like it did years ago and suggests to the gang to do likewise when 14 Mc. plays tricks. W1APU nabbed his 35th the other day in CE3AJ.

FREQUENCY LIST

C.W.			
AC4YN	14,106	VU2AN	14,350
CT2BE	14,390	VU2FO	14,400
CP1AA	14,401	VU7BR	14,340
EA7AV	14,410	XFB8AB	7,020
FA8BG	14,420	YS2LR	14,405
KC6CKM	14,300	XZ2DY	14,254
KF6DHW	14,370	**PHONE**	
G8MF	14,300	CN1AF	14,080
J8CG	14,410	CN8BA	14,075
LZ1AA	14,430	FI8AC	14,410
PK4KS	14,300	EA9AH	14,000
SU1WM	14,395	FB8AH	14,370
U8ID	14,398	I1MI	14,015
	14,300	I1KN	14,400
U6WB	14,420	K7FST	14,240
VK4HN	14,300	OH2OI	14,155
VP8AD	14,380	PK3WI	14,060
VP9X	14,290	SU1RD	14,255
VQ2HC	14,280	VQ2PL	14,270
VQ2JC	14,350	VQ4ECJ	14,006
VQ3HJP	14,395	VQ4KTB	14,005
VQ5ELD	14,024	VQ5KTF	14,200
VS6AR	14,385	VU2CQ	14,135
		ZL2JQ	14,248

Charley Pine, W9CWW, gives a little enlightening comment on some of his pals. It seems as though W9KG is on ten phone and then, too, rumor is around to the effect that maybe a y.l. has something to do with Keat's inactivity. W9ARL moved into the city for a few months but being quite an antenna fiend, he couldn't stand the gaff and now is back in the country again. W9TJ is also out in the "sticks" and has a rhombic and a set of V beams draped around in the sky. W9VWV is doing very well and recently hooked FA8RY on 7060 kc. He uses two half waves in phase pointed to Africa. VWV has hooked five different CR's in the past few weeks, which is really something for that part of the country. I got a bang out of a yarn W9CWW tells about himself. Quoting from his letter:

"I didn't have a VQ2 or that zone, as I never had heard any station there until October, when I heard VQ2MI. It seems that VQ2MI is only on Sunday mornings over there, so I began gunning for him and the trial began. I asked VWV to help me out as he raises Africans much better than I. So for five straight Saturday nights I rushed the x.y.l. home so I could be on the air between 9:30 and 10:30 to try to snag him. Three of the Saturdays I didn't hear him and the other two he got hooked up with some east coast station that passed him around until he faded out. On the sixth Saturday night I heard him and called VWV to get on and on the next CQ de VQ2MI both of us called him. VWV got him, and was I elated. At the same time I noticed the x.y.l. talking over the phone and when she came in she said the neighbors had called and were plenty mad about the lights blinking. After a hurried conference it was decided I had better stay off the air. In the meantime VWV had told VQ2MI to listen for me and the darned VQ2 listened and called me for 20 minutes . . . and here I sat 'grounded' because of tough neighbors. Man, that's agony.

"The first of the week I went down to the power company and hired an electrician and ran in separate lines and cured the light blinking, at a cost of $15.00. The next Saturday night the VQ2 didn't come through and I thought I was lost. The happy ending is that the following Saturday night I heard and raised VQ2JC for my 38th zone, and I hope I live happily ever after."

Well, Charley had quite a time and no fooling. I wonder how the neighbors are now. CWW has 98 countries.

SU1WM sends word through W6DLY that VQ5ELD is on about 14,024 kc. and may be addressed through the Post Office, Entebbe, Uganda. W6DLY worked them both and has 35 and 92. W9FS is a new one to the list with 39 and 130. He waited a long time to kick through, but I think he was really waiting for that Xmas typewriter before writing, a gift from the y.l. Bert's "fist" on the mill resembles mine to a great extent . . . and X is the most popular letter on the keyboard. W2IYO has been doing himself proud with Asian contacts; just take a peek at a few: J8CA, J8CD, J8CG, J2JJ, J2NF, J2KG, 3DF, J3FK, J5CC, XU8NR, XU8NA, XU2JN, XU6D, VS6AH, PK1BO, PK1RI, PK1TT, KA1RP, KA1FG, KA1DL, VK9BW, CR7AF, CR7BC, K7FTS.

W5BB worked ZD4AB on Xmas Eve. However, Tom was somewhat burned up because ZD4AB said, "Hello, Tom, I called you several times the other a.m. to say 'hello' but ND." Tom has been after him for two months. 5BB also hooked KF6DHW on Canton Island, this

Left to right, PK3AT, XE1CE (ex X1G), XE1GK, ZL2JQ, and XE2FC on a fire escape at the Sherman Hotel during the A.R.R.L. National convention in Chicago. Photo by W4AYE.

being a phone QSO. The frequency was 14,370 kc. and both BB and 5VV have a sked with him. By the way, KF6DSH is ex-W5BMP. Will someone give the QRA of UK8IA to W5BB? I know a flock of others who would like to get it, too. W9TJI is up one with FI8AC, and now it's 33 and 76.

We are glad to see G3BS with our happy "family";—this list shows 30 zones and 75 countries. W6AM shoved aside the mike the other day long enough to work a couple of ZS stations. There isn't anything too unusual about that part of it, but the time of day was extremely extraordinary . . . ZS5CX at 1:32 p.m. and the other a little earlier. W8EUY, after eight years, got his first XU, XU4XA. Ren is also bemoaning the fact that he hasn't as yet hooked YI2BA or VU2AN for no. 21. One note of discord comes from 8EUY when he says that the phone bug has bitten him and he will soon be giving his "handle" to the boys, in what he calls his "faltering monotone," For W8ACY, two new ones are VQ8AS and VP7NS, making 33 and 97. W1APA is using a Dodge rear end for a reduction system on his new Premax rotary.

W5FNA says OK2SO and LY1J are striving to work all the states but seem to be having a heck of a time. W7BB says after the crack about him in the January issue he'll have to get on the air or it'll make a liar out of me. He'd better get on the air or that 39 and 123 won't last long in the Honor Roll. There! W8MTY ups his zones to 38 and the ones to help in this good fortune are XU6MK, FI8AC and TF3C. Countries are 107. Other nice contacts for Sam were with FA3WW, CR6AI, PK1TM, YS2LR, PK1RI, VU2FU, VQ2PL, VQ8AS, VQ8AI, ZD4AB, ZD2H, OQ5AV, OQ5AQ, J2NF, J2KG, U9AB, CR7AG, CR7BT, CR7AW, CR7AL, LZ1AA. 8MTY says Bob "Race" Haas, W8HWE, will not come out west to watch the nags run this winter; instead he is skiing in a big way. He should come out this way and let the "hosses" watch him ski.

W3AZX is convinced that LX1A, LX1AX and TF5G are all the same station, and a phony. But . . . W3KT just said he received a card from LX1AX. Gosh, I give up. W9MXP says he doesn't see how J2KG does it with a pair of 35T's . . . and for those who don't know what I mean, take a look at his card sometime. W6HIP passes along the following from our friend SU1WM . . . VU7BR is located on Bahrein Island and will be found around 1430 G.m.t. on 14,340 kc. W6HIP uses a 250TH with 850 watts and the antenna is a half-wave doublet with one end tied to the top of a 58-foot tower and the other end tied to any old fence post that might be handy. The antenna slants and to change the direction he just ties the end of it to another fence post. HIP's zones are 34 and countries 76.

G5BD is hitting the high spots and has increased his totals to 39 and 118. He had been gunning for a K6 for years and decided to stay up one night until he killed the "bogey." He finally did at 0500 G.m.t., and it was K6PLZ who answered after calling him a half dozen times over a period of two hours. Art says it was worth it but the irony of the whole business was that at 1830 G.m.t. (a respectable time) he worked K6PLZ again. Other new ones are XU7CH, VQ3HJP, CP1AA, VK9VG, VQ2HC, VQ5ELD, CR6AI, VS2AE. Art is getting all "het" up over the "Marathon."

KF6DHW, Chas. D. Calley, Jr., now located on Canton Island in the Phoenix group, will be there for about seven months yet. He will operate on 10 phone and 20 c.w., and when he calls CQ on phone on 8100 kc. he will listen for replies on 20 phone. Chas. will QSL when he returns to Honolulu or via any ships that may happen to call at atoll. KF6PMO will also be on 10 meters from Howland Island, but probably on c.w. only. From K4KD we learn that he has had a "great crash" as he calls it. It was his 35T, with the result that he has been off the air. Anyway, before the "great crash" Maw got J5CC for a new zone and YS2LR and ES1E for countries. He's crying because the gang in P. R. are having a swell time passing dx stations around and here he is without a final amplifier. By the time you read this, though, he should again be going strong and will be using a crystal at 14,031 kc. part of the time. W6AJN worked 108 different Europeans in 1938 and is going to try for more this year. His zones stand at 30 and countries at 56. W3FQP worked FI8AC, XU8NR, J2JJ, J2KG, PK1BO, VS6AO, XU4XA and PK6QM.

GI6TK has now 35 zones and a total of 80 countries. Frank wants Mississippi, New Mexico, Nevada, South Dakota and Arizona. GI6TK says he will be on 28,168 every week-end from 1100 to 1900 G.m.t., c.w. and phone. YL2CD is hunting for Mississippi, New Mexico, Nevada, Utah, Wyoming and Nebraska. YL2CD is T9 on 14,042 and ECO around 28,080 kc., c.w. only.

ON4HC, whose station picture you will see elsewhere in this column, has worked 33 zones and 88 countries. ON4HC says that if any of the boys have not received their cards from him to write and he will be glad to send another. The frequencies of the crystals in use at ON4HC are 3510, 3520, 3530, 3575, 7190 and 7160, which of course are used when doubling into bands down to ten meters.

A while back, December 19 to be exact, W6MUS worked XFB8AB and took the QRR from him. It seems as though Paul Bour, FB8AB, is on St. Paul Island and was short of coal and fuel. Their ship, the Ile Bourbon, of course is there and apparently all were in good spirits, but it was urgent that the agents for the steamship line be notified of their predicament. W6MUS got in touch with W6OMR and they finally decided to attempt to get the telephone company to put a gratis call through to Madagascar.

The telephone company couldn't see this, so MUS and OMR paid for a telegram to the Coast Guard Headquarters in San Francisco asking them to notify the agents of the Ile Bourbon. The Coast Guard cooperated 100 per cent but couldn't find this ship listed in the directory. However, they immediately notified the French Consul and the French Steamship Lines. Through this source the proper parties in Madagascar were informed and the Ile Bourbon was well taken care of. W6MUS was the first signal XFB8AB had heard in three days, as something had happened to his receiver and transmitter and was using a single tube to receive with. XFB8AB was on 7010 kc. around 1400 G.m.t. These fellows deserve credit for what they have apparently done, especially because they didn't waste any time doing it. W6PQZ also worked XFB8AB on December 22 and Paul said his dynamotor made so much noise he had a tough time copying any signals.

K7GLL and her station are shown in a photo on these pages. Beulah B. Tolonen, the operator and owner, is a registered nurse, college graduate. For the past two years Beulah has spent the summers working for the large copper mine at Kennecott. Prior to this she spent nine months on bleak St. Lawrence Island in the Bering Sea, where she was connected with the government nurse service. She is an ardent c.w. operator, and a real dx enthusiast. Beulah has piled up hundreds of dx contacts as the cards on her wall show. She not only knows how to tune a rig but knows just how an antenna should be constructed. Last but not least she can really copy code as well as being a good practical technician.

W6ANN just worked VK2EO, who told him he had contacted his 130th country. New ones for 2EO are VU7BR, G8MF, U9AB. W6ANN has 33 and 81 to his credit. W6LYM hooked EA7AV who gave his QRA as J. Portela, Veedor St. 15, Cadiz, Spain. W6IBZ also worked him . . . in fact, just before LYM. It is a surprise to hear that EA7AV is on again and his frequency was about 14,410 and time was from 1500 to 1700 G.m.t.

In a line from G2PL he says that Ginger Rogers is still very popular with him . . . but over the air he said something about Dorothy Lamour running a close second. Pete is using an HF100 in the final with 100 watts, and wants to know why no W6's are on 80 meters. He adds that he is sort of settling down to one y.l. I wonder if he will be doing that middle aisle stunt very soon?

W4MS has been quite active on phone and has 21 zones and 40 countries. His rig is a bi-push into a T55 with a T200 final. Receivers are an HRO and RME-69. The call of his x.y.l. is W4AXF. W8LFE has worked OH2OI making 29 zones and 67 countries on phone. Just as a tip, LFE says so far in January he has worked 17 zones to count in the Marathon. Higgy has grabbed a few other nice ones in VS6AG, ON4DI, GW5PH. For W8QDU two new zones are CN8BA and VQ4CRE, making 24 and 51, on phone.

A Word About Contributions

When you fellows send dx news, or any contributions into this department, we should receive it not later than the 10th of the month. To illustrate when this news will appear in print, let's just take this copy for an example. We'll assume this copy was received from you by the 10th of January. It is sent to the printer, who in turn sets it in type, a proof is "pulled" and the proofreader goes over it. When corrected it is again turned over to the printer. This news appears in the March issue, and we strive to get it off the press by the middle of February. Actually the news and information you send in, appears approximately five weeks later in print. You can see by the above explanation that it is impossible to put any of the January 10 news into the February issue. This is mentioned because a few of the gang have wondered why contributions from them have not appeared in the very next issue.

This is as good a spot as any to suggest a method of keeping record of your countries worked. In the List of Countries in the January Radio you could make some sort of mark, such as a dot or a dash, in front of each country worked. Inasmuch as there are six well-spaced columns of countries, you might keep a sub-total at the bottom of each column, then add all col-

[*Continued on Page 87*]

A Simple 112-Mc. Transceiver

The amateur who is new to the game and either can't afford or feels he hasn't had sufficient experience to construct a mobile transmitter sufficiently stable for operation on 28 or 56 Mc. will find this 112-Mc. transceiver to be the answer to the mobile question.

Three or four years ago amateurs had a grand time talking from car to car with simple 56-Mc. transceivers. These transceivers were easy and inexpensive to build and permitted QSO's over distances of from 5 to 25 miles with little difficulty. But the new regulations and changing conditions have changed all that; on 28 or 56 Mc. it is necessary to have a stabilized transmitter and fair play calls for the use of a superhet or other non-radiating receiver. While many amateurs have installed such mobile equipment for use on 28 Mc. and are having fun working extreme dx in addition to locals, there are others who do not want to go to this amount of trouble and expense but would like to be able to work mobile locally.

The answer is the neglected 112-Mc. band. With ordinary care, it is possible to get a transceiver of the type commonly used on 56 Mc. a few years ago to work on 112 Mc. And because it is possible to use a full half-wave radiator without its being unduly tall (a half wave is only 4 feet at 112 Mc.) results about as good as are ordinarily obtained on 56 Mc. with a quarter-wave antenna can be expected.

In the 112-Mc. transceiver to be described, a simple ultra-audion oscillator circuit is used, which is made superregenerative for receiving by insertion of a high value of grid leak. A type 6F6 pentode is used as an audio amplifier to drive the phones when receiving or as a modulator for the 76 oscillator when transmitting. A study of what changes take place when the send-receive switch is thrown will result in a better understanding of how both tubes do double duty.

Construction

While it is not necessary to follow the layout for the a.f. system shown in the photographs as the length of d.c. and a.f. leads is unimportant, the r.f. portion should be arranged exactly as shown. This includes the 76 socket, the tuning condenser, grid coupling condenser, r.f. chokes, and tank coil. The oscillator circuit is quite simple, but unless constructed exactly as shown there is a possibility that difficulty will be encountered.

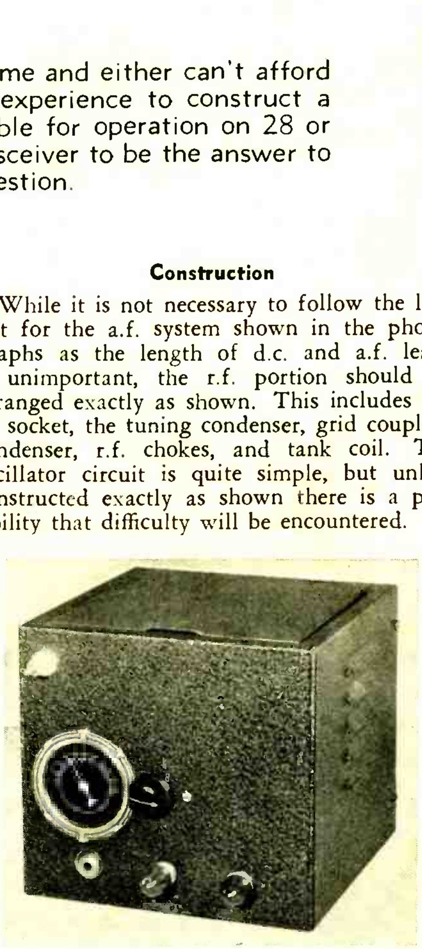


Figure 1. This compact 112-Mc. transceiver provides the least expensive form of mobile operation. The insulated terminal at the upper left was for a single-wire feed system which was discarded as inefficient after comparative tests were made.

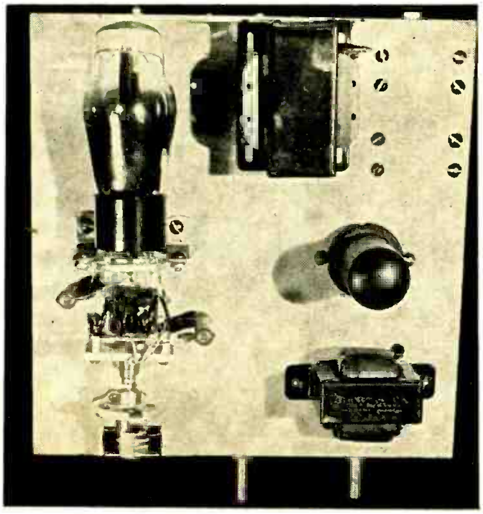


Figure 2. The parts to the left should be placed and wired exactly as explained in the text. This includes tube socket, r.f. chokes, tuning condenser, grid condenser, and coil.

The 76 socket, which must have either ceramic or other h.f. type low loss insulation, should be of the type that has the terminals extending straight out the base as an extension of the jaws that hold the tube prongs. This results in shorter leads to the coil, as the length of the socket terminals has to be taken into consideration at this high frequency, and it is important to provide as short a path as possible from the grid and plate prongs of the tube to the tuning condenser and coil.

The 76 (5-prong) socket is mounted vertically, raised up off the chassis a half inch or so by means of angle brackets, so that shorter connections may be made to the tuning condenser. The socket is oriented so that the grid (isolated) pin is at the top.

The tuning condenser, a ceramic insulated midget having but three plates, is mounted on the chassis by means of a mounting bracket designed for use with this type midget condenser and available as an accessory. The bracket is fastened to the ceramic portion of the condenser, thus permitting both rotor and stator to "float." This is necessary because in this circuit not only are both sides of the condenser "hot," but if there is too much capacity from either side of the condenser to ground there will be an improper ratio of grid-cathode to plate-cathode capacity and the feedback will not be of the right value for best operation. In other words, there should be no more metal making connection to either side of the condenser than absolutely necessary. This explains the insulated coupling connecting to the tuning condenser shaft. It should preferably have ceramic insulation.

The coil consists of three turns of no. 14 enameled wire, ½ inch in diameter and spaced to approximately 1 inch. This coil is mounted directly on the condenser, with as short leads as possible. Because a small difference in the coil dimensions or length of grid and plate leads has such an effect upon the frequency, it may be necessary to "prune" the coil a bit to hit the 112-Mc. band.

The grid condenser should be of the midget mica type, the smallest available (in physical size). This should connect from the grid terminal on the socket to the *rotor* terminal on the tuning condenser. The grid condenser may be seen just under the coil. The plate terminal on the socket should go directly to the closest stator lug on the tuning condenser.

The "hot" end of each r.f. choke should be connected with as short a lead as possible, one to each side of the grid coupling condenser. These r.f. chokes should be the special u.h.f. type, as regular r.f. chokes, even the high-frequency type, have too much distributed capacity for effective operation at 112 Mc.

The cathode of the 76 is grounded to a lug under the closest of the two screws which fasten the socket to the two brackets. The heater wires and the wires to the bottom of th r.f. chokes come up through a hole in the chassis midway between the tuning condenser and socket. The balance of the wiring is all below deck, and as it carries only d.c. and high level a.f., no care need be taken to obtain short leads. Cabling the wire with waxed cord as shown in the bottom view of the chassis is not necessary but makes a workmanlike job.

To reduce the number of external connections required, the 4½-volt microphone battery is strapped to the bottom of the chassis as illustrated. On the front panel are the microphone jack, regeneration control, and send-receive switch, from left to right across the bottom. On the rear of the chassis are the phone jack and a four-prong socket for making connection to the power supply and heater voltage. If desired, the phone jack may be placed on the front of the panel along with the microphone jack, though it will then be advisable to mark them to avoid getting the phones and microphone reversed.

As will be noted in the view of the complete unit in its cabinet, figure 1, a vernier dial is used. This type dial is desirable because the band covers only a relatively small portion of the dial. This use of but little bandspread was deemed advisable because of the difficulty in "finding" the band and the effect of various antenna coupling methods on the frequency of operation. Because of lack of receiver selectivity and due to the low ratio of the vernier dial, no trouble is experienced with critical tuning.

The material ordinarily used for tube bases has a rather poor power factor at 112 Mc.; hence the base of the 76 is slotted between the grid pin and adjacent pins by means of a fine tooth hack saw. One "slice" is taken, just deep enough to go all the way through the bottom of the base. Be careful or you will crack the base; and don't go too far or you may crack the stem of the tube. The base should be held in a vise with just enough "squeeze" to keep it steady during the sawing process. Slotting the base in this manner lowers the losses sufficiently to increase the output noticeably when transmitting.

The size of the cabinet is not important just so long as it is sufficiently large to hold all the components without crowding, the one illustrated being approximately 7 inches on a side.

Power Supply

One advantage of a superregenerative receiver is that it is relatively insensitive to noise such as is generated by auto ignition systems, vibrator hash in vibrator power supplies, commutator hash in dynamotor power supplies, and so forth. Therefore the power supply need have but the regular a.f. filter; no r.f. filtering will be required.

The transceiver power supply should deliver between 225 and 250 volts under load. If the voltage is greater than 250, the 76 will run too hot and draw more than the maximum advisable plate current when transmitting. If the voltage is less than about 225 volts, the tube cannot be made to superregenerate in the "receive" position when normal antenna loading is used. The drain on the power pack at 225-250 volts is around 42 ma. when receiving and approximately 65 ma. when transmitting.

Probably the most practical and least expensive source of high voltage is a 200-volt 100-ma. self-rectifying "vibrapack," such as designated in the diagram. On the highest voltage tap these packs will deliver approximately 225 volts at 65 ma. (transmitting condition) and nearly 250 volts at 42 ma. (receiving condition). A single section "brute force" filter of the type used for regular 60-cycle a.c. power supplies will provide sufficiently pure d.c.

As the vibrapack is used both when transmitting and receiving, a single husky switch can be used to apply battery voltage to both the pack and tube heaters. Wire at least as heavy as no. 12 should be used between the vibrapack and the "A hot," as it will draw between 4 and 5 amperes and even a slight drop in voltage will result in considerable reduction in the maximum plate voltage available for the transceiver.

Stealing Power

Most of the vibrator power supplies used in the newer auto radios, especially those having six or more tubes, will deliver around 225 volts under load. This voltage may be robbed for use on the transceiver by running a lead from the B plus side of the speaker output transformer to the transceiver.

A switch inserted in the heater lead to the tubes in the auto set will prevent these tubes from drawing heater current when the power pack is turned on (regular switch on auto set), and at the same time permit the full output of the high-voltage pack to be used on the transceiver, as the tubes in the auto set cannot draw plate current when their heaters are not lit. If your auto set is of the type that has a filamentary rectifier (84, 6Z4, 6X5, etc.) instead of a gaseous cold-cathode or synchronous vibrating rectifier, the heater to this tube must not be opened or there will be no high voltage delivered by the pack. The heater switch should be con-

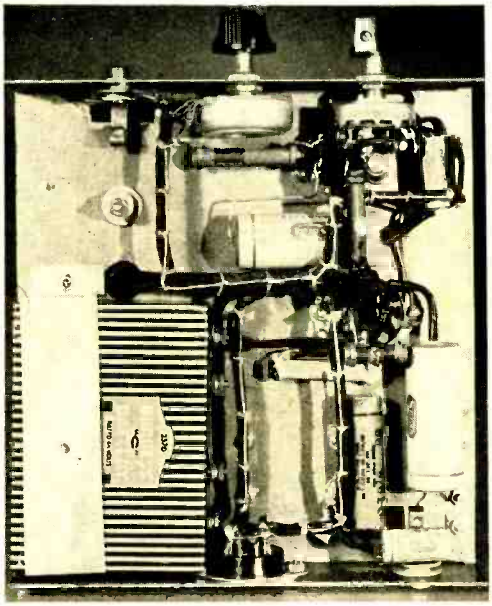


Figure 3. Under-chassis view of the 112-Mc. transceiver. Exact placement of these parts and length of leads between them is not important. All grounds are made to the nearest convenient point on the chassis.

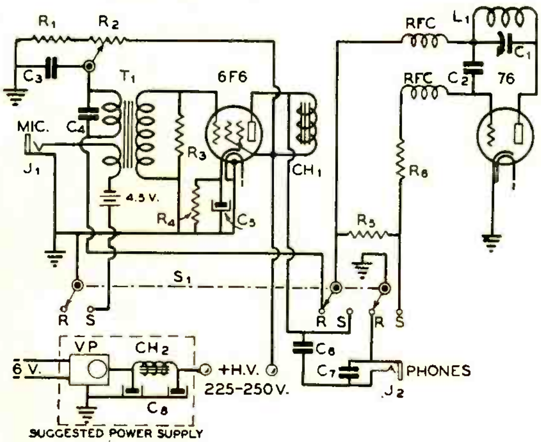


Figure 4. General wiring diagram of the 112-Mc. transceiver

C_1—10-μμfd. midget, ceramic insulation
C_2—100-μμfd. midget mica (smallest physical size)
C_3—0.25-μfd. tubular, 400 volt
C_4—.002-μfd. tubular, 400 volt
C_5—10-μfd. electrolytic, 25 volt
C_6—0.25-μfd. tubular, 400 volt
C_7—.01-μfd. tubular, 400 volt
C_8—Dual 8-μfd. electrolytic, 450 volt
L_1—See text
R_1—100,000 ohms, 1 watt
R_2—100,000-ohm pot.
R_3—250,000 ohms, ½ watt
R_4—500 ohms, 2 watts
R_5—1 meg., 1 watt
R_6—15,000 ohms, 1 watt
RFC—U.h.f. radio frequency chokes
S_1—3-pole 2-throw rotary switch, shorting type
CH_1, CH_2—10 hy. or more, 75 ma.
VP—200-volt 100-ma. "vibrapack," synchronous rectifier
T_1—Midget "transceiver" transformer, plate and s.b. mike to grid
J_1, J_2—Open circuit jacks

nected so that it opens all heaters *except* the heater of the rectifier tube.

Because the voltage of the power pack will go up considerably at no load and there is a possibility of blowing filter or by-pass condensers in the auto set if they are not conservatively rated, the heater of the 6F6 in the transceiver should be allowed to reach operating temperature before the regular switch (not the heater switch) in the auto set is turned on. Also, be sure not to apply high voltage to the transceiver unless the heaters in the auto set are opened, because otherwise both auto set and the transceiver will draw plate current, and the combined plate current may be high enough to damage the power pack.

The correct procedure is as follows: Turn on heaters to transceiver (assuming high-voltage lead is connected from auto set to transceiver). Open heater switch on auto set. After a half minute turn on regular switch on auto set. When all through working the transceiver, turn off regular switch on auto set. Turn off heaters in transceiver. Close heater switch on auto set. The auto set is then ready for b.c.l. operation; just turn on the regular switch on the auto set.

Antenna

The best antenna for general coverage, either for fixed station or mobile use, is a vertical half-wave doublet, placed as high and in the clear as possible. An excellent mobile antenna is a "fishpole" exactly 4 feet long and well insulated at the base.

One advantage of a half-wave radiator over a quarter-wave radiator as commonly used for mobile work on 28 and 56 Mc. is the higher radiation resistance. This higher radiation resistance results in a broader resonance curve, which minimizes "dead spots" on the receiver dial and unequal performance on different frequencies in the band when transmitting.

Efficient feeding of a 112-Mc. antenna is a problem, especially if the antenna is more than a short distance from the source of r.f. The reason for this is that many feed lines that have negligible losses at 14 Mc. are sadly inefficient at 112 Mc.

Unfortunately the rubber insulated cables, either concentric or twisted pair, are very poor performers at this frequency. The lowest loss and least expensive line is the open wire type. A two-wire line of no. 16 wire, spaced from 1½ to 2 inches with ceramic spreaders, makes a very efficient line if kept at least 3 or 4 inches away from large pieces of body metal where the line parallels such metal. The line is delta matched to the radiator by fanning it out and attaching it at points 6 inches each side of center. The line should leave the antenna at a right angle for at least 8 inches, and the feeder wires should be exactly the same length. The feed line can be supported away from the car body and kept from swinging by means of waxed cord tied to the spreaders.

The most logical place in the car for the transceiver is in the glove compartment. If you look around you can find an antenna of the type that bolts to the door hinge that telescopes out to four feet. Most door hinge antennas are not quite four feet extended, but if you look around you can find one that ex-tends to four feet. Unfortunately the insulation at the base probably will not be good enough for u.h.f. (there is a voltage loop at the bottom of a half-wave antenna; hence insulation is important). However, with a little ingenuity you can substitute a piece of micalex, victron, or ceramic material for the mud or other composition the manufacturer intended for insulation. Just remember in so doing that there is considerable torque at the base of the antenna as a result of the whipping it does while the car is being driven, and the support should be made sufficiently strong from a mechanical standpoint.

With such an antenna on the same side of the car as the transceiver, only a short length of line will be required to connect the antenna to the transceiver. Small feedthrough insulators (brown will be less conspicuous on a dark car) can be used to take the wires through the side of the car body. If you sell the car or the transceiver the holes can be filled with body solder and touched up with paint for a couple of dollars.

There will be a slight unbalance in the line due to the fact that the capacity to the car body is much greater from the lower part of the radiator. Nevertheless, this type of feed system (two-wire open line) is the most efficient that can be used.

Antenna Coupling

The antenna feed line is coupled to the transceiver coil by means of two turns of insulated solid hookup wire shoved down straddling the center turn of the three-turn coil. It should be shoved down until the transceiver will no longer superregenerate over the whole band when the regeneration control is full on, superregeneration being indicated by a fairly loud hiss or rushing noise in the phones when the send-receive switch is on "receive." Back off the coupling just enough to permit superregeneration over the whole band and then leave the coupling alone until such time as you make any changes in the antenna or feed line.

If it is necessary to telescope the antenna to get the car in your garage, scratch marks on the telescoping sections to enable you to extend the radiator to exactly the same length each time you use the transceiver.

Operating Hints

It will probably be found that the transceiver does not transmit and receive on exactly the same frequency. If this effect happens to be present in exact reverse in the transceiver used by the fellow you are working, in other words if his transmits on a higher frequency and yours transmits on a lower frequency than when receiving at the same dial setting and the difference in kilocycles is approximately the same in both transceivers, you will not have to manipulate the tuning dial when shifting from transmit to receive and vice versa.

In most cases, however, it will be necessary to jump between two dial settings so that you will not "chase" the other fellow up or down the band during the QSO. Just remember during a QSO to return the dial to exactly the same setting each time you switch to "transmit" and both transceivers will stay in the same part of the band. It will only be necessary to move the dial a division or two between transmit and receive to keep from wandering across the band.

While nearly all 76's seem to work fairly well, some makes work a little better than others. If the oscillator is unstable or cannot be made to superregenerate strongly, try another make 76.

A little practice in tuning the transceiver will make you an expert, as it is really quite simple. However, it might be well to point out to the uninitiated that the transceiver is most sensitive to weak signals when the regeneration control is right on the "edge" of superregeneration.

When the transceiver is fired up the first time it can be checked on "receive" by listening for the superregenerative hiss. With the antenna disconnected it should break into superregeneration when the regeneration control is advanced to about two-thirds full on.

The transceiver can be checked on "transmit" by means of a small dial lamp connected to a turn or two of wire. When coupled to the tank coil the lamp should glow brightly, and increase in brilliancy when the microphone is spoken into.

Both these initial checks should be made before installing the transceiver in a car because it is possible that an error in construction was made which would permit the instrument to work on transmit but not receive, or vice versa.

The gain of the modulator is such that with an ordinary telephone microphone of the "F" type one should talk directly into the microphone in a normal tone of voice. Talking too loudly will result in overmodulation and consequent distortion, while talking too far from the microphone will reduce the transmitting range.

When not using the transceiver be sure either to throw the send-receive switch to "receive" or pull the microphone plug. Other-

[*Continued on Page 88*]

56 MC....

By E. H. CONKLIN,* W9BNX

December 11 was an "open" day for dx between the midwest and the east. Near Boston, W1CTW heard W9NY on c.w., but why others were not logged we couldn't say. In the hour following 9:30 a.m. central time, W9TPI in Indianapolis logged W1IJ, W3EZM, W3GQS, W2HWX and four others not identified. W1IJ was calling him. Some signals were fully R9 on peaks. W2HWX was working a local and did not hear about conditions until too late. He received heard reports from W9ZJB in Kansas City, from W9TPI, and from Henry Morris of Benton, Illinois.

On December 3, from 10:15 until 10:45 p.m. eastern time, W2HEJ was in contact with a station signing W9GXL located in Chicago. Signals had the characteristic dx fade. We wrote GXL at the Indiana address without result and found no stations in Chicago who heard dx signals that night. It may be a case of erroneous identification, bootlegging, or just plain local "fun." The National Bureau of Standards reported no sporadic-E reflections at that time.

DX Relay

January 1 was probably a bad selection for a dx relay attempt, particularly with the following day, a holiday, available. That one can be chalked up against us. We went over to W9CLH in Elgin and warmed things up, then tried to find a way to key the carrier without blowing up the modulator or using a can opener. Finally with the help of W9BBU we got the i.c.w. modulation going nicely but with a continuous carrier, though we preferred complete keying in case signals were weak. The first calls to W9ZHB in Zearing (Bureau County, Illinois) and W8CVQ in Kalamazoo brought response from audible but unidentified carriers. We had brought along a receiver identical to the one at W9CLH but with an 1851 r.f. stage in it—which was not able to bring in 30-mile signals consistently on our own antennas. Switching to this set resulted in phone QSO's with both stations at distances of 70 and 135 miles. The relay messages got off satisfactorily in spite of the weak winter signal level. In the evening, W9ZHB still was able to get our phone R9 but we had to use code to handle messages with W8CVQ because modulation was not getting through.

We were impressed by the advantage in using c.w. whenever dx attempts are made, switching to phone if the signal is good enough. Much time is saved that way because it is then unnecessary to turn off the beat oscillator and listen to every voice on the band in locating the dx station. Furthermore, much better dx is possible with the same equipment. Another thing was the help given by W9CLH's high antenna, consisting of a vertical four-section W8JK. Several antennas have been tried there, both horizontal and vertical, and all beams have brought in W8CVQ but dipoles have not. The signals were not strong enough to make the noise silencer useful, but it was believed that a really good r.f. stage or two, designed for maximum results on 56 Mc., would lift the signal up to a point where the silencer would go into action.

We understand that W9ZHB is using a rotary horizontal rhombic, one wavelength on a side. It was certainly directive and has made 80-mile work a regular thing all winter, with R6 signals from Peoria and R9 from W9CLH. Ed told us that when W9CLH puts up a good *horizontal* beam, results will be much improved. He would give us no more details until he works a W7 to complete his w.a.d., or until we come down there in person.

W8CVQ was unable to hear anyone to the east even with his new acorn superhet. We understand that some of the necessary relay stations had not completed their rebuilding but would be ready for the February 22 attempt.

In Wyandotte, south of Detroit and 130 miles east of Kalamazoo, W8IUD/RHF, together with W8NIX and W8SS in Detroit, had twelve schedules with W8CVQ during the week-end. C.w. got through on ten transmissions, but phone did not. On one occasion, W8CVQ got into Ann Arbor on phone. It appears that an intermediate relay or use of c.w. will be necessary to make the jump to Detroit consistently in midwinter.

W2MO wrote saying that he was rebuilding on January 1 and was not ready for the relay. The new final, with 800 watts to a

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* ex W9FM; Associate Editor, RADIO, 512 N. Main St., Wheaton, Ill.

tubes, will be finished

have not received reports handling messages in the s eve and rebuilding may re toll. We hope for better 22.

e *can* be relayed to the Atlan o is now clear because W3RL 3GRL's signals have bridged y gap on the southern route, from Leesburg, Virginia, to Hagerstown and Cumberland, Maryland. The latter were reached in a relay last year from VE3ADO via W8CIR near Pittsburgh. This requires one portable station in getting to Hagerstown from Pittsburgh.

W3RL is located 21 miles west of Washington and 15 miles across a valley from W3GLV. He says that if W8CIR can get a message into Cumberland or Hagerstown, one more possibility is to place a portable on Sugarloaf Mt. near Frederick, Maryland, and work into Baltimore, thus eliminating the Washington gang. Upon studying a map, he finds another possibility involving two portables. From W8CIR the route would go to a high point near Uniontown or Connellsville, Pa., to a portable on Alleghany Front Mt. on U. S. route 50 west of Romney, West Va., thence to W3FXL at Waterford, Va., W3RL, W3GMZ and on to Baltimore. This might be changed by using a portable on Skyline Drive, Va., instead of W3FXL. We object to the use of portables, but until concentrated effort on the Syracuse-Schenectady gap or the one across Pennsylvania gives us a better choice, the southern route seems to be the only possibility.

W3GMZ in Washington says that he is ready for the relay with 250 watts on 100TH's, frequency 57,240 kc. W3HDC and W3AWM are also getting equipped for bigger and better five-meter dx.

In Allentown, Pa., W3BYF says that he has never heard stations north or west except portables but he has been heard by W8PIK at Williamsport who used a portable on a hill back of his home; and other points 100 or more miles in that direction. Better equipment up that way, therefore, will probably open up the band.

In Albany, W3FBA uses 400 watts. He has worked west only 18 miles to Schenectady where he says the boys can get only another two miles to Scotia. He heard a portable on Mt. Greylock, Mass., 35 miles away, in November and has been heard eastward in Springfield, Ludlow and Pittsfield, Mass. The more active stations locally include W8JHW, W2HYO, W2CYW and W2KLZ.

W2KLZ at Johnsonville, N. Y., also feels that his part of the country is the "missing link" in the relay. He is right. He can work W8JHW in Waterford and W8EID in Greenwich with R9 signals but no ground wave contacts have been made west of Schenectady. He adds that W8ITN in Gloversville operates on five meters occasionally—that is one-third of the way to Utica, and only 65 miles from Syracuse. W8ITN plus some activity around Utica, Rome and Syracuse may break down the gap on the New York route! W8LWA up in Ft. Edwards, north of Albany, is reported able to work west in the summer, and a station is said to be in construction on Whiteface Mountain (W8RZI?).

We hope that fellows in central New York state will write to us so we can arrange tests to bridge the gap. We see no reason why these relatively short jumps cannot be worked with c.w., moderate power, good receivers and antennas. The way to get over hills may be to back away from them a little even though it makes the distance greater.

In the Boston area, W1CTW writes to say that one relay route would be to Mt. Wachusett, to be handled by the Worcester Radio Club. Then to Mt. Wilbraham, where W1AWW or another Springfield station will be available. From there, a route through Connecticut to New York City can be worked out. A message has already been passed along this route to Albany and down the Hudson River to New York.

Equipment

W3BYF is still testing receivers and cannot find a commercial superhet or converter that will beat a well-built set designed just for the one band. Perhaps he is expecting too much of the band-switching all-wave jobs. Almost any purchased receiver will work better on 56 Mc. if the grid clips of the detector and r.f. tubes are removed, and new tuned circuits hooked in. This doesn't require cutting into the set and is the easiest solution to the sensitivity problem. W8MSK in Birmingham, Michigan, 40 miles northwest of Detroit, felt last spring that his factory job should be whooped up, so he built an acorn 954 r.f. stage especially for five meters, including a new detector tuned circuit. With it, he heard W8VO in Akron, W8CIR near Pittsburgh, and other Ohio and Pennsylvania stations with some consistency during June and July.

Recently we had a discussion of ham problems with an RCA tube engineer who indicated that the sharp cutoff tubes, particularly the acorn 954, are our best bets as superhet mixers. Of the standard tubes, other than the acorns, he indicated that the sharp cutoff high mutual conductance tubes (1852, 1851, 1231) are to be preferred if the intermediate frequency is 1600 kc. or higher so that there will be no "pulling." The operating conditions for the 1852 as a converter are: 300 volts on the plate; screen fed from plate through dropping resistor to provide 150 volts to screen; cathode bias resistor at least 1000 ohms; inject 3 volts r.m.s. or higher into the number one grid. There seems to be no objection to the use of these tubes as mixers on lower frequencies as well.

Austin Forsyth, G6FO, has been making rather consistent contacts up through December with G5BY, 126 miles away. We mention it at this point because he feels that while the superhet has many advantages, an efficient straight regenerative receiver will find anything coming into the aerial on 56 Mc. just as on other bands, and he has yet to see a commercial superhet on this band which will do better than even a moderately good detector and one audio stage, even without an r.f. stage. W3GLV and others have already made this clear to us, although they have indicated the necessity of using a firm antenna or an isolating r.f. stage, and either a voltage stabilized plate supply or a small B battery on at least the detector screen. So drag out the old superregen, change the grid leak to make it straight regenerative and test it against your superhet or converter on a really weak signal.

We have heard some comments about noise silencers not operating on 56 Mc. Quite often this is the fault of an insensitive receiver rather than of the silencer. A good r.f. stage up front or more antenna pick-up will usually fix it.

G2BI finds that even one-turn links must be connected right, the difference being some four times in grid drive. We have had the same trouble on other bands, due to unintentional interstage coupling which can buck or aid the link coupling.

A lot of five-meter beams, W3BYF says, give louder signals when only one feeder is connected to the receiver—but his W8JK antenna is well enough balanced and receiver capacity coupling sufficiently low so that both feeder connections are necessary on dx signals.

Last month we incorrectly mentioned i.c.w. as illegal. While one rule simply moves the frequency limits of the stability paragraph, another specifically states that A2 emission *can* be used above 56 Mc. We suggest, however, that i.c.w. be used with an interru[...] rather than simply keying the n[...] whenever possible. This will permit [...] it at a greater distance.

Simple Compliance

Another thing about these regulations [...] that they do *not* require crystal control. The fellows that have left the band because of the understanding that they must stabilize, need only disconnect the modulator for c.w. and adjust the oscillator so that it won't yoop too much when keyed.

When we were at W9CLH on New Year's day we worked a Chicago station that used only one small duo-triode receiving tube in an m.o.p.a. and had satisfactory stability under modulation. Perhaps it isn't so hard to get on phone at that.

V Wheel Operation

In Atlanta, W4DYH has been using a V wheel which was heard by W9NY on December 11. Past discussions with the FCC on this have brought out the point that there may be a useful result of such operation, which should not necessarily be classed as superfluous, especially if unmodulated and not creating local interference. The theory of such operation is that someone ought to check up on the character of the radiated signal and be in a position either to take it off the air, or telephone someone else (not necessarily a licensed operator) to do it if interference with other services occurs.

Olio

We knew we could find another word meaning *potpourri,* vegetable stew or conglomeration. It's *olio.* So we bring you here miscellaneous items and comments from here and there. We could use more letters from the gang during the coming months. Don't forget us!

From Indianapolis, W9TPI writes to say that this column has helped him to get extremely interested in the five-meter band and he will stick it out a year even if no dx contacts are made. He has a 100-watt m.o.p.a. Other active stations in town are W9VXR-NPV-VNV-VPN-DSC-EMR. Nothing doing on 112 Mc. as yet.

Around Boston the band is very quiet during rebuilding, Calvin Hadlock says, but is getting more active gradually. In mid-December a round-robin was attended by fourteen stations, all crystal controlled. It sounded like Utopia.

W2AMJ is still about the best signal coming through at W3BYF in Allentown. Lately

[*Continued on Page 88*]

YARN *of the* MONTH

QTE?

Shortly after I return from my annual vacation from the grind of aligning the feeble signalinhalers foisted upon the gullible public by the Whoosis Radio Co., there is a resounding shakeup in the ranks of Zilch Communications, Inc. The intermediate result of this shakeup is one vacancy in said ranks. The resulting scramble among the local gang was approximately the same as when the hotel phone kicks out a nickel during a ham convention.

When the hubbub is finally over and the smoke has cleared away I find myself firmly installed in the Zilch transmitting station. Instead of tuning receivers, my life has been reduced to a routine of checking frequencies, replacing tubes, and reading oven thermometers.

Shortly after my ensconcement in the new position, strangely enough we commence having trouble with the jugs in the 500-watt amplifier stage of the rig. It is quite embarrassing to me as such failures most frequently occur during my watch. But I manage to stand up under the strain and in a short while, with the aid of parts picked up here and there, I manage to get a really hefty ham rig going. It is not long before I find myself in the category of those who naively relate to their brethren, "It's amazing; I reduced the input to 900 watts and I still get out."

Things go along swell in their own limited way and eventually the chief operator, Jack Dunkheimer, returns to the fold after a leave of absence which started shortly before my name was inscribed on the payroll book. With the return of Dunkheimer the other lads feel it necessary to impart a bit of information concerning our boss. They go on to relate that Jack, while being tops in intelligence and ingenuity, is actually a lazy lout. Furthermore, he has an OW who actually knows radio, being second only to Dunk in the respect. They say that he even goes so far as to let the little woman come out and do his work for him when he, the Great Dunkheimer, feels indisposed. And to cap the climax they even go so far as to state that Mrs. D. is quite R9 in her own right.

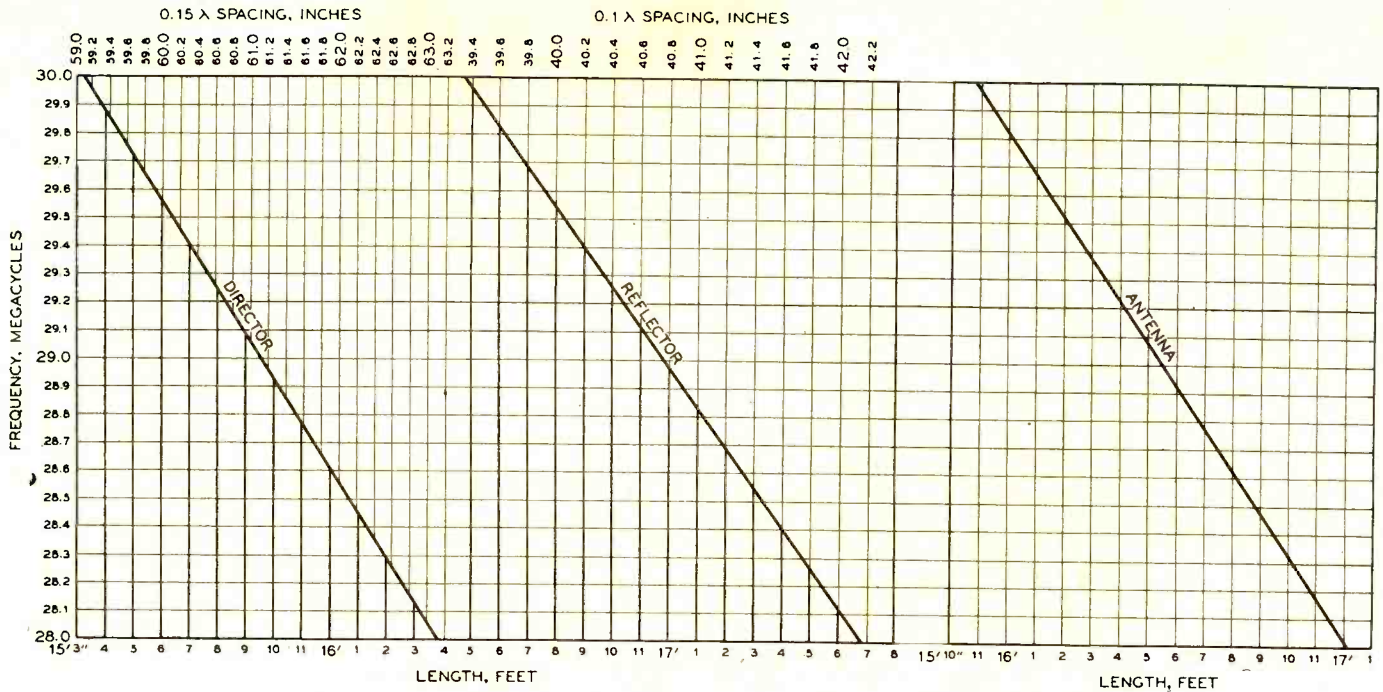
Now all this information is a bit confusing, to say the least. In the first place, Jack appears to be about as fine a fellow, considering the fact that he is of the *genus radio operatorus,* as you would like to meet. In the second place, dating from my earliest days as a ham I have been firmly convinced that the desirable of the species have no time to learn the code and other technical matters. In fact, as far as I was concerned, all female radio operators worthy of the name could be classed ——, and I wasn't interested in that class. Thus it was with great curiosity, but with no heart pounding in spite of the other operators' signal-strength rating, that I awaited my first encounter with the chief's little helpmate.

In the meantime, due to the fact that more 500-watt tubes have been going soft, I am welcomed into the best ham circles and am having quite a whirlwind social life. One day I report for the four p.m. to midnight trick and am immediately informed that the female wonder is coming to work at midnight to substitute for Jack. Now a guy who would send his wife out for the graveyard trick could easily be accused of brutality in the first degree. I was beginning to change my opinion of Jack; maybe the rest of the ops were right after all.

About 11:55 p.m. I am restored to awareness by the sound of tires crunching on the gravel driveway, followed by the click of high heels on the steps. What follows is rather

[*Continued on Page 92*]

BY LEWIS B. COE, W9CNY



Dimension Chart for Three-Element Close-Spaced Array.

It should be pointed out that the spacings given for the array in the November article are arbitrary, and need not be those given. For instance, the director and reflector may both be spaced a tenth wavelength, or the director may be spaced a tenth and the reflector 0.15 wavelength. Altering the spacing will require new lengths for the elements (or at least for the parasitic elements) and the chart shown herewith can no longer be used for determining the correct element lengths with any degree of accuracy. There is little difference in operation with any of the three spacing combinations mentioned, however, and one might just as well use the spacings for which the chart was calculated: 0.1 wavelength spacing for the reflector and 0.15 wavelength spacing for the director.

The chart shown here can be used for determining dimensions of a 20-meter array by dividing the frequency by 2 and multiplying the dimensions by the same factor.

POSTSCRIPTS... *and Announcements*

Three-Element Close-Spaced Array

Judging by comment heard on the air and from the volume of correspondence received concerning it, the three-element close-spaced array described in the November issue* is taking the country by storm. While it should be realized that for maximum directivity it is advisable to adjust the parasitic elements individually in each installation, many amateurs seem reluctant to prune the elements and prefer to put up their array "ready cut" with the assurance that the dimensions will be sufficiently accurate to give good results.

For the benefit of these amateurs the accompanying chart on the facing page is given. This chart has been found more accurate than the one appearing in the November article, though the latter is sufficiently close to give excellent results.

* Gioga and Dawley, "The Three-Element Rotary," RADIO, Nov., 1938, p. 13.

Ionospheric Soundings for Amateurs

Two errors were made in the equations that appeared in the January article by A. W. Friend, "Ionospheric Soundings for Amateurs." The first appeared in the caption to figure 5 on page 102, the last line of which reads "$A = \phi$" when it should read "$A = O$."

The second appears on page 104 in the equation to determine the pulse length from the diameter and speed of the disc and the size of the contacts. The equation reads:

$$\frac{t - 60\ (a + b)}{\pi D\ (r.p.m.)}$$

It *should* read:

$$t = \frac{60\ (a + b)}{\pi D\ (r.p.m.)}$$

A T20 100-Watt Phone

An omission was made in the schematic drawing of the Jones T20 phone rig described in the article beginning on page 38 of the January RADIO. The center-tap was omitted from the driver transformer of the TZ20 modulators. The tap on this transformer should connect to ground.

1939 FCC Amateur Examination Schedule

No examinations are given on state or national holidays. Information regarding examinations for which exact addresses and dates are not given may be obtained from the Inspector in Charge of the District.

Albuquerque, N. Mex.: April 22, October 21

Atlanta, Ga., 411 Federal Annex: Every Tuesday, Friday and Saturday

Baltimore, Md., Fort McHenry: Every Wednesday and Saturday

Billings, Mont.: Sometime in April and October

Bismarck, N. D.: Date unannounced, correspond with Inspector in Charge of the District

Boise, Idaho: Sometime in April and October

Boston, Mass., 7th Floor, Customhouse: Daily except Thursday

Buffalo, N. Y., 514 Federal Bldg.:[1] First and third Saturday of each month, other days by appointment

Butte, Mont.: Sometime in May and November

Chicago, Ill., 246 U. S. Courthouse Bldg.: Every Saturday

Cincinnati, Ohio: Sometime in May, August and November

Cleveland, Ohio: Sometime in April, July and October

Columbus, Ohio: Sometime in March, June, September and December

Dallas, Tex., 302 U. S. Terminal Annex Bldg.: Every Tuesday

Denver, Colo., 504 Customhouse: First and second Saturday of each month

Des Moines, Iowa: April 14, 15; July 14, 15; October 13, 14

Galveston, Tex., Room 404 Federal Bldg.: Every Wednesday and Saturday

Hilo, T. H.: July 21 and 22

Honolulu, T. H., Aloha Tower:[2] Every Monday and Saturday

Jacksonville, Fla.: June 3 and November 4

Juneau, Alaska, P. O. Box 2719: Examinations given at convenience of the Inspector. Arrangements should be made by corresponding with the office.

Kansas City, Mo., 609 Pickwick Bldg., 903 McGee St.: First and third Friday and Saturday of each month

Kaunakakai, Molokai, T. H.: July 17

Lanai City, Lanai, T. H.: July 18

Lihue, T. H.: August 11 and 12

Little Rock, Ark.: April 18 and September 12

Los Angeles, Calif., 1105 Rives-Strong Bldg.: Every Monday and Saturday

Miami, Fla., Room 314 Federal Bldg., P. O. Box 150: Every Tuesday and Saturday

Nashville, Tenn.: May 19, August 18 and November 17

New Orleans, La., 326 Customhouse:[2] Every Monday, other days by appointment

New York, N. Y., 748 Federal Bldg., 641 Washington St.: Every Tuesday, Thursday and Saturday

Norfolk, Va., Room 402, New P. O. Bldg.: Class A daily, all classes every Friday and Saturday

Oklahoma City, Okla.: May 13, August 12 and November 18

Philadelphia, Pa., Room 1200 Customhouse, 2nd & Chestnut Sts.: Every Wednesday and Saturday by appointment

Phoenix, Ariz.: 2 days sometime in April and October

Pittsburgh, Pa.: Sometime in March, June, September and December

Portland, Ore., 207 New U. S. Courthouse: Every Friday and Saturday

Salt Lake City, Utah: Sometime in March and September

San Antonio, Tex.: March 11, June 10, September 9 and December 9

San Diego, Calif., 503 New California Bldg.: Examinations given at convenience of the Inspector. Arrangements should be made by corresponding with the office.

San Francisco, Calif., 328 Customhouse: Class A daily, class B every Monday and Saturday

San Juan, Puerto Rico, 303 Ochoa Bldg., P. O Box 1353: Examinations given at convenience of the Inspector. Arrangements should be made by corresponding with the office.

St. Louis, Mo.:[2] May 12, 13; August 11, 12; November 9, 10

St. Paul, Minn., 927 Main P. O. Bldg.: First and third Saturday of every month, other days by appointment

Savannah, Ga., 208 P. O. Bldg., P. O. Box 77: Examinations given at convenience of the Inspector. Arrangements should be made by corresponding with the office.

Schenectady, N. Y.: Sometime in March, June, September and December

Seattle, Wash., 808 Federal Office Bldg.: Every Friday

Spokane, Wash.: Sometime in May and November

Tampa, Fla., 203 P. O. Bldg.: Examinations given at convenience of the Inspector. Arrangements should be made by corresponding with the office.

Wailuku, Maui, T. H.: July 19 and 20

Washington, D. C., FCC Headquarters: Every Thursday, other days by appointment

Winston-Salem, N. C.:[2] May 6, August 5 and November 4

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[1] If the first Friday falls on a holiday, examinations will be gien the following Friday.

[2] All examinations begin promptly at 9:00 a.m., local time, except at New Orleans, La., Honolulu, T. H., and Winston-Salem, N. C., where they begin at 8:30 a.m. Examinations on Friday in St. Louis begin at 12:00 noon.

Thanks

Although there are probably many readers of our RADIO HANDBOOK who do not read RADIO this seems about the only place to extend a blanket "thank you" for the many letters of comment which have been received with regard to the current edition. Apparently the policies which the editors have followed since the inception of this book have this year really "rung the bell." Only one query crops up with any regularity: why do we accept advertising in that book? The reason is financial: without the revenue from advertising its cost would be much higher. Most of the larger technical book publishers charge from $5.00 upwards (and mostly upwards) for books which differ physically only by having a fancier binding—and perhaps less information! As we've pointed out on this page before, the difference between the price you do pay and the price this book would otherwise have to carry is a gift to you from its advertisers. Won't you reciprocate by giving preference to their products when suited to the job at hand?

Errors

One reader, who is evidently affluent enough to read *Fortune,* writes in to suggest that we offer $5 to the first reader to point out to us each error in RADIO. No, thank you. We appreciate the implied compliment, but we ourselves have no delusions of having yet attained that degree of accuracy. While there's life, there's hope.

NEW BOOKS

and trade literature

TAYLOR TUBE MANUAL

The 1939 Taylor Tubes Catalog and Manual is now available to radio amateurs and other interested parties. The book comprises 44 pages, 8½ by 11 inches, and is well illustrated. The first 14 pages of the manual are given over to descriptions of the various types of Taylor tubes, their operating characteristics, and prices. Two additional pages contain the characteristic curves of twelve of the most popular types of Taylor triodes.

The balance of the manual is devoted to general tube information, operating suggestions, and descriptions of four complete Taylor designed transmitters and other additional equipment. The first of the transmitters is a 275-watt-input phone rig with instant change between two bands and quick change between any of the other bands. Two separate r.f. channels are employed; one is used for the lower-frequency bands, and the other for the h.f. bands. Another of the transmitters employs a T21 into a TZ40 in a quick-band-change c.w. rig.

The other two complete transmitters are: a 450-watt phone rig with a pair of T55's modulated by a pair of TZ40's, and a 10-160 transmitter with a single T55 modulated by a pair of TZ20's. A one-kilowatt final using T200's and the 100-watt grid-modulated 814 transmitter described in the January, 1937, issue of RADIO are also described.

WHOLESALE MASTER CATALOG

A new master catalog of 188 pages has just been announced by Wholesale Radio Service Co., Inc., 100 Sixth Avenue, New York City. Its unusually large size is made necessary by the additional lines of public address and photographic equipment now being handled by the company. Forty pages are devoted to an enlarged listing of the unusually comprehensive variety of standard cameras and photographic equipment and supplies.

Copies of this new master catalog are obtainable without charge by a post card request to the above address, or by personal call at any of the following branch stores: Chicago, 901 W. Jackson Blvd.; Boston, 110 Federal St.; Atlanta, 265 Peachtree St.; Bronx, N. Y., 542 E. Fordham Rd.; Newark, N. J., 219 Central Ave.; Jamaica, L. I., 90-08 166th St.

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Calls Heard

Numeral suffix indicates "R" strength. Send Calls Heard to Calls Heard Editor, c/o RADIO, 7460 Beverly Blvd., Los Angeles, Calif.

Edgar H. Adler, W1DYV
6 Clinton St., Faunton, Mass.
October 14 to November 14, 1938
(14 Mc. c.w.)

CT1PC-7; EI4J-7; **FS**—AD-7; AM-5; SJ-6; RJ-5; FA8BG-8; HB9CZ-3. **I1**—EI-6; KN-6; MH-6; LX1JZ-5; **ON4**—AUV-6; AW-6; BRD-5; DX-5; FE-6; FL-5; OH6NS-5 **PAO**—CE-6; CN-5; FV-6; PO-6; PJ1BV-4; **SM**—5NK-5; 5YV-6; 6VX-7; SU1DB-6; **VP2**—AB-9; AT-7; LC-6; VQ2MI-5; VQ4CT-4; YM4AS-5; XE1AG-8; **ZE1**—JI-5; JG-5; **ZL**—1MB-9; 2FA-5; 3JA-6; 4CK-6; **ZS**—1AG-6; 1BA-5; 1BC-6; 1BG-5; 1CN-5; 1DA-5; 2Y-7; 2AC-5; 5CW-6; 6BF-6; 6BZ-7; 6DM-5; 6DW-4; 6EH-5.

October 30 to November 13, 1938
(28 Mc. phone)

G—2IS-9; 2VG-6; 5SA-7; 5TP-6; 6GO-7; 6VP-6; 8MX-8; VE4ZU-5; ZS6DW-4.

(28 Mc. c.w.)

D4—GJO-6; GXF-7; PQU-6; VZV-6; **FS**—BS-6; CP-7; RR-7; **G**—2CR-8; 2DH-5; 2PL-8; 2XC-6; 5BD-8; 5LI-6; 5SR-6; 5XY-7; 6KS-6; 6QZ-7; 6RB-7; 6WY-6; 6YR-9; 8IP-7; 8PA-6; **GM**—6XW-6; 8FR-7; 8MI-5; HC1FG-5; I1IT-7; **ON4**—KM-6; EJ-5; **PA**—KV-6; QZ-6; XR-6.

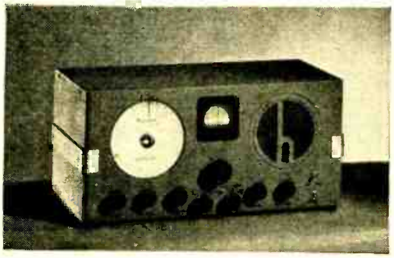
Cadet Amateur Radio Club, W2KGY
West Point, New York
(14 Mc. c.w.)

EP4RK; FB8AB; FI8AC; **J**—2KG; 2KN; 2NF; 2NG; 3FJ; 5CC; **K6**—PMP; TE; **KA**—1AP; 1BC; 1FG; 1JZ; 3KK; OQ5AQ; PJ1BV; **PK**—1BO; 1MF; 1TG; 1TT; 1RI; 2RN; 3EM; PK6XX; TF5M; U6WB; **VQ8**—AB; AI; VR4AD; **VS2**—AE; AL; VS6AO; VS7RF; **VU**—2EU; 2FO; **XU**—4XA; 6ST; 6TL; 7CK; 8CM; 8NR; ZD4AB; ZK1UG.

[*Continued on Page 96*]

What's New . . . .

IN RADIO



NEW 5-10 METER RECEIVER

Recognizing the growing interest in the u.h.f. range above 26 Mc., Hallicrafters has announced a new receiver that covers only the range from 27 to 68 Mc. The receiver, known as the Hallicrafters Skyrider "5-10," covers the above frequency range in two wavebands with an 1852 r.f. stage on both bands. Through the use of this u.h.f. r.f. amplifier tube and since the receiver covers only the u.h.f. bands, selectivity, sensitivity, and image rejection are considerably better than in conventional low-frequency receivers that have u.h.f. coverage. A total of 8 tubes are employed in a superheterodyne circuit. Through an unusual wiring arrangement the receiver may either be operated from the 110-volt a.c. line or from an external vibrator supply operating from a storage battery. Thus the set is well adapted to portable-mobile operation in addition to its suitability for home-station use.

RADIO-FREQUENCY RELAY

The Gordon Specialties Company, Chicago, Illinois, is now manufacturing a heavy-duty r.f. relay that is especially well suited for antenna changeover, multi-band transmitter tank switching, and 60-cycle power switching. The heavy ⅜-inch silver contacts and ample use of Alsimag 196 insulation make the relay very satisfactory for high-power antenna switching. The relay is double-pole double-throw in design and the two sets of contacts are well separated by a strong Alsimag bar. The wide spacing of the sets of contacts is advantageous when the relay is to be used in an open-wire transmission line since there is no serious disturbance of the transmission line characteristics.

The contactor is solenoid operated by a 110-volt 50-60 cycle coil which draws approximately 5 watts. The 4-lb. pull of the solenoid insures that the contacts are firmly closed when the relay is operated. The spacing of the open set of contacts is approximately one-half inch—ample spacing for the potentials encountered in voltage fed antenna systems. All metal parts are heavily plated and the base is equipped with rubber mounting feet to insure quiet operation.

NEW ACORN TUBES

Three entirely new types of acorn tubes have been placed on the market by the RCA Manufacturing Company. All three of the tubes, 957, 958 and 959, have low-current filaments of the coated type as contrasted to the previous types of acorn tubes which were equipped with indirectly heated cathodes. The filament of each of these types can be operated from a single flashlight dry cell. The power requirements of the filaments are extremely small when compared to existing tube types; the 957 and 959 each require only 0.063 watt (one-sixteenth watt), while the 958 with its greater power handling capabilities requires 0.125 (one-eighth) watt of filament energy.

These tubes are designed for use on the ultra-high frequencies, as were their predecessors in the acorn family. Due to their extreme economy of both plate and filament energy, in addition to their very small size, they are very well suited for use in compact portable and other battery-operated equipment where minimum size and weight are important considerations.

The 957 Triode

The 957 is a triode with an amplification factor of 16 and is designed especially for use

[*Continued on Page 94*]

Seattle, Warsh.

Dear Hon. Ed.:

Scratchi are got such stewpendus idear in bonnet that he got to sitting rite down and rite you a communication about wonderful skeem. Scratchi have idear for new sistem what are enable c.w. amchoors all over world in any langwage to make talk to each other in spite of fack that cannot understood each other's langwage. Scratchi are get the idear after coming to conclusion after much insensive study that a dot and a dash are the same in any langwage. Just lissen for yourself, hon. ed., a Rushing and a Messican are make dots which are sound eggsactly alike. This are give the sistem collosus advantage over various internashonal langwages being promoted, as are not having to learn how to make with mouth new sounds which are not sounding at all like anything ever heer in native langwage.

The Scratchi sistem are also have the importance advantage that it are a grate time saver. Not only are it much quicker to learn, but are much faster to use, as it are based on same idear as Q signals, only more incloosive. For instinks in the Scratchi code sistem, which after much deliveration have decide to call the Scratchifisti Internashonal Code, the simbull B4U8MNX are meening the same in all langwages of the world inclooding American:

"Very pleezed to QSO, especial if you are dx and particular if you are a new zoan for me. The wether, a descripshon of my rig and antenna, and you signals strength will be on QSL card which will ship to you. Incidentally if you are reel gentlefellow you will sending me ditto, which I will appreshiate very much, especial if you are dx and praticular if you are new zoan for me, and if not sending same you are a bum. In fack if you are in zoan 23 and don't QSL you are a lice besides. I don't having nothing reely importance to talk about so will be see you again soon but not too soon. Thanks for fine bizness QSO and very bestest regards."

Just think, hon. ed., how much time, efforts, and electricity will be save, especial if latter are pay for. In fack, might be a good idear for U. S. A. amchoors to using Scratchifisti Internashonal Code when each working one another, on account of many desirabull feechers such as save wear and tear on key.

Scratchi are seek counsil of lawyer man on patent the sistem, but are discover cannot getting perteckted on this grate idear, so are decide mite as well be altrooist and filanthrowpist and donate the Scratchifisti Internashonal Code to the world free of charge, which are very cheep indeed, hon. ed., and even are willing so long as cannot getting rich myselfs from same to let you sponsor the idear in RADIO at no cost, which are reely a bargan.

Pleez let Scratchi know if you are interest in make RADIO famus as magazeen which bring this boom to mankind to attenshon of public, and will get busy on figure out rest of the 25 code simbull which are need to cover all the things that amchoors ever talk about inclooding answers.

Respectively yours,
HASHAFISTI SCRATCHI

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Question Box

I am planning to build a new transmitter and I have the r.f. section all figured out, but I am somewhat puzzled as to the amount of audio power necessary to plate modulate the final amplifier. Most textbooks state that audio power equal to 50 per cent of the class-C amplifier d.c. input is required. However, I have been told, and have seen the statemenut in print, that the modulator need only have an audio output equal to from one-fourth to one-third of the class-C input. Will you please clarify this situation? Actually, how much audio power must I have fully to modulate my 500 watts input?

There is a great deal of misapprehension about the modulator power question as concerns amateur transmitters. This is due to the fact that modulator tube ratings are based on sine-wave output, while amateur transmitters are used (or should be used) for the transmission of speech only. The latter conditions are somewhat different from those set up by the manufacturers in determining their ratings.

Based on the sine-wave condition, the *average* audio output of the modulator must be one-half of the d.c. input to the modulated stage for 100% modulation. Since the average power in a sine wave is exactly half of its peak power and the average power in a speech wave is considerably less than half of its peak power, it would seem

[*Continued on Page 94*]

The Open Forum

Detroit, Mich.

Sirs:

There are now in the state of Michigan about 400 to 500 amateurs who have received from the Secretary of State their 1939 auto license plates having their station call letters instead of the usual numbers.

W8NFR's efforts and the splendid cooperation of Leon D. Case, Secretary of State, made this possible. The idea was originated as an encouragement for hams in the Detroit area to join the Great Lakes Amateur Radiophone Association, Inc. W8NFR compiled a list of call letters of amateurs interested in the idea. He also contacted the Secretary of State's office where he found them receptive to the idea and very willing to help.

Some few amateurs thought they would beat the rest of the gang in getting these special plates by sending their requests direct to the Secretary of State. If very many had done this they might have upset the plans. However, in each case the Secretary of State sent these few hams a letter instructing them to request the special plates through W8NFR. In this way a single list of 400 to 500 hams was compiled, which was sent as one group to the Secretary of State, thus carrying more weight to the request. It also simplified the work at the Secretary of State's office.

We are sending you the above information as in some way or other hams throughout the country have found out about this and W8NFR has received letters from practically every state asking how we did it. If you wish any more information please contact either W8SS or W8NFR.

Kenneth E. Stecker, W8SS
(Secretary of The Great Lakes Amateur Radiophone Assn., Inc.)

Chicago, Ill.

Sirs:

I am an enthusiastic short-wave listener who, if it were not that so many other interests keep me busy every minute, would probably be a licensed amateur by now. I think it is a very fascinating hobby, but because business and other affairs take up so much of my time, I find it necessary to pursue a hobby that affords some physical exercise; otherwise I would get very little.

A friend of mine who is an amateur gets his exercise by running up and down the roof putting up a different type of antenna every couple of days, but I probably would be unfortunate enough to get one up the first time that worked to my satisfaction and I wouldn't have further excuse for running up and down ladders twenty times an evening. So I stick to golf.

But some day soon I hope to be able to take more time off from my work, and when that time comes I'm going to get a ticket and get on the air. When I do, my amateur activity will consist entirely of working the "rig." Experimenting does not appeal to me; talking to fellows all over the world does. I am not even going to build my own transmitter. I can afford to buy a factory job that would work much better than anything I could ever build; so why should I attempt it?

What bothers me is the attitude of some of these self-styled "engineers" on the air who look down their nose at anyone who doesn't build his own station equipment. I realize that to some it is a very interesting phase of the game, possibly even more so than operating, and I have nothing but admiration for the fellow who can design and construct an elaborate transmitter and get it working properly. And I can understand and pardon his pride in his accomplishment. But why some of these fellows should take such a scornful attitude towards the "dope" that isn't particularly interested in the technical side of radio and just gets by the examination by the skin of his teeth is beyond me.

I'm not such a hot golf player but I'll bet I could trim the ears off some of these patronizing "class-A engineers" that clutter up the 20-meter phone band telling everybody how smart they are and what a fine rig they built for themselves (probably by duplicating a transmitter described in Radio). But just

[*Continued on Page 93*]

Supporting the Rotary Beam

[*Continued from Page 14*]

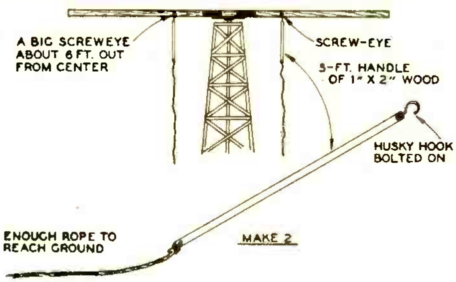

Figure 8.
Details of the handles which are used to control the boom from the ground during the tipping process. The handles are unhooked after all adjustments have been made.

strength tests indicate that the power gain has been tripled while the reduction of interference from the back and sides is almost too good to believe.

The total cost of all lumber, metal, welding and incidental hardware was around $15.00. Even if the cost had been twice this figure, the money would have been considered well spent on a cost-to-performance and satisfaction basis.

The "Square-Corner" Reflector

[*Continued from Page 23*]

is the product of the square of the current in the element and the resistive part of its impedance. Then due to symmetry, we may write for the total power in the four elements,

$4P = I_1^2\, 4\, [R_{11} + R_{1L} + R_{14} - 2R_{12}]$, where,
R_{11} = the self-resistance of element 1,
R_{1L} = the loss resistance of element 1,
R_{14} = the mutual resistance of elements 1 and 4, etc.

The current in element 1 is then,

$$I_1 = \sqrt{\frac{P}{R_{11} + R_{1L} + R_{14} - 2R_{12}}}.$$

The current in a half-wave antenna with the same power input, P, is

$$I_0 = \sqrt{\frac{P}{R_{00} + R_{0L}}},\ \text{where,}$$

R_{00} = the self-resistance of the half-wave antenna and
R_{0L} = the loss resistance of the half-wave antenna.

The current factor thus becomes,

$$\frac{I_1}{I_0} = \sqrt{\frac{R_{00} + R_{0L}}{R_{11} + R_{1L} + R_{14} - 2R_{12}}}$$

The expression for the gain in field intensity of the square-corner reflector over a single half-wave antenna is then,

$$\text{Gain} = \sqrt{\frac{R_{00} + R_{0L}}{R_{11} + R_{1L} + R_{14} - 2R_{12}}}$$

$$\left| [1 + 1 \angle 2S^\circ \cos \phi - 1 \angle S^\circ (\cos \phi + \sin \phi) - 1 \angle S^\circ (\cos \phi - \sin \phi)] \right|,$$

where,
S° = antenna-to-corner spacing in electrical degrees or
S° = 360° × antenna-to-corner spacing in wavelengths.

The factor in the brackets is the vector sum of the fields of the four elements at a distant point in a direction making an angle, ϕ, with an axis through elements 1 and 4. The distant point is in a plane which is perpendicular to the elements. This equation was evaluated for various values of S to obtain the curves of figure 3 and for various values of ϕ to obtain the dashed pattern of figure 7.

The four element system used in the analysis has four lobes of radiation as shown in figure 9-B. When the corner is present, however, lobes 2, 3, and 4 are absent and all of the power is concentrated in lobe 1.

A corner reflector with a 60° angle can be replaced for analysis by five images, 2, 3, 4, 5, and 6, as illustrated in figure 10-A. Likewise, a 45° corner can be replaced by seven images as in figure 10-B. The gain expressions for these reflectors can then be developed by the method outlined above for the square-corner reflector.

●

At the ham license speed of thirteen words a minute, less than a quarter of a second is required to send a dot. It takes five and six-tenths seconds to signal CQ, and the figure 5 can be cleared more quickly than any other numeral.

●

Electrical Multi-Measurements

[Continued from Page 31]

an auxiliary circuit, the universal meter can be made to give indications on frequencies as high as four megacycles.

Figure 11 is self-explanatory as regards connections. If a resonant circuit is under test, R_1 should assume a value of the order of several megohms. At extremely high frequencies greater deflections may be secured on the meter by connecting a fixed condenser of approximately 0.00025 μfd. in series with R_1. This procedure tends to neutralize the inductance effects of long leads.

If a tuned coil is connected as shown, the meter becomes a very sensitive device for neutralizing transmitters, especially in the stages of final adjustment. Bringing the resonantly tuned coil close to the tank circuit of any r.f. amplifier will provide definite indications as to the feedback of radio frequency power.

In this connection it should be noted that when the coil is tuned to resonate even with weak electromagnetic fields, the meter may swing violently off scale; great care must be exercised in determinations of this type.

Decibels Gain or Loss

At times it may become desirable to determine the voltage gain or loss of a circuit in decibels. For this purpose the semi-logarithmic curve shown in figure 12 permits an easy conversion from voltage ratios to decibels. In all cases the larger voltage is divided by the smaller, and the corresponding decibel value read from the curve. If the input voltage to the circuit is larger than the output voltage the value read from the curve is a loss; while if the input voltage is smaller than the output voltage, the curve will give the decibels gain of the circuit. This method is based upon the assumption of the same impedance at input and output.

Frequency Determination

Measurements of frequency may be made very simply by means of known capacitances or inductances. If the resistance in the circuit be considered negligible, the frequency determined by means of an inductance is

$$F = \frac{E}{2\pi LI},$$

where E is the voltage across, and I is the current through, the known inductance of L henries.

The frequency as determined by means of a capacitance is given by

$$F = \frac{I \times 10^6}{2\pi CE},$$

where E is the voltage across, and I is the current through, the known capacitance of C microfarads.

Frequency measurements will hold up to about 500 cycles, above which the universal meter will give results that grow increasingly inaccurate.

Vacuum Tube Measurements

The meter is easily adaptable as an indicating instrument for use with vacuum tube measuring equipment. Just as the external shunts and resistors extend the range of the meter upward, so does the vacuum tube extend the range of the meter downward, and a vast new region becomes available for investigation.

Conclusion

The measurements described so far cover quite a wide range of the science of electricity. However, some few remaining types of measurements, for various reasons, have been left to the ingenuity of the advanced experimenter. Such measurements as form factor and harmonic analysis will be found somewhat difficult. Ballistic measurements are more complex; while the direct measurement of power levels and power ratios by means of the elusive decibel should actually be troublesome.

The amateur or experimenter who goes through the trouble of constructing the universal meter described here will find that he has a valuable piece of apparatus at his disposal. He will find, because of the simple quantitative determinations now possible, that his work has taken on a new significance and clarity.

Securing Foreign QSL's

Many amateurs who have difficulty in securing those much desired dx QSL cards are unaware that "foreign" postcards may be obtained in the United States and be sent to the dx station. These cards have postage fully prepaid, and, if partly filled out by the sender, are very likely to receive the dx man's signature and be returned. While such a QSL may not be as desirable as the station's regular printed card, to the operator who has so far received but few foreign cards, it will be much better than none at all. This type of card (very similar to the more familiar one-cent double postcards in domestic use) is obtainable for all foreign countries in the Universal Postal Union.

Foreign reply cards are double postcards; the sender's message is written on one half; the other half is the reply portion, which even though it contains a *United States* stamp impressed thereon, may be mailed in the country of destination back to the United States without the addition of local postage stamps; in other words, the reply portion is fully prepaid. The regulations permit the sender to address the reply portion back to himself if he so desires; he may also place a questionnaire or similar material on the reply portion to be filled in by the addressee.

We understand that similar cards are issued by nearly all countries which are members of the Universal Postal Union. In every case, the reply portion will be treated as unprepaid unless both halves arrive together from the country of origin, and unless the reply half is addressed back to the country which issued it; it is not, however, required that the original sender address the reply portion, though, as mentioned before, he may do so.

In the United States two denominations are in use. The two-cent (no. 11) card (two cents each half) is for use to Canada, Newfoundland, Spain (and all possessions, but not the Spanish *zone* of Morocco), Andorra, and all *independent* countries in North, South, and Central America. Three-cent (no. 12) cards are for all other countries, three cents being the cost for each half of the card.

It is advised that the foreign correspondent be informed regarding the validity of the return card, for their use is rare, and most people go upon the assumption that postage stamps are good only in the country which issued them, to which this is the only general exception.

Because of small demand, these cards are not stocked in most U. S. post offices; if they are not available locally the postmaster will order them if you insist.

These international reply cards have no counterpart for letter mail, but *International Reply Coupons* may be obtained at nearly any post office (price, nine cents) which will be redeemed in any country of the Universal Postal Union for sufficient stamps to carry a letter of the first unit of weight from that country to the United States. The "first unit of weight" is one ounce in most English-speaking countries; it is 15 to 25 grams in most other countries, with 20 grams (about ¾ ounce) being an average. Similar coupons may be obtained in all countries of the Union.

At present it is believed that practically all countries, colonies, and places having a postal service are members of the International Postal Union except the Government of Latakia and the Laccadive and Maldive Islands.

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Equipment for Portable Mobile

[*Continued from Page 39*]

With the source of power decided upon the next step will be the choice of transmitter layout.

Transmitters

Here is a subject upon which a book could be written with the greatest of ease; it seems that everyone has his own pet idea on what to use and how to build it. The layouts given here have been proved and tested by many hours of actual operation.

Some amateurs will want to have good speech quality with wide audio range, while others will be content with really good single-button quality. At this point let me say that I have heard many mobile rigs using single-button mikes that have as good quality as some of the boys using crystal and other better microphones in less carefully adjusted transmitters. A microphone that is high pitched to make best use of the speech frequencies will help considerably to put the signal through QRM and QRN at the receiving end.

R. F. Lineup

Now for the radio frequency lineup. We have tried all sorts of combinations for an exciter and all have their advantages and disadvantages. A version that has been quite satisfactory is a 6N7 type tube with the first half connected as the oscillator and the second half as either a doubler or quadrupler. This combination at 250 volts will draw about 25 milliamperes fully loaded for both halves of the tube. Of course a 6A6 may also be used in the arrangement.

Another point of varied discussion is, "What to use for a final amplifier?" A simple tetrode tube such as the 6L6 or 6V6 will make a splendid final doubler stage. Many people will argue that the efficiency of a doubler in a final stage is poor, but after actual laboratory tests the efficiency from a final doubler was found to be just noticeably less than from a neutralized triode amplifier.

Speech and Audio

After the selection of the radio frequency portion of the transmitter has been made the problems of speech amplifier and audio system must be considered. As a general rule it will be found that a single-button microphone operating directly into some simple modulator arrangement will provide the necessary output with reasonably good quality.

A point here on microphones should help the person constructing this equipment. There are several good makes of single-button microphones on the market today. Locally it has been possible to purchase excellent units used by the telephone company in their French-type telephones. This unit is known as the "F1" unit; it is waterproof and is able to operate in any position. The quality and output of this type of microphone is remarkably good.

The actual audio lineup if a single-button microphone is used will require but one tube or two in push-pull fed by one of the new-type high-gain microphone transformers. A single 6V6 with 250 volts on the plate, driven directly by a single-button mike will produce audio sufficient to modulate any small transmitter running up to 7 or 8 watts input.

If more output is desired the plate voltage will have to be increased as has been done in the larger transmitter to be mentioned which runs about 15 watts input with 350 volts available. Substitute a 6L6 for the 6V6 and use the same biasing arrangement and the output will be sufficient to modulate the greater input. Naturally, if a low-gain microphone is to be used, pre-amplification will be necessary.

As a conclusion to the transmitter discussion, the author suggests the use of a 6N7 oscillator-doubler, a 6V6 final doubler and a 6V6 modulator for a low power transmitter powered by a 300- volt vibrapack. If higher power is desired a dynamotor may be substituted, with the lineup changed as follows: 6N7 crystal oscillator-doubler, 6L6 doubler-final, and 6L6 modulator. Here again we have but three tubes, the simplest and a very efficient lineup for ten-meter mobile operation.

Of course, the individual may build anything up to a kilowatt, but it has been found that when the band is open, if your frequency is clear, a 4-watt carrier will put out ample signal to enjoy good ten-meter mobile dx QSO's. The outlay for a small rig of this type will be in the neighborhood of $35 for the entire transmitter including tubes, vibrapack and antenna system.

Antennas

With the transmitter more or less decided upon, an antenna system must be chosen. For the greatest simplicity and best all-around results a quarter-wave insulated vertical antenna mounted on the rear of the car is the answer. Be sure to place the antenna as far away from the body of the car as possible. It will be noted that if the antenna is placed on the rear of the car the signal strength from the transmitter will be about two to three R's louder in the direction that the car is pointed.

Feeding the antenna is a very simple proposition. For low power the use of a concentric feed line will be very practical. There are several good makes on the market. In all cases be sure to ground the tubing or shielding at several points along the car body. The concentric feed is connected directly to the bottom of the ungrounded antenna. The pick-up coil as a one- or two-turn link coupled to the final tank coil and adjusted for proper loading. Provision is made by a double-pole double-throw relay included in the transmitter to switch the antenna from the transmitter to the receiver. Thus the one antenna may be used both for receiving and for transmitting.

Operation

To give an idea of just what can be done with low powered mobile equipment, there have been cases where W6's have worked English stations while driving along main boulevards of Los Angeles. While we admit that this is perhaps a little unusual, it shows what can be done. One station who succeeded in working this dx was using about 35 watts input.

So far as dx is concerned, mobile operation will turn in some surprising results, but it seems that perhaps the most enjoyable part of working mobile is to be able to talk a couple of thousand miles with good signal strength and good reception. It is no feat whatsoever to work across continent with R9 plus signals at both ends while the mobile station is in motion.

While taking long trips or on vacations this equipment will afford much pleasure in driving long stretches. The author has had occasion to make several long trips recently and the added enjoyment afforded by the mobile rig has been well worth the trouble and expense of the installation.

Emergency Work

Emergency work in the past few years in so far as mobile equipment is concerned has been rather cumbersome in that gasoline engines, large receivers, and large transmitters have been required. However, with a small transmitter in the car and a receiver operating on either the high-frequency or low-frequency bands, emergency communication may be carried out with much greater ease. The mobility of the station permits instantaneous operation without stopping to set up the equipment. Again, if this equipment must be used in a region where a car cannot travel it can easily be taken from the automobile and carried to this spot, along with a few spare storage batteries to keep the station on the air.

Thus, mobile equipment must not be classed only in the pleasure category, for in times of disaster the equipment can do much to save life and property.

Police communication has been kept in mind and the ideas discussed will apply closely.

In so far as local communication is concerned, it will be found that these transmitters will serve the purpose very nicely. Tests have been conducted in transmitting from car to car and communications has been held for over 75 miles air line. We must admit, however, that one of the cars was in a strategic, highly elevated position. However, the results obtained are still very gratifying when it is not possible to take advantage of an elevated location.

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You haven't enough time to read *all* radio magazines? See page 8 for a *real* time-saver.

Gain in R.F. Stages

[*Continued from Page 43*]

attempts to obtain measurements but this was largely overcome except for type 1851. The greater gain indicated with this type is probably due to some regeneration provided by the long grid lead to the top cap. Apparent first stage gains on the order of ten at 51 Mc. could be obtained for all types by permitting some regeneration, but the amplifier was generally unstable under these conditions.

Results of the Tests

A wide difference in stage gains may be obtained for different layouts. However, the results in Table I illustrate the effect of grid loading as shown by the difference between the gain of the first and second stage, and indicate what gain one might expect at 50 Mc. from these tubes. The normal loading effect of the antenna upon the first stage does not show up in this arrangement because the signal is fed directly into the grid. In no case was the grid tapped down on the grid coil.

Acorns Versus Television Pentodes

At an amateur station, a comparison was made between an acorn tube and an 1851, both on 28 and 56 Mc. While the acorn tube operated with good stability, there was considerable trouble from oscillation with the 1851. The latter was tamed by tapping the grid and plate leads down on the respective tuned circuits. With this arrangement, signals were measurably louder with the 1851, but the catch was in the fact that regeneration was taking place.

While this regenerative gain was in this case desirable in order to ride over a gross inefficiency of the receiver at 56 Mc., it ordinarily contributes nothing to the signal-to-noise ratio of the regenerative stage. To be preferred would be two good r.f. stages of high gain without regeneration, if greater output than provided by a single stage is desired.

Conversion Gain

Last fall at the National Convention, Ross Hull mentioned that signal generator tests on an acorn tube and a 6K8 as converters from a signal frequency of 56 Mc. to an i.f. of 10 Mc. indicated more gain with the 6K8. Two major vacuum tube laboratories have suggested that results of this nature may indicate regeneration in the 6K8. The 6J8G has attractive conversion characteristics at relatively high frequencies, but even here the high mutual conductance television pentodes or, better still, the acorn pentodes, have advantages at ultra-high frequencies.

A Compact Phone Transmitter

[*Continued from Page 48*]

A five-socket a.c. outlet furnishes a means or supplying a.c. to the transmitter and the remaining four sockets supply a.c. to the receiver, much-needed coffee pot, razor, etc. For portable operation this socket comes in very handy, since there is always a shortage of double sockets. Having this located on the panel has its advantages.

Antennas

For portable operation the off-center-fed Hertz seems to be most foolproof. This particular antenna will load up, regardless of how high or low it may be situated. In one instance an antenna of this type was wrapped around the eaves of a house, and although the two ends were only 5 feet apart, it loaded perfectly. For 20-meter operation, a doublet is used. Any of the conventional coupling systems may be used.

Tuning Procedure

First remove the plate leads from the caps of the 866 tubes. Turn on the high-voltage transformer, thus placing voltage on the buffer-doubler, oscillator, speech amplifier, and modulator. Plug the milliammeter into the oscillator jack and tune the oscillator stage for minimum plate current. Next, plug the meter into the buffer-doubler stage, and tune it for minimum plate current. When this stage is used as a buffer, it is necessary to neutralize it. No buffer-neutralizing condenser is shown in the diagram for the reasons already explained. With the buffer-doubler stage tuned for dip, we are ready to tackle the final stage.

Final-Amplifier Tuning

The final grid circuit is tuned for maximum grid current with no plate voltage. Neutralize this stage by the grid-dip method. Now turn the transmitter power supply off and connect the 866 plate leads and couple the antenna to the final plate tank circuit. Plug your milliammeter into the final stage and turn on the plate power supplies. Tune the final plate circuit for minimum plate current. Bias should be set at least to cutoff for tuning. To continue tuning, the operator must interpret what the plate and grid meter—as well as a modulation indicator—are indicating. The modulation indicator may be anything that will indicate "upward" or "downward" modulation, such as a flashlight bulb and a loop of wire near the final tank, but should preferably be capable of detecting carrier shift.

Here are a few things to remember when tuning a grid-modulated stage: Too much grid excitation will limit the modulation capability. Lack of sufficient grid excitaton will result in low carrier power output. Insufficient antenna coupling acts the same as excessive r.f. grid excitation: does not permit high percentage modulation. Too much antenna coupling will cause loss of power output and a high plate dissipation in the final tubes. The grid current will decrease slightly when antenna coupling is increased. With the above facts in mind, we are ready to place the transmitter on the air.

Set the grid voltage at two times cutoff by means of the tap on the bias supply bleeder. Filament voltage should be adjusted exactly to manufacturer's ratings and plate voltage to approximately 2000 volts. For simplicity in the explanation of tuning, we will use an off-center-fed Hertz antenna and ground to the chassis of the transmitter. Couple the antenna lead about 5 turns from the ground end of the final tank coil and turn on the transmitter, retuning the tank to resonance if necessary. Modulate, and notice whether the modulation is upward or downward. If downward modulation is experienced, we have too much grid current or too loose antenna coupling. Adjust the grid current to 5 ma. by link coupling a 10-watt bulb to the grid tank of the final amplifier, detuning the grid circuit of the final amplifier slightly if necessary. Modulate again and note whether the modulation is upward or downward.

If modulation is still downward, the antenna coupling must be increased. Keep the grid current around 5 ma. and increase the antenna coupling until upward modulation is obtained. When the transmitter is adjusted to modulate upward, the antenna load and grid current should be juggled for maximum output while maintaining upward modulation. Ideal tuning is to run as much grid current as possible and still have about 95% modulation capability. Just how many grid ma. will be run depends on the antenna, plate voltage, bias, and type tube or tubes used. Grid current will vary from 5 to 12 ma. on average transmitters. The grid current will kick upward with modulation.

A radio frequency ammeter is helpful while tuning. When such an indicator is used, the transmitter is tuned for maximum output with upward modulation. It will be noted that no mention has been made of the plate current. The plate meter has two purposes to fill: one is to indicate when the final tank circuit is in resonance by dip; the other is to furnish a means of computing power input.

Plate Dissipation

The operator should know what color the plates of the tubes will show when they are operating at their maximum plate dissipations. The final plate meter gives no indication of how much of the load is being dissipated in the tube; therefore, it is important to be able to determine the dissipation of the tube or tubes by noting the color of the plates. A pair of 35T tubes will safely dissipate 140 watts *in grid-modulated service* if adequate ventilation is provided. To determine just what 140 watts of dissipation in these tubes looks like, apply plate voltage (no excitation) and adjust grid voltage until 140 watts of power is being consumed by the tubes. In making this test, tuned circuits should be eliminated to avoid self-oscillation and give assurance of zero efficiency. The plates of the tubes will show a bright red at this dissipation. In tuning the transmitter, never let the plates exceed this color.

This tuning procedure undoubtedly sounds rather complicated, but with a little practice one will be able to load up a strange antenna in less than two minutes. After the correct load is once determined for a certain antenna, the transmitter can be shifted from one band to another in a little over one minute. This amount of time is required to change plug-in coils.

Construction Notes

The chassis measures 12" x 27" x 6". The deep chassis gives ample room for location of many parts and all wiring underneath. The picture shows clearly the complete construction and layout of the transmitter. The top view lineup is as follows: The three tubes in the lower left-hand corner are speech and modulator tubes, with the modulation transformer sitting beside the 42. The three condenser cans contain the low-voltage and bias-voltage filter condensers. The tube directly under the final tank coil is the 83v bias rectifier. The tube between the large transformer and final tank coil is the 5Z3 low-voltage rectifier. The tips of the 866 tubes can be seen over the top of the main power transformer.

In the upper left-hand corner, the r.f. lineup starts—first, the 6F6 oscillator, crystal, and oscillator coil; next, the 6L6 buffer-doubler tube and coil can be seen. The grid coil of the final stage is located under the plate meter and very close to the buffer-doubler coil. Locating the coil in this manner does two things: First, the excitation from the buffer-doubler is inductively coupled to the grid circuit of the final stage, due to the location of the coils. Second, no space is wasted.

The plate parasitic choke can be seen between the plates of the two 35T tubes. Notice that the final r.f. choke is located on top of the chassis. If the choke were located under the chassis, it would be necessary to run a lead through the chassis carrying high voltage and r.f. The r.f. lead coming from the tank coil to the tuning condenser below the chassis runs through a regular tube socket hole. This gives enough clearance to avoid a flashover from this lead.

Coils

The coils are wound on ribbed 1½" forms for the exciter, buffer-doubler, and grid circuit of the final amplifier. The final tank coil is of commercial manufacture.

Due to use of grid neutralization of the final amplifier, less than the usual inductance is necessary. For 75-meter operation, a 40-meter low-C commercial coil is used; for 20-meter operation, a 20-meter commercial coil is tapped.

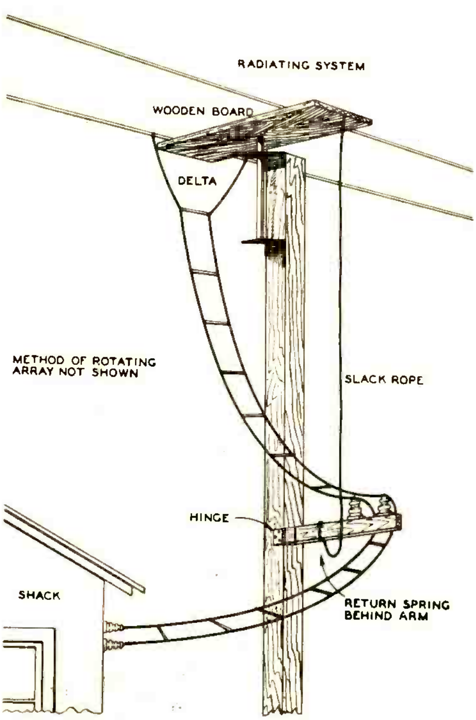
The 1000-ohm resistor in the center tap of the 35T filaments is shunted by a switch. This resistor is placed in the circuit during preliminary tuning and is shorted out after the rough adjustments have been made.

See Buyer's Guide, page 98, for parts list.

Feeder Anchoring System

The accompanying diagram shows the feeder anchoring system used by George W. Dotson, W4EZQ, to enable him to rotate his beam through 360° without entangling the feeders. The feeder proper is a 600-ohm transmission line fanned out to a delta at the driven element to affect a match between the antenna and the line. Through the use of the hinged arm shown in the diagram the feeders are kept separated throughout their length as the antenna is rotated.

The arm itself is about two feet long and is hinged to the pole so that it can only rotate in a counter-clockwise direction from the position shown. A light tension spring fastens from the back side of the arm to the right-hand side of the pole to return the arm to the normal position. The rope tightens up as the beam is rotated and serves to pull the arm around through its possible 180° of travel to keep the feeders from contacting the pole and from becoming entangled in themselves.



Exterminating Parasitics

[*Continued from Page 50*]

frequency parasitics are not as detrimental to equipment as the high-frequency parasitics. One method of eliminating them is to shield the grid coil from the plate coil. If a rough radio frequency spark persists and there is grid current but no indication with the flashlight globe, the next step is to apply the methods for the suppression of high-frequency parasitics.

U.H.F. Bug Removal

A small grid choke made of no. 12 to no. 16 enameled copper wire with 8 to 30 turns wound on a ¼" form, but with the form removed, is inserted in series with the grid of one tube. In the push-pull stage chokes must be tried separately and then together if the other attempts are not successful. Chokes in the grid circuit are just as successful as when used in the plate circuit and there is considerably less radio frequency loss due to circulating currents when the chokes are in grid leads instead of in the plate leads. Another point must be made clear in regard to grid chokes of the nature just described. If the choke has many turns and the amplifier is operating on a high frequency, it is possible to have it act like an auto transformer, producing a rise in grid current on one tube. To compensate for this rise, the center tap of the grid coil must be moved to reduce excitation on the tube having the grid choke, or the tap exciting the grid with the choke in series must be moved in part of a turn. Grid current must be balanced at all times in order to assure balanced operation and equal plate dissipation on the tubes in the output circuit.

Occasionally when an amplifier oscillates on its excitation frequency crossing the plate leads of the tubes instead of the neutralizing condenser leads will prevent oscillation. A common commercial practice in reducing a tendency toward u.h.f. parasitics is to use non-inductive resistors in series with the grid leads of the tubes. This is a losser method and if limited excitation is available it is not very satisfactory. However, if a small choke such as previously described is shunted across the resistance the losses will be reduced. The resistor should be of carbon, approximately 50 ohms, 3 watts, and the value of the shunt choke can be determined by experiment.

Radio frequency chokes, especially in split-stator-type amplifier circuits, can cause trouble in the form of low-frequency parasitics. By merely changing from one type of choke to another either in the grid or the plate circuit it is usually possible to eliminate the oscillations when other methods fail. Certain varieties of pie-wound chokes in the center tap of the plate or grid coils may be the offenders and in this case, single layer solenoid type chokes may offer a solution. Another solution to this problem is to use an inductively wound resistor in place of the grid r.f. choke.

Occasionally the split-stator condensers in the grid and plate circuits must be insulated at their mountings and be grounded at one point on the rotor, usually the physical center. Then the ground return should be connected to one common spot on the filament as shown in the diagram. A change from capacity coupling to unity or link coupling also may suppress these oscillations.

In general, the way to combat u.h.f. parasitics is to upset the circuit balance in any way to eliminate a circuit which may resonate at a high frequency to form a tank circuit. Crystal oscillators, doublers, triplers, quadruplers and single-ended amplifiers also are all subject to parasitics and can be treated with the methods described above.

DX

[*Continued from Page 58*]

umns together for your total. Then, too, as long as we're statistically (gee, wotta word to say fast) minded, you might as well put another mark on front of the prefix when that country QSL's. At a glance you can tell just where you stand . . . I hope. Now then, for your zone record, you might refer to your large zone map and write in one station in each zone, directly on the map. Some of the fellows have a clever way of putting one QSL card from each zone around the WAZ Map, on the wall, and attaching a string or thread to each card. These same strings are then run to their proper zones on the map and attached by a colored map pin. By the way, did you know there was a reproduction of the zone map in January RADIO? Gosh, that number just had everything in it . . . except a recipe for lemon pie.

Somebody told me I should give a little sermon on the ethical and proper use of EC oscillators, conversion exciters, variable crystals, etc. In view of the DX Contest coming up, it might be well to suggest that when we QSY we make a practice of keeping at least 5 kc. from the station we call. It would be better to make it 10 kc. because every receiver won't be able to check 5 kc. If we hear some dx signal, we'll say on 14,360 kc., and we decide to call him from near his own frequency, let's not get nearer than 10 kc. If we were to climb right up on this fellow's exact frequency, and give him a long call, possibly some other dx man around town would choose to call him short from another spot.

If this dx signal comes back to him while we are still giving this long call, this guy across town won't get much, and time would be wasted in asking for repeats. It's true some of the gang will unintentionally slip, but if we really try to do this we can help make this contest a success, instead of hearing a bunch of swishing signals hurrying to plop on every nice juicy dx signal. Remember . . . not nearer than 10 kc.

Last month I bit off quite a chunk when I said never mention to the x.y.l. about "a nice spot" when looking for a new house into which to move. They immediately wonder if you want a radio location or a home . . . when "spot" is mentioned. Well, here we are at a new sp . . . er, ah, that it I mean in another home. Right now the x.y.l. is wondering whether she got the best of it, or I did. Anyway, what a job to get going again. New antennas, poles, wiring the shack, setting the rig up, and a million little things. Before finishing this off I should list a few pet gripes sent in by the boys throughout the country.

It seems that they think the phone men who use the term "handle" should have it whittled down . . . and use "name" instead. After all, when you say, "My name is Sea Biscuit," it does sound better than "handle." To go on . . . another is for the c.w. men who use bugs to fill in between every three words with a "diddle de dah dit," and again the phone fellows who are reciting some supposedly funny incident and can't really laugh but keep saying "Hi." It must be funny when they can't laugh themselves. I could add one of my personal gripes . . . "and that's the dope on that." Yessir, ham radio is here to stay.

Now to get into a different climate, I'd like to say that recent visitors here were OE1FH, KA1MG, VP4GA (who is W5GA), W2EUG, VP4GA is Charley Cowden and may be reached at 177 N. Hill St., Pasadena, Calif. This will be the first month in years my log book won't show a single QSO. . . . Can you imagine it, not even a nine. Golly sakes, that's awful. Good luck in the contest, and let's hear from you as soon as it's over. Your "1939 Marathon" results, too.

The Amateur Newcomer

[*Continued from Page 63*]

wise the microphone will be drawing current and running down the microphone battery needlessly.

The drain of the microphone is low enough that many hours of transmission can be had from one battery, but there is no point in leaving it on when the transceiver is not in use. When it becomes necessary to raise your voice in order to secure full modulation, it indicates that the battery has seen better days and is in need of replacement.

Those who have not tried it will wonder why the auto battery wasn't used for microphone voltage. The answer is that unless a filter is used to remove it, there will be a bad "hash" modulation on the carrier because of the vibrator connected to the same battery. A separate battery is simpler and cheaper than a hash filter for the microphone.

Fixed Station Use

The transceiver may be used at the home station by running the heaters on a.c. and using a 250-volt receiver or speech amplifier power supply for high voltage. How far you can work will depend upon the elevation of your location and whether the radiator is well above surrounding objects. No difficulty should be experienced in working about 20 miles air line with two of these transceivers, but the range will be reduced greatly when hills intervene.

See Buyer's Guide, page 98, for parts list.

56 Mc.

[*Continued from Page 66*]

W2AWY, Red Bank, N. J., has also been heard regularly.

The usual excuse for a dead band seems to be that the fellows were on 28 Mc. in the daytime and didn't shift. The next few winters will probably bring quite a reduction in 28-Mc. dx, after which "five" probably won't suffer so much.

W8BMU in Canton, Ohio, has worked five districts, but, since summer, local activity has been low. Stations within hearing include W8VO-KAY-KG-LHU-BDG - NYD - QXV-MWL-QA.

W3RL still uses 60 watts but he has added an eight-element rotary beam with two half waves in phase, two reflectors and four directors. The front-to-side ratio, he says, is over 60 db.

Several months back we mentioned the European dx of July 2, including a QSO between G5MQ and I1IRA in Italy, and G2XC's reception of I1ER. We find in G6FO's *Short-Wave Magazine* that G2HG was logged in Switzerland too, all at nearly the same hour.

We urge you all to send us local five-meter news by the *tenth* of each month.

112 MC NOTES

Recent correspondence indicates that the initial rush of self-excited oscillators to 2½ meters may let up in view of the construction of m.o.p.a. and crystal transmitters for five-meter operation. We have a few letters, though, which may contain helpful suggestions for those starting up on 112 megacycles.

From Chicago, W9SFW writes that he has been on the band for about three months, and this is what he has learned:

"Operation on 2½ meters does not differ greatly from that on five meters. The precautions of construction necessary for proper operation on 'five' apply to '2½' but to a greater degree. The problem of dielectric is important, and ceramic type insulation should be used exclusively. Short connections are especially important. Particularly difficult is the problem of keeping r.f. out of high gain audio systems.

"It is easy to make an oscillator 'perk' on 2½ meters if a good r.f. choke is used in the B plus lead to the oscillator tank coil—one wound especially for 2½ meters. The band usually can be reached by cutting 56-Mc. coils but a little clean-up work will increase the output.

"Finding the band is an interesting problem which sometimes appears difficult. Because of the few stations now using the band, the trial and error method of pruning the receiver coil and listening could become a long and disappointing method. The use of a Lecher wire system at least a couple of wavelengths long will give reasonable accuracy. After finding the band, the second harmonic of a five-meter transmitter can be tuned in for the exact location. Depending on this method alone is too uncertain because of the possibility of picking up the wrong harmonic.

"Antennas of course are similar to those for 56 Mc. except for dimensions. One important suggestion is to avoid use of twisted pair and similar rubber insulated feeders.

"Receiver sensitivity is obviously down, which may affect results. Man-made noises appear to be lower but auto ignition QRN is higher—if it is not, the receiver is not operating properly."

The rig at W9SFW uses a '45 ultra-audion oscillator with 80 mils at 250 volts on the plate. The tank coil has two turns spaced

⅜ inch, ¾ inch in diameter. The receiver uses a 6J5G, 76 and 89.

Another letter comes from W9ZGD in Milwaukee, which we shall quote in part:

"The receiver is superregenerative with 76 detector and 6C5 quench oscillator. The transmitter uses a pair of '45's' with one inch pipes about eighteen inches long in the grid, a single large turn in the plate with no tuning condenser. A V wheel is in operation on about 113.7 Mc. quite a lot. Horizontal antennas are used both for transmitting and receiving now.

"W9YNK had a time trying to get a self-quenched detector to work. A separate quench oscillator worked right away. W9CCD cannot get his push-pull oscillator to work unless the filaments are by-passed."

At ultra-high frequencies it is often necessary to give particular attention to the filament circuit. Chokes or tuned transmission lines are sometimes necessary to obtain oscillation and reasonable efficiency as the limits of the oscillator are approached.

The need for chokes in the grid and plate leads can usually be removed by some form of transmission line as tuned circuits. The parallel wire line is suitable for push-pull circuits and the concentric line for single ended arrangements. The latter generally helps to avoid much radiation in the operating room where it may get into the speech equipment.

Is there enough interest in 2½ meters to justify devoting space to news and the interchange of ideas? It is up to you, so what do you say? Write to E. H. Conklin, W9BNX, Associate Editor of RADIO, 512 N. Main St., Wheaton, Ill.

Yarn of the Month

[*Continued from Page 67*]

blurred, but the front door is thrown carelessly open by a bit of evening-gowned, silver-slippered, fur-coated, blond-headed blue-eyed loveliness which breathlessly said, "Oh, hello, Jack's told me all about you. Almost late tonight—big dance at the club—be with you in a minute."

There is a swish in the direction of the locker room and the door slams shut. I am more or less out on my feet, but my ears don't quite escape the obvious sounds of feminine apparel being whisked about. Presently the door opens and I see that she has done a quickie into a pair of slacks and little sweater effect. The sweater evidently was designed by a guy who saw no point in using six skeins of yarn when five and a half would do with a bit of stretching.

"Er, ah, been warm, hasn't it?" I manage to stammer out.

"Yes, hasn't it," she agrees as she starts to warm up the filaments on the 10-kw. rig.

"Paper says rain tonight," says I, feeling hopelessly muddled.

"Really," and she punched the start button on the 4000-volt rectifier.

"Guess I'd better get going," I mumble, being at a loss for anything better to say.

"All righty. Awfully glad to have met you. Good night."

In the days that followed I didn't know whether to shoot Jack Dunkheimer for being an inhuman brute or kiss him for sending such an angel to brighten my squalid existence. In the next few weeks Ann takes Jack's place four or five times and I become much better acquainted with her although I'm still in a daze most of the time. Then one afternoon I relieve Ann at four p.m. and we are having a little chat.

"Gee, Ann," I remark seriously, "Jack is plenty lucky to have a wife like you."

"A wi - -," she begins, and then she sorta chokes up and bursts into hilarious laughter.

"What's funny about that?" I demand.

"Why I'm not Jack's wife, I'm his sister. Where'd you ever get that idea?"

"The other operators —" I started to say when I was interrupted by more laughter.

"I should have remembered," she said, when the humor had begun to die, "the older operators pulled that same wife gag on the last young fellow that came to work here. It should have been obvious the way you've been avoiding me."

"Of all the dirty tricks. They even told me that Jack made you work for him."

"Jack has been wondering about your attitude toward him. Truth is that I come out here to catch up on my reading. I learned the business helping Dad in his laboratory at the Bureau of Standards. What do you think now that you know the truth about little Ann, the brow-beaten wife?"

"Gosh, that's swell," struggling for words as I tried to remember who it was that wanted to buy the rig last week, "sort of changes things around a bit."

About this time is heard a set of those long silvery horns that set the owner back about the cost of a kilowatt final.

"Oh, excuse me. I'll have to run. That's Harry, he's manager over at Amalgamated Electric. We've been engaged almost a week now." Then she paused at the door, "Be seeing you the next time Jack makes poor little Ann stand his watch for him."

Open Forum

[*Continued from Page 74*]

because I might be a better golf player than another fellow doesn't mean that I feel compelled to give him the idea that I resent his enjoying golf or suggest that he give it up for knitting or Chinese checkers. I know fellows who never break 100 that get even more enjoyment out of golf than I do, and I don't see why they are not just as much entitled to use the course as I am. Also, I don't believe it in order to go around giving them unsolicited advice on how to cure their slice. So long as they obey the course rules and don't step on my toes I say "more power to them."

I'm glad there are fellows on the air who enjoy talking about things other than the lineup of their transmitter and why they changed their final tank condenser over to split stator; otherwise I wouldn't have the slightest desire to get on the air.

HARRY C. BROWN

●

Shopping? *The Marketplace* may have just what you want.

See page 97 for latest offers.

What's New

[*Continued from Page* 72]

as a detector, audio amplifier or low-powered oscillator. It requires 1.25 volts at 50 ma. on the filament, has a transconductance of 650 micromhos and a plate resistance of 24,600 ohms at 2 ma. plate current. This tube will be most satisfactory for use in receiving and speech amplifying equipment.

The 958 Triode

The 958 is also an acorn triode, but it has somewhat higher ratings than the 957 and is most suited for use in transmitting service or as an audio output tube to feed a sensitive loudspeaker. The tube has a greater filament drain, although it is still extremely low (1.25 volts at 100 ma.), lower amplification factor (12), greater transconductance (1200 micromhos), and lower plate resistance (10,000 ohms). The 958 is designed for use as an amplifier or oscillator with a plate power input of 0.4 to 0.5 watt.

The 959 Pentode

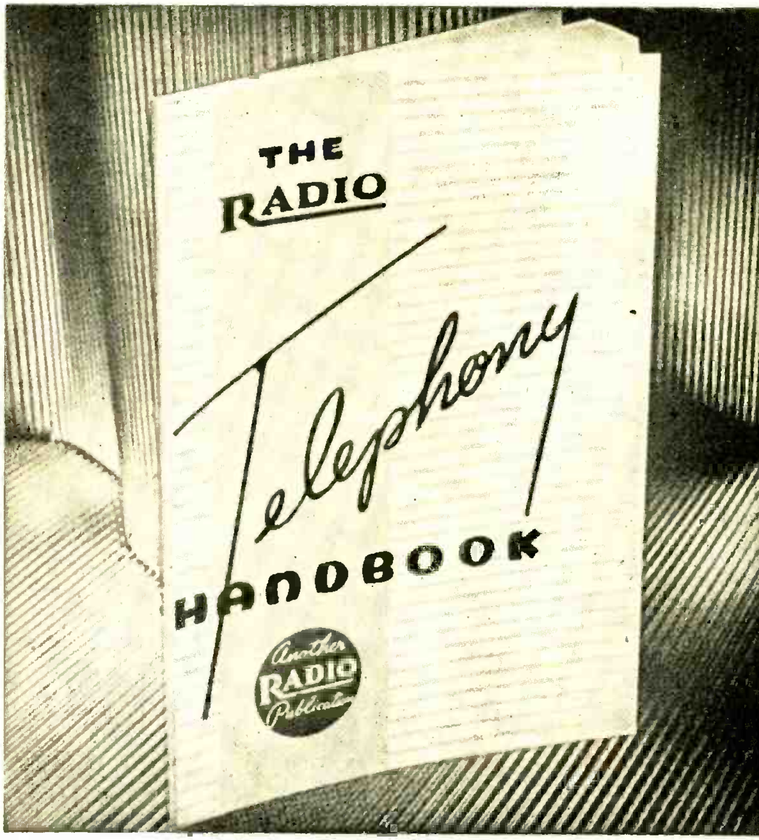
The 959 is a sharp cutoff pentode intended for use as an r.f. amplifier or detector in u.h.f. receivers. It may also be used as a resistance-coupled audio amplifier in speech amplification systems. The tube requires the same filament power as the 957, 1.25 volts at 50 ma., has an amplification factor of 480 and a transconductance of 600 micromhos under the rated operating conditions of 135 plate volts, 67.5 screen volts, and —3 volts of grid bias. Under these conditions the plate resistance is approximately 0.8 megohm.

Question Box

[*Continued from Page* 73]

that a smaller modulator could be used for speech modulation. This is the point about which the greatest amount of misunderstanding exists. Based on sine-wave conditions the modulator in your transmitter, for instance, must deliver an average power of 250 watts, or a peak power of 500 watts. For speech, the modulator must still deliver 500 *peak* watts but the *average* power in the speech output will be closer to 175 watts. This does not mean that any modulator rated at 175 average watts will fully moduate the 500 watts of class-C input. If the 175-watt modulator is operating properly in accordance with the manufacturer's specifications its peak power output will simply be twice 175, or 350, watts.

By choosing the proper class-B modulator tubes it is possible, however, to obtain the required 500 peak watts of voice output from tubes which are


THE
RADIO
Telephony
HANDBOOK
RADIO

rated at only 175 watts for sine-wave output. The increased output is made possible by raising both the plate voltage and the plate load impedance on the modulator tubes. By operating the tubes in this manner, the peak plate current and average plate dissipation are kept within the manufacturer's rating due to the nature of the speech waveform. It must be emphasized that this type of operation is suited for speech only. Any attempt to obtain 500 peak watts of sine-wave output from the modulator will result in the tubes being greatly overloaded and will soon lead to their demise. Tubes chosen for this type of service must also have adequate insulation and high vacuum to withstand the increased voltage.

The actual calculation of the operating conditions for the higher peak output is somewhat involved. As an example, however, a pair of TZ40's operated at the recommended plate-to-plate load of 6900 ohms and at 1000 plate volts and zero bias will give 175 average watts, or 350 peak watts, of sine-wave output. These same tubes operated at 1500 plate volts and a plate-to-plate load of 12,000 ohms will supply approximately 525 peak watts of audio on speech. This latter set of conditions would be suitable for use with your proposed transmitter. Approximately 15 volts of bias will be required for the 1500-volt operation and the driving power will have to be increased slightly to provide the extra grid swing required with the increased bias.

Calls Heard

[*Continued from Page 71*]

Beirut, Syria
October 17, 1938
(14 Mc.)

K4—FCV-7; KD-7; K5AA-6; NY1AB-6; **W**—1AXX-4; 1DBS-7; 1DKD-6; 1GNE-7; 1KHV-5; 1LAX-6; 1LMO-5; 2AOA-6; 2BHW-6; 2EDM-8; 2EGI-5; 2FKE-5; 2GSA-6; 2HQX-5; 2HXT-6; 2ISU-5; 2IYO-7; 2KEZ-7; 2KJY-7; 3AOO-6; 3BHV-7; 3CRW-6; 3EUJ-5; 3EZN-5; 3FQO-6; 3GTL-6; 3GTR-7; 3GWJ-6; 3HJL-7; 3QP-7; 3US-6; 3WU-5; 4CJF-6; 4DE-6; 4FJI-5; 8GMZ-5; 9KFL-4.

John C. Kuespert, W9WCE
733 13th St., South Bend, Ind.
October 1 to December 31, 1938
(14 Mc. c.w.)

CE—3AJ; 4AD; **CM**—2AZ; 6DV; 7AB; 7RN; CT1JV; **CR7**—AG; AY; **CX**—1CB; 1CX; 1NE; 2AJ; **D**—3CDK; 3GPF; 4SZK; EI4J; **ES**—1E; 2C; 5C; **F**—3LQ; 8JD; 8QL; **G**—2IM; 2JY; 2LB; 3BS; 3MB; 3QV; 5KG; 5LY; 5RV; 5UG; 5UM; 5YV; 6KU; 6SM; 6TI; 6UG; 8II; GI5TK; **GM**—3RL; 8CN; HB9CE; **HC**—1FG; 1PZ; **HH**—2MC; 3L; 4AS; **HR**—2ON; 7WC; **J**—2JJ; 2KG; 2NF; 5CC; J9CG; **KA**—1FG; 1RP; **K4**—DTH; ESH; FAB; FNH; **K5**—AA; AC; AE; AG; **K6**—AMH; IQN; MV; NPO; ORA; QIU; LA5Q; **LU**—2OA; 3HK; 4BH; 5AN; 5BL; 8EN; 9AX; **NY**—1AB; 2AE; OA4Q; **OH**—1NF; 1NV; 2OG; 2OP; 3NP; 6NG; 6NS; **ON4**—KM; XA; **OZ**—7UU; 9R; **PA**—AZ; FF; KB; MK; SD; XF; PK4KS; **PY**—1OS; 1GJ; 2AC; 2AL; 2BM; 5AP; 5QG; 7AN; 8AH; **SP**—1OP; 1YX; **SM**—3MT; 5OS; 5RH; 5UW; 6QP; 6UA; **SU**—1SG; 1WM; **TF**—3C; 5C; 5M; **T1**—2CAH; 2LC; U2NE; **VO**—3P; 3X; VP2AT; **VP4**—TO; TP; VP5RS; **VP7**—NT; NU; VR6AY; VS6AO; **VU**—2BG; 2LK; YA7RX; YN4AB; **YR**—5AX; 5ML; 5VX; YS2LR; VU7AY; YV5AQ; ZC6EC; ZD2H; ZE1JI; **ZS**—1AG; 1BX; 1CH; 1CH; 1CN; 1DA; 1L; 2AL; 2X; 5CU; 6AU; 6BZ; 6DY; 6EW; 6EZ; ZS3F.

The Marketplace

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(a) Commercial rate 10c per word, cash with order; minimum, $1.00. Capitals: 13c per word. For consecutive advertising, 15% discount for 3d, 4th, and 5th insertions; 25% thereafter. Break in continuity restores full rate. Copy may be changed as often as desired.

(b) Non-commercial rate: 5c per word, cash with order; mimimum, 50c. Available only to licensed amateurs not trading for profit; our judgment as to character of advertisement must be accepted as final.

(c) Closing date (for classified forms only): 25th of month; e.g., forms for March issue, published in February, close January 25th.

(d) No display permitted except capitals.

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(f) Ads not relating to radio or radiomen are acceptable but will be grouped separately.

(g) No commissions nor further discounts allowed. No proofs, free copies, nor reprints sent.

(h) Send all Marketplace ads direct to Los Angeles accompanied by remittance in full payable to the order of Radio, Ltd.

QSL'S: 75c for 100; 2 colors. $1.80 for 300. Postpaid. W9DGH, 2005 North Third Ave., Minneapolis, Minn.

HYTRON transmitting tubes. W9DGH.

LISTEN for High Frequency Broadcast Station, W9XA, 26,450 Kilocycles, Kansas City, Missouri.

QSL's—SWL's—RAINBO EFFECTS! Stamp! FRITZ—455 Mason—Joliet, Illinois.

YOUR sigs recvd hr., phone CQ's, etc., on guaranteed phonograph records, special 35c. Brown's Radio Laboratory, Dolgeville, New York.

CRYSTALS, 80-160 X-cut $1.50. 40 X-cut $2.25. Guaranteed. Upper Peninsula Crystal Service, 72 Third Street, Laurium, Michigan.

GLASS feeder spreaders. Perfect insulation. 2 to 6 inch, 4c. W9NER, Washington, Missouri.

CRYSTALS AIRMAILED: 160-80 AT 40X $1.95; 40 Lo-drift $2.75; 80M VARI-FREQUENCY, 100 kc. BARS. 20M CRYSTALS, MOUNTED $4.50. COMMERCIAL CRYSTALS QUOTED; COD's accepted. C-W Mfg. Co., 1170 Esperanza, Los Angeles.

CRYSTALS MOUNTED: 40X $1.60; 160-80 A $1.25; COD's accepted. Pacific Laboratories, 344 Fetterly, Los Angeles.

RECONDITIONED guaranteed receivers. Practically all models cheap. Shipped on ten day trial. Terms. List free. W9ARA, Butler, Missouri.

ANSWER Factory Reopens. Advice by mail on radio problems. Price quoted on any problem stated clearly. Robert Kruse, Guilford, Connecticut.

SERVICEMEN: Radio cartoons enliven advertising, boost business. Cut catalogue. 10c. Radiolabs, Winnipeg.

SELL: Rebuilt Dodge generator. 700 watts, 110 volts, 60 cycles. $30. W2LPS/3 Lafayette College, Easton, Penna.

PUSH PULL PARALLEL 6L6 modulator or driver described in July, 1937, issue of RADIO, laboratory model, less tubes $34.50 f.o.b. RADIO, Ltd., 7460 Beverly Blvd., Los Angeles, California.

CHASSIS. Panels. Racks. Specials. Priced right. R. H. Lynch, 970 Camulos, Los Angeles. Calif.

NAT SW3, power supply, 4 sets coils good condition, $17.50. New T20, $1.85. Other equipment. W7EJJ.

W6KX QSL's cost more—are worth more. Printed by Keith LaBar, 1123 North Bronson Avenue, Hollywood, California. Special cards made to order for the discriminating amateur.

BARGAIN: 1 kw. 20-meter phone, HF200's final, 212D's modulator, rack and panel with 14 meters. 250-watt phone, 160-20, rack and panel with 9 meters, preselector DB 20, PR 15, and misc. parts. W9VOO.

Advertising Index

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.

COMPACT PHONE TRANSMITTER

Page 45

C_1, C_2, C_3—Solar MW-1233
C_4—Bud 905
C_5—Solar MW-1210
C_6, C_7, C_8—Solar MW-1233
C_9, C_{11}—Bud 330 (stators in parallel)
C_{10}—Solar MW-1219
C_{12}, C_{13}—Solar MW-1239
C_{14}, C_{17}—Solar XM-25-21
C_{16}—Cardwell XC-100-XS
C_{18}, C_{22}, C_{24}—Solar DT-878
C_{19}—Solar S-0238
C_{20}, C_{26}—Solar S-0263
C_{21}—Solar S-0219
C_{23}—Solar S-0228
C_{25}—Solar DT-858
C_{27}, C_{28}—Solar DT-859A
C_{29}, C_{30}—Solar XL-6-4
C_{31}, C_{32}—Solar XL-20-2
C_{33}, C_{34}—Solar S-0240
R_1, R_4, R_7—Centralab 516
R_2, R_3, R_5, R_6, R_{18}, R_{23}—Ohmite Brown Devil
R_8, R_9, R_{10}, R_{11}, R_{12}, R_{14}, R_{15}—Centralab 514
R_{13}—Yaxley N
R_{19}—Ohmite 0578
R_{20}—Ohmite 0788
R_{21}—Ohmite 0973
R_{22}—Ohmite 0962
J_1, J_2, J_3, J_4—Yaxley 702A
CH_1, CH_2—Thordarson T-43C92
T_1—Thordarson T-72A59
J_1, J_2—Mallory Yaxley type A-1
VP—Mallory Yaxley type VP-551
Cabinet—Bud type 870
Knobs—Bud

112-Mc. TRANSCEIVER

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C_1—Cardwell ZR-10-AS with mounting bracket
C_2—Solar type MT
C_3, C_6—Solar type S-0256
C_4—Solar type S-0212
C_5—Solar type DT-879
C_7—Solar type S-0219
C_8—Solar type DJ-364
R_1, R_4, R_5, R_6—Centralab 516
R_2—Mallory Yaxley "Universal"
R_3—Centralab 514
RFC—Ohmite type Z1
S_1—Mallory Yaxley 3142-J

IMPROVED U.H.F. R-C SUPERHET

Page 15

C_1—Cardwell ZR-10-AS
Mica Condensers—Solar MW
C_{11}, C_{16}—One Solar DT-885
C_{18}, C_{19}—One Cornell-Dubilier KR-588
C_{20}—Cornell-Dubilier EY-11080
Carbon Resistors—Centralab 514 and 516
T_1—Thordarson T-29A99
T_2—Thordarson T-13R08
CH_1—Thordarson T-68C07
R_3, R_6, R_{14}—Mallory Yaxley standard universal
Tubes RCA

EFFICIENT "SEMI-SKELETON" AMPLIFIER

Page 40

C_1—Aerovox Type 1450
C_2—Bud #1532
C_3, C_4—Aerovox Type 1450
C_5, C_6—Bud #1000
C_7—Bud #1576
R_2—Bud #766
RFC—Bud #569
V_1, V_2—Taylor T40's
Closed circuit jack—Bud #1325
Punched semi-chassis—Bud #7710
Panel support brackets (pair)—Bud #7709
Coil jack bar brackets (2)—Bud #7714
4-prong ceramic sockets (2)—Bud #954
5-prong ceramic sockets (2)—Bud #955
Drilled Masonite panel—Bud #1593 BPA
Dials—Bud #172
Coil jack bar—Bud #1356

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EAST STROUDSBURG, PA.

W9UVC

CQ CQ ATTENTION ALL HAMS

THORDARSON QUALITY AT PRICES YOU WILL APPRECIATE

THE "19"* SERIES

* PLATE TRANSFORMERS
* CHOKES
* MODULATION TRANSFORMERS
* FILAMENT TRANSFORMERS
* DRIVER TRANSFORMERS

"19" SERIES PLATE SUPPLY TRANSFORMERS

Primary 115 Volts, 50-60 Cycles

Transformers rated in D.C. volts from two section filter.
Electrostatic shield between primary and secondary.

Type No.	Sec. A.C. Load Volts	D.C. Volts	D.C. M.A.	Your Cost
T-19P55	660-0-660 550-0-550	500* 400	250	$ 4.50
T-19P56	900-0-900 800-0-800	750 600	225	4.80
T-19P57	1075-0-1075 507-0-507	1000** 400	125 150	6.00
T-19P58	1200-0-1200 900-0-900	1000** 750	200 150	7.80
T-19P59	1560-0-1560 1250-0-1250	1250 1000	300	9.60
T-19P60	1875-0-1875 1560-0-1560	1500 1250	300	11.10
T-19P61	2125-0-2125 1875-0-1875	1750 1500	300	12.00
T-19P62	2420-0-2420 2125-0-2125	2000 1750	300	12.90
T-19P63	1560-0-1560 1265-0-1265	1250 1000	500	13.80
T-19P64	1875-0-1875 1560-0-1560	1500 1250	500	17.70
T-19P65	3000-0-3000 2420-0-2420	2500 2000	300	17.70
T-19P66	2125-0-2125 1875-0-1875	1750 1500	500	22.50
T-19P67	2450-0-2450 2125-0-2125	2000 1750	500	25.50
T-19P68	3000-0-3000 2450-0-2450	2500 2000	500	30.00

* This transformer has a bias tap at 30V. ** These transformers designed for double rectifiers and will deliver both secondary ratings simultaneously.

"19" SERIES SWINGING AND FILTER CHOKES

Inductance listed is that actually measured at rated current.

SWINGING CHOKES

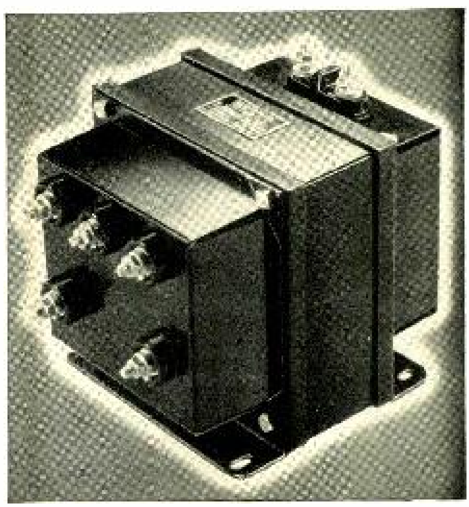
Type No.	Cap. D.C.M.A.	Inductance Henries	D.C. Res. Ohms	Volts Insulation	Your Cost
T-19C35	200	5-20	130	3000	$2.85
T-19C36	300	5-20	105	3000	3.90
T-19C37	400	5-20	90	4000	5.40
T-19C38	500	5-20	75	4000	6.90

SMOOTHING CHOKES

Type No.	Cap. D.C.M.A.	Inductance Henries	D.C. Res. Ohms	Volts Insulation	Your Cost
T-19C42	200	12	130	3000	2.85
T-19C43	300	12	105	3000	3.90
T-19C44	400	12	90	4000	5.40
T-19C45	500	12	75	4000	6.90

THORDARSON QUALITY FOR THE "HAM" IN THE POPULAR-PRICE FIELD! COMPARE!

Shown at the left is catalog information on the plate transformers and chokes in this new series of transformers. Complete information on the full series in Catalog No. 400-C, from your parts distributor or write factory for *Free* copy.



"19" Series Plate Transformer
Mounting Style 2 K
Fully Shielded - Air Cooled

THORDARSON ELECTRIC MFG. CO.

500 W. HURON ST., CHICAGO, ILL.

Demand "Power by Thordarson"